



A Prospective Care with Tobacco Counseling and Medication in a Patient with Oral Submucous Fibrosis – A Case Report

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ABSTRACT

Oral Submucous Fibrosis (OSMF) is one of the most prevalent potentially malignant disorders seen in South east population since ages. The prevalence of Oral Submucous Fibrosis in India is 6.42%. Oral submucous fibrosis is defined as an insidious, chronic disease affecting any part of oral cavity and sometimes the pharynx. It is always associated with fibroelastic changes of Lamina Propria, with epithelial atrophy, leading to stiffness of oral mucosa and causing trismus and inability to eat. Contributing factors includes consumption of spicy food, Gutkha, pan masala, nutritional deficiencies, tobacco chewing and areca nut chewing habits. Despite the extensive amount of research held in this field, its treatment still remains a challenge. In this study, we present our experience in successfully managing OSMF with intralesional injections of dexamethasone 1.5 ml, 1500 IU hyaluronidase and 0.5 ml local anaesthesia on a patient diagnosed with oral submucous fibrosis diagnosed with grade ii OSMF who had a habit of gutkha and tobacco chewing. With proper habit and behaviour counselling, patient was also prescribed medications with capsule S.M. Fibro BID and ointment kenacort TID which was followed by intra-lesional injections once in a week. The remarkable results were seen with increase in mouth opening and symptomatic relief without any side effects.

Keywords: Dexamethasone, Habit counselling, Hyaluronidase, Oral submucous fibrosis, Tobacco.





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INTRODUCTION

Oral submucous fibrosis (OSMF) is a precancerous condition due by inflammatory reaction and progressive fibrosis of the submucosa, seen predominantly in Southeast Asia and Indian subcontinent [1]. It was first described as 'Vidari' by Sushruta in 600 BC which involved progressive contraction of oral cavity, depigmentation of oral tissue and discomfort while consuming food [2]. In 1952, it was termed as 'Atrophica Idiopathica Mucosae Oris' by Schwartz and word 'Submucous Fibrosis of Palate and Pillars' was coined by Joshi in 1953 [3]. In India this condition was first described as diffuse oral submucous fibrosis (Lal 1953) and as submucous fibrosis of the palate & pillars (Joshi 1953) [4]. In 1966, Pindborg defined OSMF as "an insidious chronic disease affecting any part of oral cavity and sometimes pharynx. Although occasionally preceded by and/or associated with vesicle formation, it is always associated with juxta-epithelial inflammatory reaction followed by fibroelastic changes in lamina propria, with epithelial atrophy leading to stiffness of oral mucosa causing trismus and difficulty in eating [5]. Malignant potential rate of OSMF was first estimated to be 7–13% in 1956 by Paymaster [6].

The prevalence of OSMF in India ranges from 0.2–2.3% in males and 1.2–4.6% in females, with age range from 11 to 60 years [7,8,9]. A marked increase in incidence is observed after widespread marketing of commercial tobacco and areca nut products, known as Gutkha¹⁰. Although the etiopathogenesis is multifactorial, areca nut-chewing in any formulation is considered main causative agent. Contributory risk factors suggested includes chewing of smokeless tobacco, high intake of chillies, toxic levels of copper in foodstuffs and masticatories, vitamin deficiencies, and malnutrition resulting in low levels of serum proteins, anaemia and genetic predisposition [11]. The management of OSMF has been discussed previously by several authors^{12,13,14}. The first and foremost treatment plan in OSMF is strict discontinuance of habit with motivation and intense counselling session for educating and creating awareness about the disease and its malignant potential¹⁵. Hyaluronidase acts by breaking down hyaluronic acid which lowers the viscosity of intercellular cement substance. Better results were observed with respect to trismus and fibrosis¹⁶. Several glucocorticoids are used for treatment of OSMF such as short-acting (hydrocortisone), intermediate acting (triamcinolone), and long-acting glucocorticoids (betamethasone and dexamethasone). They act by their anti-inflammatory activity by inhibiting the generation of inflammatory factors and increasing apoptosis of inflammatory cells. Thereby partially relieving patients of their symptoms at an early stage of OSMF¹⁷.

Case Report

A 33-years old male patient driver by profession reported to outpatient department with chief complaint of dirty teeth in upper and lower front region followed by bad breath and difficulty in opening mouth since seven to eight months. Patient had habit of gutka chewing since five years with consumption of 2-4 packets in a day and tobacco chewing since 18 years with consumption of 7-8 times a day. History of cigarette smoking, 1-2 cigarettes per day and habit was stopped 10 years back. On intra-oral examination generalised dental stains were present as shown in Figure A. Burning sensation was present all over the mouth since six-seven month with the score of 7 on visual analogue scale. On inspection mucosa appears to be pale and blanching was seen on right and left buccal mucosa, floor of the mouth & retromolar area extending from the commissural area up to the pterygomandibular raphe as shown in Figure B. All findings of inspection confirmed on palpation. Mouth opening was reduced to 27 mm and tongue protrusion reduced to 36 mm and cheek flexibility reduced by 0.5 mm as shown in Figure C. Fibrous bands were palpated both on right and left buccal mucosa extending from commissural area up to pterygomandibular raphe. Stiffness of buccal mucosa in affected area. Surface was rough and leathery. Considering combination of clinical findings and habit of gutka chewing along with tobacco, a provisional diagnosis of stage II OSMF was given. (Acc. To Nagesh and Bailoor classification). Looking at clinical signs and symptoms of disease, differential diagnosis was given as iron deficiency anaemia, trismus, fibrous ankylosis, plummer-vinson's disease, scleroderma. A required investigatory methods was performed in which complete blood investigation was done and tobacco dependence was measured using fagerstromnicotine dependence scale both for smoking and smokeless tobacco which had lower level of dependence for smoking form of tobacco with score of 0 and moderate level of dependence for smokeless



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form of tobacco with score of 5. Relevant dental indices were also recorded: Gingival Index by Loe H and Sillness J (1963), Plaque Index by Loe H (1967), Russel Periodontal Index (1956), Modified Lobene stain index (1968). After all investigations final diagnosis was given as stage II OSMF. A comprehensive treatment plan was made, based on concept of conservative management for oral submucous fibrosis. The first step was motivating and counselling patient, so that he quits his habit. During intense counselling session with patient, carcinogenic potential of chewing tobacco and areca nut was explained. The threat of conversion of premalignant condition into malignancy was explained and importance of immediate quitting of habit was emphasised as shown in Figure D. The tobacco counselling initially was started with 5A's (Ask, Assess, Assist, Advice and Arrange). At 15th day patient was explained regarding 5R's of tobacco chewing (Relevance, Risks, Rewards, Roadblocks and Reiterations) and patient was advised to start with 4 D's (Delay, Drink, Deep breath and Do something). Patient was asked to contact us anytime in case if he feels any discomfort or suffers from withdrawal symptoms. Medications like capsule SM fibro (twice a day for 1 month), kenacort ointment (thrice a day for 1 month) and triamcinolone acetonide 0.1% w/w. were initially prescribed for one month. The patient was recommended to perform mouth ballooning, hot water gargles, and muscular stretching exercises. Required dental procedures like oral prophylaxis, restoration of carious teeth and extraction of indicated tooth was performed under local anaesthesia with epinephrine. Patient did not suffer from any withdrawal symptoms. After a month, patient returned for follow-up appointment, and mouth opening had increased by 1 mm, on account of the tissue remodelling achieved by combination of medical therapy and oral physiotherapy that included vitamin B complex capsules, antioxidants and iron supplements. There was also reduction in the burning sensation; though clinically no changes were observed in the status of the diffuse leucoplakic lesion on the left buccal mucosa. For improvement in mouth opening, patient was started on Intralesional injections on 30th day for every once in 7 days. Intralesional injection (Dexamethasone – 1.5 ml Hyaluronidase- 1500 IU with 0.5ml of lignocaine HCL injection) was given on right and left buccal mucosa, retromolar area, floor of mouth and soft palate as shown in Figure E. After intralesional injection, first follow-up on 37th day shows increase in mouth opening by 30 mm, tongue protrusion by 37 mm and cheek flexibility was same as before as shown in Figure f. On visual analogue scale the score reduced to 3. On 45th day, second follow-up showed a 1 mm (I.e., 31 mm) improvement in mouth opening and 41mm increase in tongue protrusion as shown in Figure G. As cheek flexibility and VAS remains same. We intended to follow-up the patient at every 15 days interval for two months after treatments but the patient did not show up thereafter.

DISCUSSION

Oral submucous fibrosis, a precancerous condition, reports reveal that it is in existence since time of Sushruta reported by Schwartz in 1962 and by Joshi in 1953 who described its singleton among Indians³. Many trials were conducted but no definitive treatment is available¹⁸. As exact causative factor for OSMF is a matter of conflict, failure to achieve proper treatment for it may be reason for its incomplete regression. Stopping of areca nut chewing is foremost important measure to treat OSMF. Various drugs alone or in combination are used to treat this crippling disease. However, improvement can be obtained passably by intralesional injection of hyaluronidase¹⁹. It was observed that patients receiving hyaluronidase alone showed a quicker improvement in the burning sensation and painful ulceration, although combination of dexamethasone and hyaluronidase gave better long-term results than other regimens. OSMF is a disease with a high degree of incidence. It also carries a significant morbidity rate from oral cancer. The treatment of patients with oral submucous fibrosis depends on the degree of clinical involvement. If the disease is detected at a very early stage, cessation of the habit is sufficient. Most patients with oral submucous fibrosis present with moderate-to-severe disease. Severe oral submucous fibrosis is irreversible. Current modern day medical treatments can make the mouth opening to normal minimum levels of 30 mm mouth opening with proper treatment²⁰. The treatment of OSMF is still not satisfactory. Therefore, further clinical trials with newer modalities and combinations are required to manage this potentially malignant disorder and to prevent its malignant transformation.





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Figure A- visible stains on intraoral examination





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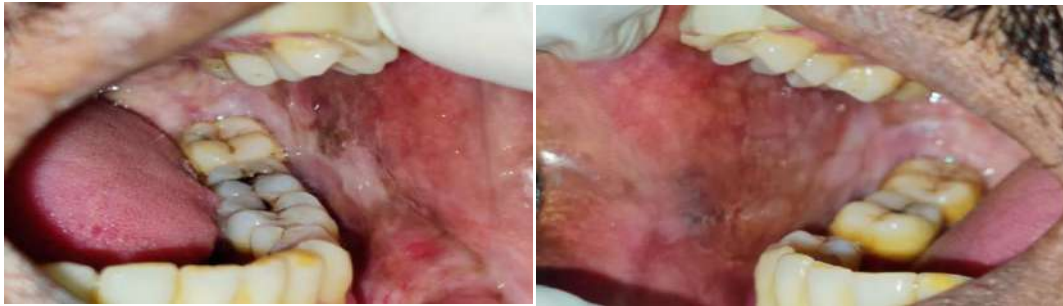


Figure B – palpable fibrous bands present on left and right buccal mucosa extending from commissure to pterygomandibular area

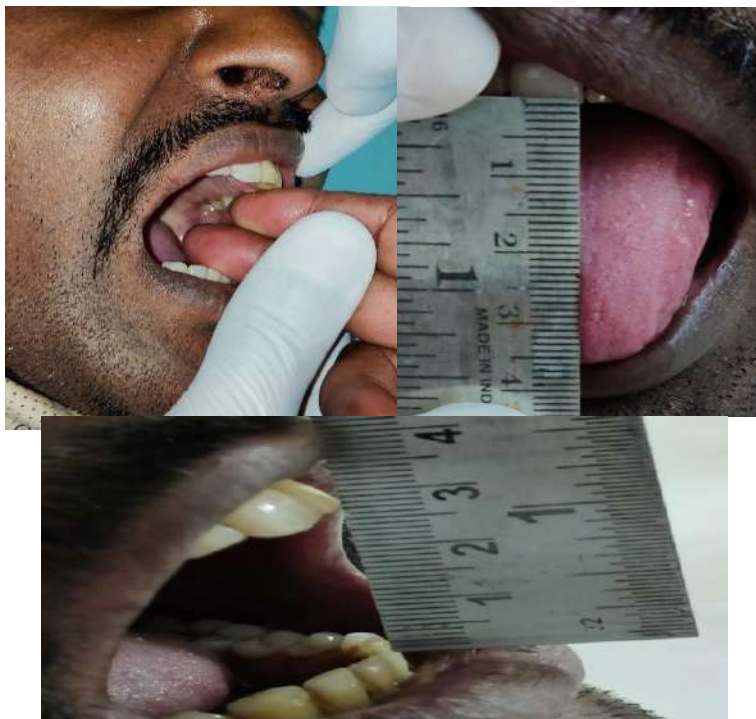


Figure C showing reduced mouth opening of 27mm and tongue protrusion of 36 mm



Figure D- patient was explained regarding various risks and consequences of continuous tobacco chewing





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Figure E- Administration of Intralesional injections(Dexamethasone–1.5 ml Hyaluronidase- 1500 IU with 0.5ml of lignocaine HCL injection) on fibrous bands



Figure F – First follow up after administering intralesional injection with an improvement in mouth opening about 30 mm and 37 mm tongue protrusion



Figure G – Second follow up after administering intralesional injection with an improvement in mouth opening about 31 mm and 41 mm tongue protrusion





An Assessment of Quality of Life In *Uthiravatha Suronitham* (Rheumatoid Arthritis) Patients Reporting at Ayothidoss Pandithar Hospital, National Institute of Siddha – A Cross Sectional Study

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ABSTRACT

Rheumatology refers to inflammatory diseases that affects the skeleton, muscles and joints. Rheumatoid arthritis is an autoimmune disease leads to systemic inflammation. It is characterized by persistent synovitis, and auto antibodies (particularly to citrullinated peptide and rheumatoid factor). Genetic factors attributes about 50% risk for development of rheumatoid arthritis. Rheumatoid arthritis belongs to the systemic connective tissue diseases which is progressive and chronic in nature. It affects peripheral joints mostly. The clinical features were pain (usually at rest), swelling of joints, deformities of joints, morning stiffness for more than one hour, physical activity limitation and quality of life decreased consequently. It was a cross sectional study to assess the Quality of life in *Uthiravatha Suronitham* (Rheumatoid Arthritis). To estimate the quality of life (QOL) in *Uthiravatha suronitham* (Rheumatoid arthritis) patients reporting at OPD of Ayothidoss Pandithar hospital, National Institute of Siddha through Rheumatoid Arthritis Flare Questionnaire (RA-FQ) and to assess the predisposing factors of *Uthiravatha suronitham* with respect to age, gender, chronicity of illness, personal history, occupational history, family history and stress etc. This is a Hospital based cross sectional study, included 100 *Uthiravatha suronitham* patients reported OPD of ayothidoss pandithar hospital were enrolled based on inclusion and exclusion criteria. After obtaining informed consent, the data were collected by using Rheumatoid Arthritis Flare Questionnaire (RA-FQ) and Beck's Depression Inventory form to estimate the quality of life. Data will be collected and analysis will be carried out through proper statistical method. In 100 *Uthiravatha suronitham* patients, overall score is 42.9 in RA-FQ (Maximum 50) questionnaire. In





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beck's depression Inventory showed that 38% patients had Moderate depression and 33% patients had Severe depression.

Keywords: Quality of life, *Uthiravatha suronitham*, Rheumatoid arthritis, Cross sectional study, Siddha.

INTRODUCTION

Rheumatology refers to inflammatory diseases affecting the skeleton muscles, and joints. In medicine, rheumatology is one of the ancient field [1], Rheumatoid arthritis is an autoimmune disease[2] Rheumatoid arthritis is a multisystem disease with various extra articular manifestations[3] which can affect bone and cartilage leading to disability[4]. It is potent enough to cause irreversible joint damage and significant disability[5]. Elevation of ESR and CRP level and antibody to anti- citrullinated protein or rheumatoid factor presence indicates a diagnosis of rheumatoid arthritis[6]. Rheumatoid arthritis is an autoimmune disease leads to systemic inflammation. It is characterised by persistent synovitis, and auto antibodies (particularly to citrullinated peptide and rheumatoid factor).Genetic factors attributes about 50% risk for development of rheumatoid arthritis [7] .The clinical features were pain (usually at rest , swelling of joints, deformities of joints ,morning stiffness for more than one hour, physical activity limitation and quality of life decreased consequently [8]. One in three patients with rheumatoid have a chance of becoming disabled. HLA-DR4 and DRI is the most important genetic factors related to Rheumatoid arthritis. These genes share identical regions conferring the risk for Rheumatoid arthritis [9]. Approximately 3 cases per 10,000 population is the annual incidence worldwide. It is reported that the prevalence approximately 1% among 35 and 50 years age group[10].Over to 14 million people have affected Rheumatoid arthritis up to 2021, by World health organization reported [11]. A cross-sectional study carried out to provide an overview of Quality of life in Uthiravatha Suronitham (Rheumatoid arthritis) patients.

METHODS

It was a hospital based cross sectional study. This study was conducted at OPD of National Institute of Siddha, Tambaram sanatorium, Chennai, Tamil Nadu, India, Total sample size was 100 patients diagnosed as *Uthiravatha Suronitham* (Rheumatoid arthritis) patients reported at OPD of National Institute of Siddha , were selected for this study, with the age group between 30 and 65 years, The study was carried out after obtaining IEC (Institutional ethics committee) approval (IEC NO. NIS/IEC/2021/MP - 8) and was registered in CTRI (the registration number is CTRI/2022/01/039808), [Registered on: 28/01/2022]. The study was conducted from February 2022 to April 2022. After informed about the study and obtained written informed consent, the study participants were asked about the quality of life and functional status and the data were collected by using Rheumatoid Arthritis Flare Questionnaire (RA-FQ) and Beck's Depression Inventory. The data collected from the study were analyzed in SPSS 24.0 software by Microsoft word and Excel method. Selection criteria were 1. Age above 30 years and below 65 years.2. Male, female and transgender. 3. Known case of *Uthiravatha suronitham* and Patients with sero negative, sero positive RA lab investigations.4. Patients who are willing to give informed consent. Exclusion criteria for the study were 1. Age below 30 and above 65 years 2. Patient with normal CRP, Anti CCP test results.3. patient who are not willing to give consent form. 4. Patients defects (Osteoarthritis, psoriatic arthritis, Gout arthritis).

RESULTS AND DISCUSSION

Rheumatoid arthritis is a chronic inflammatory joint disease, which damages cartilages and bones to cause deformities. RA is attributable to genetic factors. It may also affect the cardiovascular, haematological, ocular, vasculitis, pulmonary and neurologic system. In this study, 100 *Uthiravatha suronitham* (rheumatoid arthritis) patients attending Outpatient department of National Institute of siddha were recruited. Among them 14% were male and 86% were female with the





age groups of 30-35(23%), 36-40(11%), 41-45(18%), 46-50(18%), 51-55(16%), 56-60(5%), 61-65(9%). We collected demographic data. Among them 34% were un employed, 30% were unskilled workers, 16% were semi-skilled workers. The prevalence of comorbidities among the patients include hypertension in 16%, diabetes mellitus in 15%. 17% of the patients had family history of *Uthiravatha suronitham*(Rheumatoid arthritis). 82% of people had undergone Ayush treatment, 9% people had undergone Allopathy treatment, 9% people had undergone integrated treatment. sleep pattern was affected in 91% patients. 54% patients had the complaints of Depression, 38% patients had Anxiety. Quality of life of all *Uthiravatha suronitham* patients were assessed using Rheumatoid arthritis Flare Questionnaire (RA-FQ) which includes five domains (Pain, Physical activity, Fatigue, Stiffness, Social events). The RA-FQ score is calculated as the sum of 0-10 (Maximum 50).It is assessed by Mean and standard deviation. The mean scores each domain is Pain 8.73(1.07), Physical activities 8.43(0.98), Fatigue 8.46(1.19), Stiffness 8.93(0.87),Social events 8.35(1.05). The RA-FQ score is calculated by overall range is 42.9(3.80) (Fig. 1) ANOVA test (Table:1) was adopted to analyse the data. This showed a significant association between depression, psychological status and RA-FQ (p value is <0.001).

Sleep (p value is <0.001), family history (p value is <0.014). The quality of life of rheumatoid patients were affected significantly. Bartlett SJ et al reported that in RA-FQ questionnaire, the mean of lot worse was increased with 8.9 points and the mean of lot better with -6.0 points. Minimal worsening had a mean of 4.7 and improvement were associated and - 1.8 points in RA-FQ. RA patients had stable scores without any improvement in scores [14]. Imran MY et, al reported that three fourth of the RA patients have depression. Rheumatoid Arthritis disease activity and the level of depression have a strong association. [15]. Beck's Depression Inventory scale was used to assess the mental health, which includes Twenty-one domains (Sad, Discourage, Failure, Satisfaction, Guilty, Punished, Disappointed, Blame, Kill, Cry, Irritation, Irritation, Interest, Decisions, Appearance, Work, Sleep, Tired, Appetite, Weight, Worry, Sex). Each question carries 1 mark, so that total is 63. It was assessed by percentage. 1% had no depression whose score ranges between 1-10, 5% had Mild mood disturbance whose score ranges between 11-16, Borderline clinical depression was found in 12% whose score ranges between 17-20, 38% had Moderate depression whose score ranges between 21-30, 33% had Severe depression whose score ranges between 31-40, 11% had Extreme depression whose score was greater than 40 (Fig.2). From the study results, it was concluded that the quality of life of Rheumatoid Arthritis patients was significantly affected both physically and mentally. Limitation of this study is, it is a single centric study where critically severe patient are relatively less. The major limitations is that there will be recall bias as this study is truly based on the patient's statement.

CONFLICT OF INTEREST

Nil

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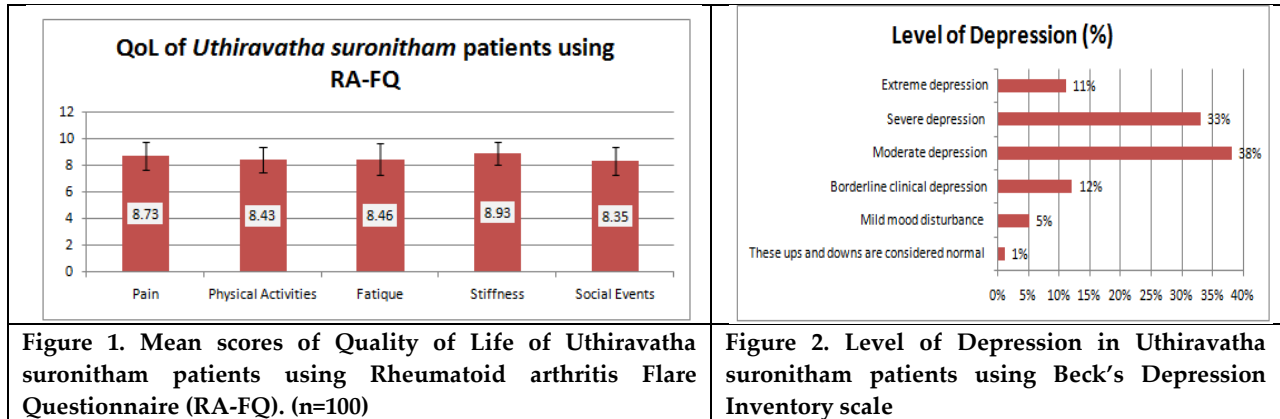
Table:1 STATISTICAL ANALYSIS FOR BECK’S DEPRESSION INVENTORY

Variable	No. of sample	RA Score		P-Value	Inference
		Mean	SD		
Level of Depression					
These ups and downs are considered normal	1	26.0	-	P<0.001	Significant
Mild mood disturbance	5	39.2	3.6		
Borderline clinical depression	12	40.8	4.6		
Moderate depression	38	43.4	2.6		
Severe depression	33	43.6	3.4		
Extreme depression	11	44.7	2.3		
Total	100	42.9	3.8		
Psychological Status					
Depression	54	43.4	3.1	P<0.001	Significant
Anxiety	38	43.3	4.0		
Normal	8	37.8	3.6		
Total	100	42.9	3.8		





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Review of *Pugai* – A Siddha Poly Herbal Formulation for *Moolam* (Haemorrhoids)

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ABSTRACT

One of India's historic medical systems is the siddha system. There is a vast array of both internal and external medicines in the Siddha system. Under the mucocutaneous lining of the anal canal's submucosa, hemorrhoids are vascular engorgements of hemorrhoidal plexuses. The most noticeable symptom for many of the patients is bleeding. *Pugai* (Fumigation) is an external therapy in which the medicine is burned directly (or placed into the fire) to produce therapeutic fumes. It has the efficacy to cure both physical and mental diseases. Diseases arising out of the derangement of *Kapham* are easily cured by this treatment. The siddha poly herbal formulation mentioned in *BrahmamuniVaithiyaSoothiram-II* is indicated for *RaththaMoolam*, *SeezhMoolam*. The ingredients in the siddha poly herbal formulation have anti-inflammatory and anti-microbial activity therefore justifying its usage as *Pugai* in the treatment of *Moolam* (Haemorrhoids). Further in vivo and clinical trial will be done for validating the therapeutic effects in future.

Keywords: *Moolam*, *Pugai*, Haemorrhoids, Siddha Poly herbal





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INTRODUCTION

Anorectal diseases are the illnesses that affect the rectum and anus. Anorectal diseases are either structural or functional abnormalities of the pelvic floor in patients with symptoms such as difficulty in defecation, faecal incontinence, rectal bleeding, anorectal pain, rectal prolapse.[1]Age ranges 41 to 50 were most frequently impacted, followed by 31 to 40, and men (70.13%) made up the majority of those affected. Two-third patients are males with a male: female ratio of 9:1. The common symptom triad in 72% patients are anal pain, constipation, and difficulty in passing stools, followed by bleeding PR. Distribution of anorectal disorders are: Haemorrhoids (61.7%) >fissure-in-ano (14%) >fistula-in-ano (10.3%).[2]Haemorrhoids may be defined as the vascular engorgement of the haemorrhoidal plexuses in the submucosa of the anal canal. It is classified into internal and external haemorrhoids on the basis of anatomical origin.³ In majority of patients, there are three main primary haemorrhoids. The two masses on the right side and one on the left. It is divided by the superior haemorrhoidal artery. The internal haemorrhoids are classified into 4 grades based on the protrusion of the mass at the anal orifice during defecation.[2]Overall, 68.2% patients were managed surgically. Haemorrhoids are treated with ligature/closed/open hemorrhoidectomy.[3]Saint Yugi classified *Moolanoi* into 21 types. In Siddha, the word "Moolam" refers to the root, or Moolathram. The Siddha method accords Moolatharam the most importance because it is the Kundalini, the center of the body that produces energy. If the early stage is not being taken care of it may lead to complications and need to be corrected with surgery. "Anilapithathondhamalathu-moolamvaraathu"(Anilam-vaatham,Pitha-pitham)-As per saint Theraiyar derangement of Vatham and Pitha humor due to lifestyle changes diet and deeds resulting Moolam.

The main Vathahumor and Pithahumor get affected which cause Moolanoi(Haemorrhoids).In Moolanoi, increased Keelvaikanal stimulates Vathahumor these totally stimulate Pithahumor, constipation develops due to effects of Keelvaikanal. So the symptoms like loss of appetite, emaciation, mental depression, decreased body fluids and blood volume are developed.[4] Pugaï(Fumigation) is one of the external therapies in Siddha system of medicine. Pugaïis defined as the method of fumigation in which the medicated fumes are generated by burning the drugs directly or putting the drugs into the fire.⁵ Gram positive staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, and other pathogenic organisms are frequently found in infected areas of human body. Gram positive Staphylococcus aureus resides in noses of 30% of the population.[6,7] Since ancient times, naturally occurring plants have played an important role in disinfection. The Siddha poly herbal formulation gives evidence for its therapeutic actions mentioned in the literatures. It has 3 ingredients, all from the plant origin. This review article will help to provide the information about the phytochemical constituents, and pharmacological activity.

MATERIALS AND METHODS

TRIAL DRUG: Moolathuku pugai⁸

PREPARATION OF THE TRIAL DRUG

INGREDIENTS

1. Leaves of *Bambusaarundinaceae* - Moongililai
2. Bark of *Tamarindus indicus* - Puliyampurani
3. Leaves of *Azadirachata indica* - Veppilai

Phytochemical and pharmacological studies of above drugs are mentioned in Table:1

METHOD OF PREPARATION

Both the leaves are burnt in the bark of *Tamarindus indicus* and the fumes are subjected to the *moolam*(*Seezhmoolam*, *Raththamoolam*)





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Pharmacological studies**Antimicrobial activity of *Azadirachata indica***

Maragathavalliet al., studied the antibacterial activity of Neem leaf extract, 0.8 g of each extract was dissolved in DMSO and then varying concentrations of the extracts (200 mg/ml, 100mg/ml, 50mg/ml, 25mg/ml, 12.5mg/ml, and 6.25mg/ml) were obtained. The test organisms used were all human pathogenic organisms of clinical origin. The test organisms were *Staphylococcus aureus*, *Escherichia. coli*, *Pseudomonas aeruginosa*. The ethanol extract had more activity on the test organisms than the other extracting solvents. Suba Priya and Naginiet al., reported that the presence of high concentrations of azadirachtins, quercetin and β -sitosterol in *A. indica* leaves might be responsible for strong antibacterial and antifungal activity.

Anti-inflammatory activity of *Azadirachata indica*

Tirupathiraoannavarapuet al., studied the anti-inflammatory activity of leaf extracts *A. indica* using inhibition of albumin denaturation. The percentage of inhibition of protein denaturation and percentage of membrane stabilization for ethanolic extracts and Diclofenac sodium were done at 50, 100 and 200 μ g/ml. It shows anti-inflammatory activity at concentration 200 μ g/ml shows 57.32% (inhibit protein denaturation) and 46.62%. The results indicate that the ethanolic leaf extracts of *A. indica* possesses anti-inflammatory activity properties.

Anti-inflammatory activity of *Bambusaarundinaceae*

Muniappanet al., 2003 studied the anti-inflammatory effect of the methanol extract of the leaves of *Bambusaarundinaceae* against carrageen in-induced as well as immunologically induced paw oedema in albino rats and found to be significant when compared to the standard drugs. The combination of methanol extract and phenylbutazone (Non-Steroidal Anti-inflammatory Agent, NSAIA) had been studied and found to be the most potent anti-inflammatory activity experimentally with least toxic (no ulcerogenic) activity. Thus, the combination of herbal product (methanol extract of *Bambusaarundinaceae*) with modern medicine (NSAIAs) will produce the best anti-inflammatory drug.

Antimicrobial activity of *Bambusaarundinaceae*

Muhammad Zubair et al., studied the antimicrobial activity of the various organic extracts of *B. arundinaceae* leaves against a panel of food-borne and pathogenic microorganisms were assessed. The plant exhibited considerable antimicrobial activity against most of the bacterial and fungal strains. The results from the disc diffusion method measured in inhibition zone (IZ) followed by measurement of minimum inhibitory concentration (MIC), indicated that *n*-hexane extract showed good inhibitory activity against *E. coli* (IZ= 22.2 mm; MIC = 3.81 mg/mL), *P. multocida*, (IZ = 19.0 mm; MIC = 5.28mg/mL) and *B. subtilis* (IZ=17.0 mm; MIC = 5.62 mg/mL) respectively.

Antimicrobial activity of *Tamarindus indicus*

Ahmed John et al., studied the in vitro antibacterial activity of ethanolic bark extract of *Tamarindus indica* with standard ampicillin against gram positive (*Staphylococcus aureus*, *Bacillus cereus*) and Gram negative (*Klebsiella pneumoniae*, *Escherichia coli*) bacteria. Determination of the inhibition zone by means of well diffusion method shows that bark extract of *Tamarindus indica* exhibited an anti-microbial effect against all tested bacteria.

Anti-inflammatory activity of *Tamarindus indicus*

Shaikh Zohrameena et al., studied the Aqueous ethanol and chloroform extracts from *T. indica* were evaluated for anti-inflammatory properties in mice (ear oedema induced by arachidonic acid) and rats (sub plantar oedema induced by carrageenan) after topical or i.p. administration, respectively. *Tamarindus indica* is known to exert anti-inflammatory and analgesic effects probably by down-regulating the nuclear factor-kappa B (NF-kB) and the p38 mitogen-activated protein kinase pathway.





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DISCUSSION

Pugai (Fumigation) is one of the external therapies in the Siddha system of medicine. This study reveals that the *Pugai* is the effective external treatment procedure to treat hemorrhoids. Fumigation signifies the artificial impregnation of the atmosphere, with the fumes or smoke of any vegetable or aromatic substances. *Pugai* using the burnt Leaves of *Bambusaarundinaceae - Moongililia*, Bark of *Tamarindus indicus - Puliampuranileaves of Azadirachata indica* are administered in affected parts of the body. The main purpose of this procedure is to reduce microbes and to control infections. Fumigation can be effective in inactivating microbes on environmental surfaces. This promotes effective and fast healing and reduces the pain in hemorrhoids.

CONCLUSION

Moolam (Haemorrhoids) may be efficiently treated using the *Moolathukupugai*. Studies conducted using current research and the aforementioned Siddha literature demonstrate that the ingredients used in *Moolathukupugai* have anti-inflammatory and anti-microbial properties. For further research, the external therapy *Pugai*, should be clinically assessed for treating Hemorrhoids. For better prediction and the advancement of evidence-based medicine in external therapies, the therapy should be accessible in general practice. External therapies for hemorrhoids can be effective, simple, and cost effective OPD procedure and this should be demonstrated with concrete data.

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TABLE:1 INFORMATION ABOUT THE INGREDIENTS

S. No	Botanical name	Tamil name	Parts used	Action	Phytochemistry	Pharmacological studies
1.	<i>Bambusaarundinaceae</i>	Moongil	Leaf	Emmenagogue, Anthelmintic	Carbohydrates, Reducing sugars, Proteins & Amino acids, Flavonoids, Saponins, Glycosides, Tannins, Alkaloids and Steroids	Antibacterial activity, Antiinflammatory, Antiulcer, Protective effects ⁹
2.	<i>Azadirachata indica</i>	Vembu	Leaf	Anthelmintic, Stimulant	Alkaloids, Glycosides, Tannins and Saponins	Anti-Inflammatory, wound healing, anti microbial activity, anti bacterial ¹⁰
3.	<i>Tamarindus indicus</i>	Puli	Bark	Astringent, Tonic	Tannins, Saponins, Glycosides, Peroxidase and Lipids	Antimicrobial activity, Anthelmintic Activity, Anti-inflammatory activity, Analgesic activity, Wound healing activity ¹¹





Isolation, Cultural and Morphological Characteristic Features of *Pythium aphanidermatum*, Causing Rhizome Rot of Turmeric

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ABSTRACT

Turmeric (*Curcuma longa* L.) is one of the most important spices in India. Turmeric belongs to the family Zingiberaceae, considered a "golden spice", "Indian saffron" and "Queen of the kitchen". Among various diseases, Rhizome rot of turmeric is causing more yield losses and causing severe damage to crops. *Pythium aphanidermatum*, A soil borne pathogen is responsible for the rhizome rot of turmeric. 10 *Pythium* samples were isolated from the turmeric growing areas of Tamil Nadu. The samples were examined for Cultural and Morphological characteristics (Color, appearance, margin, colony growth, margin, and sporulation) were observed. ITS region of rDNA amplification with specific ITS1 and ITS4 universal primers produced approximately 600 to 800 bp showing all the samples were confirmed as *P. aphanidermatum*. The sequence of isolate Pa1 was identified as *P. aphanidermatum* through BLAST SEARCH on the NCBI website (www.blast.ncbi.nlm.nih.gov/Blast). The identified sequence was deposited in Gen Bank with the accession number OM979024.

Keywords: Rhizome, *Pythium aphanidermatum*, GenBank, NCBI





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INTRODUCTION

Turmeric (*Curcuma longa* L.) is one of the most important spices in India. Turmeric belongs to the family Zingiberaceae, considered a "golden spice", "Indian saffron" and "Queen of the kitchen". In North India, turmeric is commonly called "Haldi," a word derived from the Sanskrit word *haridra*, and in the south, it is called "manjal," is a part of Indian delicacies, health care as well as rites and rituals since time immemorial (Anoop et al., 2014). The name turmeric derives from the Latin word *terra merita* (meritorious earth), referring to the color of ground turmeric, which resembles a mineral pigment. It is known as *terre me3rite* in French and simply as "yellow root" in many languages in many cultures, its name is based on the Latin word *curcuma*. (Preeti Rathaur et al., 2012). In 2020-2021, the estimated turmeric production is about 2.64 tonnes with a productivity of 6439kg/ ha (2606 kg/acre) (AMIC 2021). The occurrence of rhizome rot disease of turmeric caused by *Pythium aphanidermatum* (Edson) Fitzp. has been recorded in Karnataka, Kerala, Tamilnadu, and Andhra Pradesh states of India. In Tamil Nadu, Erode district occupies the first position in the state in area and second position in productivity next to the Coimbatore district. Turmeric is susceptible to diseases like Rhizome rot, Leaf blotch, Leaf spot, and Leaf blight. Among these, Rhizome rot of turmeric causes severe damage and yield losses. A soil-borne pathogen *Pythium aphanidermatum* is responsible for rhizome rot with symptoms of the disease is drying of the leaves starting from the margin. Water-soaked spots in the collar region, toppling down of infected tillers, rotting of roots and the affected rhizome becoming hollow with only fibrous tissues left behind. rotting of roots and the affected rhizome becoming hollow with only fibrous tissues left behind. It has given up its cultivation owing to the frequent rhizome rot disease that destroyed the crops (Tamaraiselvi et.al 2020). Depending on the intensity of the disease partial to total rotting of rhizomes may occur which would lead to the death of the whole plant. It causes severe yield reduction and reduces the quality of rhizome (Rathiah, 1982). ITS region of rDNA amplification with specific ITS1 and ITS4 universal primers produced approximately 600 to 800 bp showing all the samples were confirmed as *P. aphanidermatum*. The sequence of isolate Pa1 was identified as *P. aphanidermatum* through BLAST SEARCH on the NCBI website. The identified sequence was deposited in GenBank with the accession number OM979024.

MATERIALS AND METHODS

Isolation of *P. aphanidermatum*

The infected turmeric rhizome and pseudo stem samples showing the symptoms of rhizome rot were collected directly from the field from major turmeric growing districts in paper bags and brought to the laboratory. The pathogen was isolated by tissue segment method (Rangaswami and Mahadevan, 1998) on a potato dextrose medium. The infected rhizomes and pseudo stems were washed thoroughly with sterile water, blot dried, and cut into small pieces (5mm²), surface sterilized with 0.1 percent sodium hypochlorite (NaOCl) solution for one minute, then washed with three variations of distilled water to remove traces of sodium hypochlorite and blot dried and then placed in Petri plates containing PDA medium under *in vitro* condition. The plates were incubated at room temperature, 28 ± 2 C for 5-7 days for the growth of the fungus. The pathogen was identified as *P. aphanidermatum* based on the keys (Plaats-Niterink 1981).

Purification and maintenance of the isolates

After incubation, the pure culture of the fungus was obtained by using a hyphal tip isolation technique. The isolates were sub-cultured frequently under aseptic conditions, with an interval of 10-15 days in PDA slants. The pure culture was aseptically transferred into PDA slants and stored in the refrigerator (4°C) for maintenance and further use. The isolates are designated as Pa1 to Pa10 respectively.

Cultural and morphological characters of various isolates of *P. aphanidermatum*

The cultural and morphological characteristics of the pathogen, like colony color, appearance, margin, and sporulation were studied in the PDA medium. 15 ml sterilized media was poured into the sterile Petri dishes and





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allowed to solidify. 9 mm mycelial disc of the pathogen (*P. aphanidermatum*) taken from the peripheral region of 7 days axenic culture with the help of sterile cork borer and placed at the Centre of the Petri plates. Three replications were maintained for each isolate. The inoculated plates were incubated at room temperature (28 ±2°C). Observations on cultural characteristics were recorded 7 days after incubation. The test pathogen was identified and confirmed by comparing them with descriptions given by Plaats Niterink (1981).

Scanning electron microscopy

Actively growing fungal culture was fixed overnight in 0.05M phosphate buffer containing 4% glutaraldehyde at 28°C. On the next day, the fungal mat was washed three times in phosphate buffer and dehydration of the samples was done using ethanol for 15 minutes. The fixed and dehydrated samples were dried with CO₂ for 5 minutes and were fixed on aluminum stubs and sputter-coated with carbon polaron E-500 and immediately observed under a scanning electron microscope at 15 KV. This work was carried out in the Department of Physics, at Annamalai University.

Molecular characterization of *P. aphanidermatum*

DNA extraction

DNA was extracted from one virulent isolate of pathogenic *P. aphanidermatum*. The fungal isolate was grown in 100 ml of PDA broth for 7 days and mycelial mat grown on the Potato dextrose (PD) broth was harvested. The genomic DNA was extracted and purified using the CTAB method (Doyle and Doyle 1990). 100 mg of dried fungal mycelium was ground into fine powder in liquid nitrogen using a mortar and pestle until it formed dry powder. The powder powdered mycelium was transferred to 2.0 ml Eppendorf tubes were incubated in 5 ml, 2 % CTAB extraction buffer [10 mM Tri's base (pH 8.0), 20 mM EDTA (pH 8.0), 1.4 M NaCl, CTAB (2 %), mercaptoethanol (0.1%) and PVP (0.2%)] at 65°C for 30 min. The mixture was added with an equal volume of chloroform: isoamyl alcohol (24:1). The mixture was centrifuged at 10,000 rpm for 10 minutes. The supernatant was transferred to a fresh tube and mixed with an equal volume of ice-cold isopropanol and 5 M NaCl and incubated overnight at -20°C for DNA precipitation. The precipitation was collected and centrifuged at 13000rpm for 10 minutes and the pellet was collected by discarding the supernatant. The pellet was washed with 0.1 M ammonium acetate in 70% ethanol twice and incubated for 15 minutes. The pellet was re suspended in 50 µl of TE buffer (10mM Tris, 1mM EDTA, pH 8.0) (White et al., 1990) and the DNA concentration and purity were determined using a Nanodrop ND1000 spectrophotometer (Nanodrop Technologies Inc). Aliquots of samples were also analysed on a 0.8% agarose gel to check DNA quality.

PCR Amplification

The universal primers ITS-1 and ITS-4 were used to amplify ITS regions of *P. aphanidermatum*

Forward primer: ITS1- F (5' TCC GTA GGT GAA CCT TGC GG 3')

Reverse primer: ITS4- R (5' TCC TCC GCT TAT TGA TAT GC 3')

A single discrete PCR amplicon band of 550 bp was observed when resolved on 1.5% agarose gel. The PCR reaction mixture consisted of 10µl viz., 5 µl of PCR master mix, 1µl of forward primer and 1 µl reverse primer, template DNA 1 µl and 2 µl of sterile water. PCR was performed with an initial denaturation step at 95 °C for 5 min, followed by 40 cycles of amplification with denaturation at 94 °C for 1 min, annealing at 67 °C for 1 min, and extension at 72 °C for 1 min, At the end of the amplification reaction, a final extension step was achieved at 72°C for 10 min. The PCR products were run on 1.2% agarose gels containing 5 mg/ml of ethidium bromide in a TAE (1X) as the running solution. The electrophoretic migration was carried out during 2 h under an 80V. The amplified products were visualized and photographed under UV light (Nzungize et al., 2011). The consensus sequence of the 18SrRNA gene was generated from the forward and reverse sequences. 18S rRNA gene sequence was used to carry out BLAST with the database of NCBI gene bank database. Based on the maximum identity score first ten sequences were selected and aligned using the multiple alignment software program Bio edit version 7,2 ClustalW multiple alignment. The distance matrix was generated and the phylogenetic tree was constructed by using MEGAX. Finally acquiring accession numbers, these sequences were submitted to the NCBI (National Centre for Biotechnology Information) gene bank, USA.





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RESULT AND DISCUSSION

Isolation of samples of *P. aphanidermatum* on turmeric growing areas

A field survey was conducted in 2021 in turmeric growing areas viz., Namagiripettai, Pattanam, Mullukurichi, Metala, Vadugam, Mangalapuram, Alanganatham village in Namakkal district Gangavalli, Valapadi villages in Salem district, and Eragudi in Trichy district. The samples were isolated and designed as Pa₁-Pa₁₀. All the isolates were identified as *P. aphanidermatum*. (Table:1)

Cultural and morphological characters of various isolates of *P. aphanidermatum*

The fungus *P. aphanidermatum* was successfully isolated from the diseased rhizome samples collected from different areas and each isolate was observed for cultural and morphological characteristics. The ten isolates of *P. aphanidermatum* show variation among the cultural characteristics and morphological characteristics viz., colony growth, color, margin, appearance, shape, and sporulation when grown on PDA. These results were recorded and are presented in (Table 2).

Colony color

Based on colony color, the test isolates Pa₁, Pa₅, and Pa₉ showed white sparse colonies, whereas Pa₇ and Pa₁₀ showed dull-white colonies, and isolates Pa₂, Pa₃, and Pa₈, showed creamy white colonies, isolates Pa₄, and Pa₆ showed off white colony color (Table.2).

Colony margin, appearance, and shape

The ten isolates are identified based on colony appearance (cottony or fluffy), colony margin (smooth and rough), and colony shape (circular or irregular). Based on colony appearance, the fungal isolates Pa₁, Pa₂, Pa₄, Pa₅, Pa₆, Pa₈, Pa₉, and Pa₁₀ showed a coarse cottony thread-like appearance while Pa₃ and Pa₇ showed a fluffy appearance. The isolates Pa₁, Pa₃, Pa₄, Pa₇, and Pa₉ showed colonies with a smooth margin while the isolates Pa₂, Pa₅, Pa₆, Pa₈, and Pa₁₀ recorded colonies with a rough margin. The test isolates Pa₁, Pa₂, Pa₄, Pa₆, Pa₇, and Pa₉ showed circular radial growth whereas Pa₃, Pa₅, Pa₈ and Pa₁₀, showed irregular growth. (Table 2).

Sporulation

The isolates were categorized as poor (+), fair (++) , good (+++), and excellent (++++) according to their sporulation capacity. The test isolates varied from fair (++) to excellent (++++) sporulation. However, the sporulation count was excellent (++++) in two isolates viz., Pa₁ and Pa₂; good (+++) in five isolates viz., Pa₃, Pa₅, Pa₆, Pa₇, and Pa₁₀ and fair (++) in three isolates viz., Pa₄, Pa₈ and Pa₉. (Table 2).

Morphological and cultural characteristics of *Pythium aphanidermatum*

Hanif et al. (2015) reported that *Pythium* mycelium produces a white color with a fluffy appearance and consists of long, slender hyaline branched hypha. Ashwathi et al. (2017) observed that five isolates of *Pythium* on PDA produced a dense, white cottony mycelial growth with fluffy topography. Each produced aseptate, hyaline mycelium, oogonia terminal, globose, and smooth 20-25 μ diameter. Nandhini (2019) reported that all 10 isolates of *P. aphanidermatum* differed in their mycelial growth and among the isolates Pa₂, Pa₆, and Pa₉ produced cottony creamy white colonies while the other isolates produced white and off-white colonies. Soundarya (2019) isolated two different species of *Pythium* such as *P. aphanidermatum* and *P. debaryanum* from major tobacco-growing tracts of Tamil Nadu and reported the cultural characteristics are differentiated by rapid to moderate, whitish fluffy to sparse raised growth with smooth margins on PDA medium. Subharathinam et al. (2020) isolated *Pythium* spp. In 21 different locations of Tamil Nadu, the cultural characteristics like colony color and colony pattern revealed that all the isolates produced white color with cottony growth. Jayalakshmi et al. (2021) collected infected samples of tomatoes from different parts of Tamil Nadu. Isolated and characterized the pathogen based on their morphological characteristics and they confirmed the isolates as *Pythium aphanidermatum* by observing the hyaline, non-septate mycelium, oospore, and lobed sporangial formation.





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Table 1: Isolate the sample of *P. aphanidermatum* on turmeric growing area Pa*- *Pythium aphanidermatum* isolates

S. No	Isolates	Village	Districts	Pathogen
1.	Pa ₁	Namagiripettai	Namakkal	<i>P. aphanidermatum</i>
2.	Pa ₂	Pattnam	Namakkal	<i>P. aphanidermatum</i>
3.	Pa ₃	Mullukuruchi	Salem	<i>P. aphanidermatum</i>
4.	Pa ₄	Mettala	Namakkal	<i>P. aphanidermatum</i>
5.	Pa ₅	Vadugam	Namakkal	<i>P. aphanidermatum</i>
6.	Pa ₆	Mangalapuram	Namakkal	<i>P. aphanidermatum</i>
7.	Pa ₇	Gangavalli	Salem	<i>P. aphanidermatum</i>
8.	Pa ₈	Valapadi	Salem	<i>P. aphanidermatum</i>
9.	Pa ₉	Eragudi	Trichy	<i>P. aphanidermatum</i>





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10.	Pa ₁₀	Alanganatham	Namakkal	<i>P. aphanidermatum</i>
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Table 2: Morphological and cultural characteristics of *Pythium aphanidermatum*

S. No	Isolates	Colony characters				
		Color	Appearance	Colony growth	Margin	Sporulation
1.	Pa ₁	White sparse	Cottony	Smooth	Circular	++++
2.	Pa ₂	Creamy white	Cottony	Rough	Circular	++++
3.	Pa ₃	Creamy white	Fluffy	Smooth	Irregular	+++
4.	Pa ₄	White	Cottony	Smooth	Circular	++
5.	Pa ₅	White sparse	Cottony	Rough	Irregular	+++
6.	Pa ₆	White	Cottony	Rough	Circular	+++
7.	Pa ₇	Dull White	Fluffy	Smooth	Circular	+++
8.	Pa ₈	Creamy white	Cottony	Rough	Irregular	++
9.	Pa ₉	White sparse	Cottony	Smooth	Circular	++
10.	Pa ₁₀	Dull white	Cottony	Rough	Irregular	+++

++ = Fair
 +++ = Good
 ++++ = Excellent



Fig:1. Symptoms of rhizome rot of turmeric

Fig: 2. Axenic culture of *P. aphanidermatum*



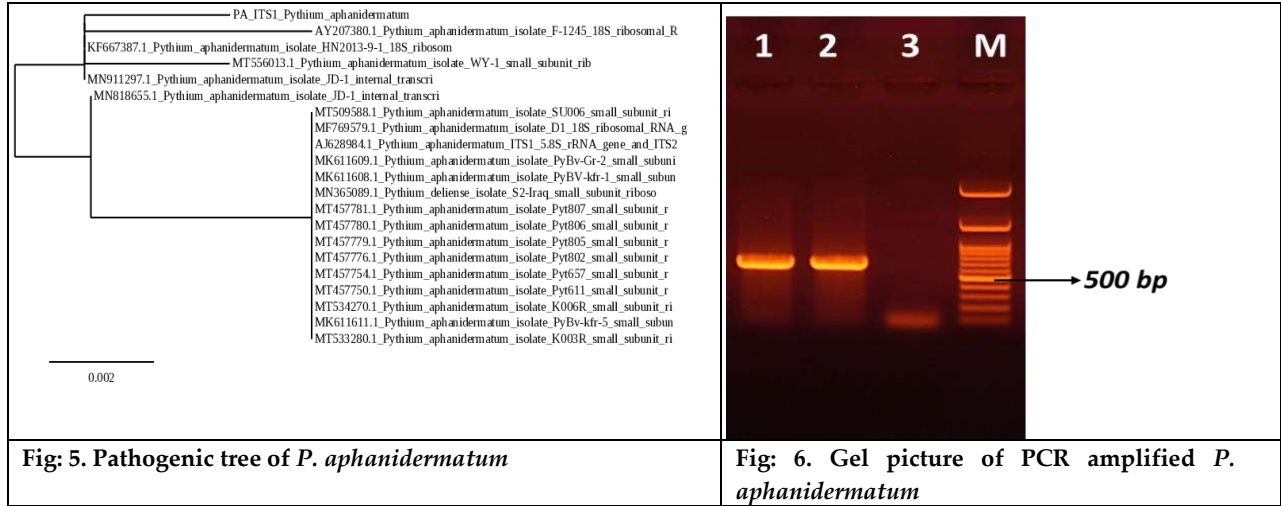
Fig: 3. Microscopic view of *P. aphanidermatum*

Fig: 4. SEM image of *P. aphanidermatum*





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***Curcuma longa*: A Review of Antioxidant, Anxiolytic and Antidepressant Activity**

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ABSTRACT

Curcumin is extracted from the turmeric plant (*Curcuma longa* Linn.) and is widely used as a food additive, culinary and in traditional medicine. Recently, there is growing attention on usage of curcumin to prevent the neurodegenerative diseases. This review summarizes the data available from several studies of curcumin in various phytochemicals role and pharmacological activities such as antioxidant and anxiolytic properties, antidepressant activity of curcumin.

Keywords: Curcumin, Phytochemical, Anxiolytic, Anti-depressive, Antioxidant properties.

INTRODUCTION

Curcuma longa, commonly known as turmeric, is an ancient spice obtained from the rhizomes of *Curcuma longa* and also known as 'Golden Spice of India' turmeric has also been used for centuries in Ayurvedic medicine, which incorporates the medicinal properties of herbs with food. [1] Turmeric is commonly used because the spice is well documented for its medicinal characteristics in India and the Chinese medical system [2]. According to Chattopadhyay et al, (2004) it's widely used in the traditional medicine in India, Pakistan, and Bangladesh because of its several beneficial properties [3]. The plant is cultivated in all parts of India [4] but it also cultivated in southern China, Taiwan, Japan, Burma, and Indonesia as well as throughout the African continent [5].





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Anxiety and depression

The ratio of the global population alive with depression is estimated to be 322 million people 4.4% of the world's population according to a new [report](#), "Depression and other common mental disorders, Global Health Estimates", published by the World Health Organization. The report also includes data on anxiety disorders, which affect more than 260 million people, 3.6% of the world's population [6]. Anxiety is an unpleasant state of internal disturbance that causes nervous behaviors such as fear, anxiety and worry. It can lead to feelings of dread over something unlikely to happen, such as a feeling of imminent death moreover, anxiety disorder is an emotion that is characterized by feelings of worrying thoughts, tension, and physical changes such as increased blood pressure [7]. Anxiety disorders and depression are different; people who develop depression may have had an anxiety disorder earlier in life. [8] Depression is another serious psychological disorder. Depressed people not only have a bad mood, but also sleep or appetite disturbances, significant weight loss or gain, loss of interest or pleasure in daily activities, low energy, inability to concentrate, feelings of worthlessness and repetitive thoughts death or suicide.[9]

Curcuma longa

Turmeric is a perennial herbaceous plant of the Zingiberaceae (ginger) family. It measures up to 1 m in height with a short stem, with long, pointed leaves and funnel-shaped yellow flowers. The important species of genus includes *Cucurma longa*, *Cucurma aromatica*, *Cucurma augustifolia*, and *Cucurma amada*. Turmeric can be grown on almost all types of soils. But well-drained sandy loam soil to clay loam soils rich in organic matter is optimum for production of good crop. The ideal temperature is 20-30°C and preferably at a pH range of 4.5-7.5. [10] It is widely cultivated in Asia, mainly in India and China. Perhaps native to India [11] in our country the leading states of turmeric production are Andhra Pradesh, Orissa, Tamil Nadu, West Bengal, Assam, Bihar and Uttar Pradesh. Other than India, it is cultivated extensively in Bangladesh, Jamaica, Sri Lanka, Taiwan, China, Burma, Indonesia, Fiji and Thailand.[12] Turmeric is a sterile plant and does not produce any seeds. The plant grows 3 to 5 feet tall and dull yellow flowers.[13]. To traditional Ayurvedics practitioners, turmeric was an excellent natural antiseptic, disinfectant, anti-inflammatory and pain reliever, and the plant was often used to aid digestion, improve intestinal flora and treat skin irritation.

Traditional uses of *Curcuma longa* a medicinal plant

India has a rich history of using plants for medicinal purposes. *Curcuma longa* is widely used in the Unani and Siddha system of medicine as a home remedy for various ailments, its origins are for various uses including as a food spice, food pigment and traditional Indian medicine for the treatment of various ailments. . Also it's used in the textile and pharmaceutical industries [14]such as wound healing [15-16], anti-inflammatory [17], antiarthritic [18], analgesic [19], antifebrile [20], antibacterial [21], antiviral [22], antifungal [23], antisensitivity [24], antioxidant [25], neuroprotective [26], antidepressant [27], cardioprotective and lipid-lowering activity [28], anticoagulant [29], antiulcer [30] antidiabetic activity [31], liver protective [32], anticancer [33], antifertility [34] and antitoxin[35]. Turmeric extract and turmeric longa essential oil reduce the growth of various pathogenic bacteria, parasites and fungi. [36]

Traditional uses of *Curcuma longa* culinary

Nowadays it is used as a food, being the main constituent of curry, medicine and colouring [37]. Sometimes in pickles and mustard, turmeric is used to compensate for fading. Turmeric is also used for coloring cheeses, salad dressings, margarine, yoghurts, cakes, biscuits, popcorn, cereals, sauces, etc. Turmeric is also a substitute for mustard in animal feed. Many doctors believe that turmeric is comparable to milk thistle in treating liver disease and improving liver function. [38]. Turmeric is used in cooking for its aroma and color [39]. It is part of curry powder (10-30% turmeric) used to season meat and fish. Vegetarian curry mixes have a lower content of turmeric due to its bitter taste [40]. Turmeric is probably the oldest known cosmetic product, as it was traditionally applied to women's skin. It is believed to reduce facial hair growth, reduce acne, and improve skin tone [41, 42]. Turmeric gel has been reported to improve the appearance of light-damaged skin conditions such as changes in pigmentation, solar elastosis, actinic poikiloderma, solar and actinic freckles, keratosis when applied for a long time, such as six months [43].





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DISCUSSION

Worldwide, more than 10 million people suffer from neurological diseases every year, and this number is expected to increase in the future [44]. About 3.1% of the population aged 70-79 in Western countries has neurodegenerative diseases, while in India the incidence of the disease in individuals of the same age is 0.7%. The difference is mainly due to different lifestyles and eating habits depending on the consumption of different ingredients. [45] In recent years, more and more attention has been paid to traditional medicine. In traditional medicine, many plants have been used to treat neurodegenerative diseases such as Alzheimer's disease (AD) and other memory-related disorders [46].

Phytochemistry of *Curcuma longa*

The phytochemical investigations of aqueous extract, acetone extract, ethanolic extract, chloroform extract and methanolic extract of *Curcuma longa* rhizome commonly using [47]. The components of turmeric are mainly curcumin and are called curcuminoids (diferuloylmethane, demethoxycurcumin and bismethoxycurcumin) [48]. Study shown that tumeric plant had 0.76 % alkaloid, 0.45 % saponin, 1.08 % tannin 0.03 % sterol, 0.82 % phytic acid, 0.40 % flavenoid and 0.08 % phenol , 0.76 % alkaloid [49] and proximal composition turmeric contains 8.92% moisture, 2.85% ash, 4.60 % crude fibre and 6.85 % fat. It also contains 9.40 % crude protein and 67.38 % carbohydrate. [50] The main phenolic compounds present in *C. longa* include demethoxycurcumin and bisdemethoxycurcumin, which are rich in curcumin (main active compound) [51][52]. Quantities of minerals and vitamins in turmeric (per 100 g dry matter) include 200 mg of calcium, 260 mg of phosphorus, 2500 mg of potassium, 47.5 mg of iron, 0.9mg of thiamine (B1), 0.19mg of riboflavin (B2), 4.8mg of niacin (B3), and 50 mg of ascorbic acid [53]. Table-1 shows the Major volatile components in different part of *Curcuma longa*.

Curcuma longa compounds

C. longa contains different curcuminoids, but curcumin was found to be the most active one, first isolated in 1815 [61] (Vogel and Pelletier, 1815), The curcumin structure was first proposed by Polish scientists in 1910 [62]. Although curcumin generally refers to 1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione, the compound is also known as "curcumin I". curcumin is a diferuloylmethane with a crystalline yellow-orange colour, molecular weight of 368.39 g/mol, melting temperature of 183°C, and with the chemical formula C₂₁H₂₀O₆ [63]. There are two additional compounds known as curcumin, which are curcumin II [demethoxycurcumin (DMC), 1-(4-hydroxy-3-methoxyphenyl)-7-(4-hydroxyphenyl)-1,6-heptadiene-3,5-dione] and curcumin III [bisdemethoxycurcumin, (BDMC) 1,7-bis(4-hydroxyphenyl)-1,6-heptadiene-3,5-dione] (Buckingham, 2018) [64]. According to Paulucci et al, (2013) Solvent extraction followed by column chromatography is the most common method used to separate curcumin from turmeric, and several polar and non-polar organic solvents including hexane, ethyl acetate, acetone, methanol, etc. have been used [65].

Essential oils from *Curcuma longa*

There are some variations in this composition, which may depend on genetics, type of raw material (dry or fresh) and plant part, harvest season, geographical conditions, light, and the method used which extracts oil [66]. *C. longa* EO has been shown to inhibit *Mycobacterium smegmatis* [67], *Fusarium verticillioides* [68], *Microsporium gypseum*, *Epidermophyton floccosum*, *Trichophyton mentagrophytes*, *Trichophyton rubrum* [69], *Escherichia coli*, *Candida albicans*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Saccharomyces cerevisiae* [70] Several studies in the literature indicate that *C. longa* EO has various bioactivities such as antimicrobial, repellent, antioxidant, anti-inflammatory and anticancer, antilarvicidal [71]. Table-2 shows the Compounds responsible for the bioactive potential of *C. longa* essential oil.

Pharmacological role of *Curcuma longa*

C. longa is widely recognized as an herbal medicine, having a wide range of pharmacological effects. Table-3 summarizes the turmeric in various pharmacological activities.



**Sunit Nath et al.,****Antioxidant properties of *Curcuma longa***

Oxidative stress (OS) is a condition caused by an imbalance between oxidants and antioxidants in biological systems. The imbalance is caused by excessive levels of reactive oxygen species (ROS) or dysfunction of the antioxidant system [84]. According to Tanvir et al,(2017) it is determined that turmeric ethanol extract has a more significant antioxidant effect than the aqueous turmeric extract that against free radical damage.[85] Pro-oxidant curcumin is a powerful bioprotectant with various pharmacological properties including transition metal ions (Cu and Fe). ROS, such as superoxide anion, hydroxyl radical, singlet oxygen, peroxy nitrite, and nitric oxide, are all successfully neutralized by this treatment .[86] Various in vitro and in vivo studies have been conducted, and the antioxidant potential of curcumin has been recognized to its chemical structure, including carbon- activated protein kinases (MAPK) and pathways involved in nitric oxide synthase (NOS) enzymes synthesis [87,88,89,90] Curcumin has been shown to be an effective oxygen free radical scavenger. Its antioxidant function is like that of vitamins C and E. It can prevent oxidation caused by lipids or hemoglobin. [91]

Anti-depressive role of *Curcuma longa*

Depression is a common chronic, relapsing mental illness that significantly affects quality of life and increases the risk of death. [92] It has been proposed that *Curcuma longa* has anxiolytic and antidepressant properties, in animals, in some preliminary studies, according to YU ZF et al. (2002), aqueous extracts of *Curcuma longa*, administered orally to rats at a dose of 560 mg/kg, were more potent than the reference antidepressant fluoxetine [93]. It has been reported that the antidepressant effect of curcumin is related to the serotonergic system, in which curcumin interacts with 5-HT 1A/1B and 5-HT 2C receptors [94]. Study shown that, mitochondrial dysfunction has historically been associated with various neuropsychiatric disorders, including depression, bipolar disorder and schizophrenia [95] [96] It has been reported that curcumin can protect mitochondria from oxidative damage by reducing intracellular generation of ROS and synchronous attenuation the apoptosis of cortical neurons in mice. [97]

Anxiolytic role of *Curcuma longa*

Anxiety disorder involves a state of increased exaggerated version of the acute stress response and fear [98]. Health repercussions of anxiety are very variable from consistent stress associated with higher risk of cardiovascular and cerebrovascular diseases [99] to physical manifestation such as headaches, uncontrolled trembling and sweating, muscle tension and aches [100]. A study conducted by (Hind Benammi et al,2014) stated that curcumin extract against experimental lead induced-anxiety in male wistar rats possibly result from modulation of central neuronal monoaminergic neurotransmission, especially serotonin, which has shown a significant reduction of the immunoreactivity within the DRN (dorsal raphe nucleus).[101] Curcumin was shown to promote hippocampal neurogenesis and improve BDNF level in mouse model of chronic stress [102]. Also it acts by inhibiting the expression of MAO-A and MAO-B enzymes which results in increase the levels of norepinephrine, serotonin, and dopamine [103]. Hgcl2 perinatal exposure caused anxiety, depression and related hormones such as corticosterone and cortisol levels in the plasma of male mice offspring, it also shown that ability of curcumin to protect against mercury toxicity [104].

CONCLUSION

Today, the "golden spice" is still used as a culinary ingredient, but modern technology has made it possible to cultivate curcumin for a variety of food and health applications. The plant *Curcuma longa* has been used in food preparations since ancient times to give color and flavor. Turmeric has been shown to have antimicrobial, antimutagenic, and anticancer properties in various studies. The anti-inflammatory, anti-cancer, neurodegenerative, and anti-depressant effects of this spice have been proven. The results show that turmeric has medicinal value that can be used in both pharmacological and phytochemicals forms. While a lot of research has already been done on this plant, more research is needed to develop drugs. Greater awareness of its, benefits, traditional uses, side effects and more research on preparations with better bioavailability is needed. The collection of *Curcuma long*, showing





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antidepressant effects, antioxidant properties from various journals, it can be concluded that plants are a very rich source of substances responsible for increasing the antidepressant, anxiolytic and antioxidant properties.

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CONFLICT OF INTEREST

Conflict of interest declared none.

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Table 1: Major volatile components in different part of *Curcuma longa*

Plant part used	Extraction method	Major chemical components	References
Rhizome	Steam distillation(SD)	8,9-Dehydro-9-formyl-cycloisolongifolene (35.3%), velleral (10.0%), germacrone (6.5%) and dihydrocostunolide (22.5%),	54
Leaf (HD)	Hydro distillation(HD)	Curzerene (16.2%), germacrone (13.6%), 1,8-cineole (13.5%), and camphor (5.7%)	55
Root	Hydro distillation(HD)	β -Elemenone (65.0%)	56
Fresh rhizome	Steam distillation(SD)	Curdione (50.6%) and germacrone (9.5%)	57
Dry root	Steam distillation(SD)	Germacrone (9.1%), curcumenol (8.5%), isocurcumenol (7.5%), and arzingiberone (5.1%)	58
Flower	Steam distillation(SD)	Curdione (27.0%) and an unidentified oxygenated sesquiterpene (12.3%)	59
Dry rhizome	Steam distillation(SD)	Curcumol (35.8%), 1,8-cineole (12.2%), ar-turmerone (7.0%), linalool (6.4%), humulene oxide (6.1%), and caryophyllene oxide (5.9%)	60

Table 2: Compounds responsible for the bioactive potential of *C. longa* essential oil

Plant Part	Compounds	Bioactivities	References
Rhizome	Ar-turmerone, curcumenone, β -turmerone, 8,9-dehydro-9-formylcycloisolongifolene, β -sesquiphellandrene, germacrone, arcurcumene, α -himachalene, and andledane	Anti-age	72
Rhizome	Aromatic-turmerone, α -turmerone, and β -turmerone	Antioxidant	73
Rhizome	Ar-turmerone, β -turmerone, α -turmerone, ar-curcumenone, β -phellandrene, α -terpinene, limonene, γ -terpinene, and α -phellandrene	Antimicrobial	74
Leaves	α -Phellandrene, α -pinene, β -pinene, myrcene, α -cymene, limonene, and 1,8-cineole	Larvicide	75
Leaves	Cis-sesquibabinene hydrate, curzerenone, β -bisabolol, and farnesol	Antioxidant and antimicrobia	76
Rhizome	α -Turmerone, β -turmerone, α -phellandrene, terpinolene, α -zingiberene, β -sesquiphellandrene, ar-turmerol,	Antimicrotoxicogenic, Antioxidant and	77



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	curzerenone, and arturmerone	antifungal	
Rhizome	1,8-Cineole, α -phellandrene p-cymene, terpinolene α -zingiberene, and β sesquiphellandrene	Anticonvulsants, sedatives and anxiolytics	78

Table 3: Turmeric in different pharmacological activities

Turmeric Extracts	Pharmacological Activity	Model	Result	References
Turmeric root extract	Antioxidant Activity	Wistar rats	The formation of free radicals or ROS with DOX increases oxidative stress, which inhibiting the activity of endogenous antioxidants, thereby reducing the overall antioxidant status of the system. Taken together, the vitamins C and E in turmeric root extract treat all these symptoms individually.	79
Water extract of Turmeric Leaf (TLE)	Antioxidant Activity	Zebrafish models	We observed a decrease in the percentage of cells in their G1 phase when TL was administered at high concentrations. TLE treatment reduced ROS production and lipid peroxidation in H ₂ O ₂ -treated zebrafish models.	80
Nanoparticulate curcumin	Immuno modulatory Activity	Healthy albino mice	The anti-inflammatory effect of nanoparticle curcumin is strongest in the initial stages. Poly d,l-lactic-co-glycolic acid coated curcumin nanoparticles will enhance the bioavailability of curcumin for effective protection.	81
Regular turmeric extract	Anti-inflammatory Activity	inflammatory rat model	REVERC3 (Bisdemethoxy-Curcumin) has been shown to have anti-inflammatory properties by reducing carrageenan-induced paw edema. Compared with turmeric extract, REVERC3 is more effective in reducing inflammation.	82
Nanocurcumin	Immuno modulatory Activity	Immuno suppressed rat model	Nanocurcumin can be used as an immunomodulatory agent in mice receiving cyclophosphamide (CP), a drug that has been associated with anti-inflammatory effects.	83





Regulatory Requirements for Fixed-Dose Combination of Solid Dosage form in Europe

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ABSTRACT

This comprehensive study delves into the world of fixed-dose combinations (FDCs) in pharmaceuticals, shedding light on their merits, demerits, approval procedures, and pivotal role in public health. This finding highlights the importance of FDCs in simplifying medication regimens, enhancing patient compliance, and reducing costs. This study discusses the European Medicines Agency (EMA) in regulating FDCs within the European Union and the criteria for evaluating the rationality of FDCs, emphasizing the need for unique mechanisms of action and nontoxic formulations. It also discusses the challenges and advantages of FDCs in treating various diseases, particularly in lower- and middle-income countries. Furthermore, this study explored FDCs' development and regulatory requirements, emphasizing the need for pharmacodynamic and pharmacokinetic studies to ensure safety and effectiveness. It also addresses potential drug interactions and the critical role of risk-benefit assessments in the approval process. Overall, this study provides a comprehensive overview of FDCs, their development, regulatory considerations, and their impact on public health, offering valuable insights for healthcare professionals, regulators, and researchers in the field of pharmaceuticals process. In conclusion, this study offers a comprehensive overview of fixed-dose combinations, encompassing their development, regulatory considerations, and profound impact on public health. It serves as a valuable resource for healthcare professionals, regulators, and pharmaceutical researchers, providing a deeper understanding of this critical aspect of modern pharmaceuticals.



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Keywords: Fixed Dose Combinations, Pharmaceuticals, Medication Regimens, Patient Compliance, Healthcare, European Medicines Agency.

INTRODUCTION

The WHO has stated that a combination of two or more actives in a set ratio of dosages is acceptable. Regardless of the formulation or brand, When referring to a particular combination of active substances, this expression is used generally. It may be administered as a completed pharmaceutical product or as a single entity product supplied simultaneously. Fixed dose combinations (FDCs) are pharmaceutical products that combine two or more medications into a single dosage form. These products have a matching mode of action and improved therapeutic activity, opening up new therapy options for practically all human diseases. The creation of FDCs is becoming more and more crucial from the perspective of public health. (1) The European Medicines Agency (EMA) assists the work of the European Commission by contributing to the debate around medications inside the European Union (EU). A fixed-dose combination contains several active ingredients in a specified ratio and varying amounts. This type of medicine is widely used to treat a variety of conditions with a single prescription because of its easier administration and potential for greater therapeutic results. However, fixed-dose combinations may also have drawbacks, such as a higher possibility of side effects or medication interactions. FDCs are particularly well-liked and have had tremendous growth in the previous 10 years in the pharmaceutical sector. (2)

FDC's reasoning ought to be based on elements like

1. The drugs in the combination should each have a unique mechanism of action.
2. The pharmacokinetics shouldn't change significantly.
3. The components in the mixture shouldn't be poisonous in supra-additive amounts.(2)

The FDC was deemed to be reasonable if

1. Complementary modes of action for APIs
2. Lower the prevalence of AMA (antimicrobial agent) resistance
3. Boost the effectiveness of the combination
4. Reduce the frequency of harmful or unfavorable medication responses
5. Reduced pill load will increase medication therapy compliance.
6. Reduce the therapy's overall cost.
7. Each API should be given at a dosage that is suitable for defining or bigger populations.

The FDC was seen to be ludicrous if it shows.

1. There is no justification or explanation for the pairing.
2. There is no justification or explanation for the pairing. (3)

The combination has no rationale or explanation. FDC is essential for those with chronic illnesses. Their irrationality has raised some concerns and value in numerous nations, therefore their reasonable usage should be founded on strong medical principles. These concerns must be evaluated against the possible benefits of FDCs, notably their cost-effectiveness in specific situations. The use of fixed dosage combinations (FDCs) as opposed to individual prescriptions of the drugs has advantages. This must be weighed against issues like rising expenses and, in some circumstances, their irrationality. As a result, it is necessary to assess their value The majority of infectious and non-infectious illnesses are prevalent in lower- and middle-income (LMIC) nations, where there are also cost-related problems. The content of the EU is given in Table I.(1,4)



**Balasubramanya et al.,****BACKGROUND**

Fixed-dose combinations come in various forms and are commonly found in household goods and medications, with multivitamins being one of the most common examples. Approximately 40 medication combinations are on the World Health Organization's list of essential medicines, however many of them are not currently accessible as fixed-dose combos. Due to a combination of diuretics and potassium chloride occasionally leading to ruptured stomach lining, fixed-dose combos suffered in the 1950s. Similarly, the creation of fixed-dose combos has gained popularity in India. but many have been approved without proper justification or evidence, leading to bans and withdrawals of licenses. In contrast, in countries with well-established regulatory frameworks such as the USA and the European Union, The number of fixed-dose combination drugs that have been approved has increased. The rise in these combinations may be due to an unmet medical need however, additional combination treatments can help close this gap. The advantages of fixed-dose combinations are covered in the section that follows.(5)

COMBINATION PACKS

The evaluation of combination packs will likewise follow the rules that govern fixed combination items. Contains multiple pharmaceuticals to be administered simultaneously or sequentially for a single therapeutic purpose.

MERITS OF FDC INCLUDE**Better treatment**

1. Instead of the present 7-8 tablets needed for the single medication regimen, just three or four FDC pills would be needed daily during the intense phase.
2. The current regimen has so many tablets that there is a higher chance that patients would forget to take a certain dosage, which might lead to insufficient treatment or, worse still, monotherapy, which increases the risk of developing drug resistance. Because FDCs contain all the drugs required for the regimen in a single pill, this risk might be decreased.
- 3.

Better case management

1. FDCs streamline the medication supply chain by minimizing the quantity of formulations that need to be ordered and shipped, especially to remote areas of the nation.
2. FDCs may be less expensive than other regimens due to reduced program expenditures for distribution and procurement.

Patient compliance

1. In comparison to monotherapy, FDC may improve patient compliance by requiring them to take fewer pills each day (e.g., 3-4 tablets per day as opposed to 15-16 tablets per day).
2. By easing patients' pill burden, medication compliance increased.

Synergistic effect

1. Sometimes a perfect mix of fixed dosage combinations comes together to provide a synergistic impact.
2. It has been demonstrated that the fixed-dose combination of these two drugs results in a synergistic analgesic effect, even though Tramadol has a prolonged analgesic impact and Paracetamol has a quick onset. (6)

POTENTIAL ADVANTAGES**Increasing activity**

1. Using the same dosage, combining substances can improve the therapeutic effect through synergistic or additive activity.
2. Synergistic activity occurs when one substance enhances the effect of another, resulting in a true therapeutic advantage. This can happen through pharmacodynamic and/or pharmacokinetic interactions.
3. Additive activity, on the other hand, is when the effects of one substance simply linearly add to those of another without interacting.



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4. Combining substances can also improve tolerance by lowering the dosage of drugs that have a small margin of safety. Additionally, combining a substance that counteracts the adverse effects of another can If the adverse impact is severe or frequent, increase tolerance.
5. Reducing the dose of a single drug might increase tolerance with a small margin of safety, or by including a chemical that mitigates the negative effects of another medication. This is only acceptable, though, if the negative effect is large or widespread.
6. The advantages of FDC for patient compliance are displayed in **Fig I.** (6)

DEMERITS OF FDC INCLUDE**Reduced dosage flexibility**

The limitation that fixed-dose antihypertensive combination medications have regarding the dosage flexibility for each of its constituent components is a drawback. Since Amlodipine and Atorvastatin.

Drug interactions

1. Depending on the chemical characteristics of the chemicals found in the environment, drug interactions between the active components and excipients used in FDCs may arise. (acidic/basic/humidity).
2. Drug interactions can affect treatment results, pose potential incompatibilities, and affect stability, which makes them serious issues.
3. The two medications become chemically unstable as a result. A redesigned tablet-in-tablet formulation has been created to stop this interaction. (1)

FDC APPROVAL PROCEDURE

A drug must complete two regulatory processes before it can be marketed in the European Union. Applications for marketing authorization and applications for clinical trials are these two processes. In contrast to marketing authorization requests, which are authorized at both the member state and centralised levels, clinical trial applications are approved at the member state level of the European Union (as of July 2013), which has 27 member states.

- NATIONALIZED PROCEDURE
- MUTUAL RECOGNITION PROCEDURE
- DECENTRALIZED PROCEDURE
- CENTRALIZED PROCEDURE

NATIONALIZED PROCEDURE

An applicant may only receive marketing authorization under the Nationalised procedure in one member state. The responsible authority of the Member State must receive an application before granting a national marketing license. New active compounds that are not needed by the Centralised procedure can get marketing authorization using this method. This process has a 210-day timeline. (7)

MUTUAL RECOGNITION PROCEDURE

In member states other than the Reference Member State (RMS), when the drug has already been authorized, applicants may get a marketing license by using the Mutual Recognition approach. Each EU member state where the applicant requests marketing authorization receives a copy of the same dossier with the essential information. The other Member States (the "CMS") to whom applications have previously been made are informed right away of the decision by the first Member State (the "RMS") to evaluate the medicinal product. RMS releases an analysis of its findings for additional states. The primary consumer of this kind of medicine approval process is the generic business. This procedure might take 390 days to complete. The MRP is displayed in **Fig II.** (8)



**Balasubramanya et al.,****DECENTRALIZED PROCEDURE**

Companies may employ this strategy to submit simultaneous requests for authorization for drugs that, in essence, do not meet the criteria for critical medicines under the centralized method and have not yet been approved in any EU country. Marketing authorization should be provided by the decision reached by the RMS & CMS in this decentralized way based on the assessment report created by the RMS and any comments made by the CMS. usually applies to products whose import into an EU country has not yet received authorization (Duration: 210 days). The Decentralized procedure is displayed in **Fig III. (9)**

CENTRALIZED PROCEDURE

A single marketing authorization and central authorization are the results of the centralized procedure, which leads to a European approval route and a single product. After being inspected throughout the EU, a product that through the centralized process has been authorized by the European Commission. The European Medicines Agency (EMA) coordinates the review process using the Member States' scientific competence. For certain things, the centralized approach is required, but not for others. The centralized procedure prohibits the usage of some items. The centralized procedure is displayed in **Fig IV. (10)**

DEVELOPMENT OF FIXED-DOSE COMBINATION

Harmonization of regulatory policies is encouraged among the countries that make up the International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use (ICH). It has a significant impact on the creation of drug development standards by organizations like the EMA and FDA. The development of fixed-dose combinations follows a distinct set of standards than conventional drug research guidelines. Because there is presently no specific ICH guideline for combination drugs, the development of fixed-dose combinations is based on the ICH monotherapy recommendations. Major drug development agencies such as EMA, FDA, and WHO have their own set of guidelines for developing fixed-dose combinations. For instance, the EMA released while the FDA has two guideline documents about fixed-dose combinations and combination treatment, the "Guideline on clinical development of fixed combination medicinal products" was released in 2017. Guidelines for registration of fixed-dose combination medical products is another guideline for fixed-dose combinations that was prepared by the WHO.(5) The overall concept of all the recommendations for fixed-dose combinations is nicely summed up in the

EMA's three overall requirements

1. Justifications and grounds for the combination
2. Proving that all active ingredients contributed to the intended therapeutic result
3. The supporting evidence is pertinent to fixed combination medicine, which is critical if it is based on the administration of many active substances together. These bodies give careful thought to the separate components of the fixed-dose combination's approved status. Four examples from the WHO guideline give a summary that corresponds to the factors taken into account across all of the guidelines.

The four fixed-dose combination scenarios that can be authorized are listed below:

1. Generic fixed-dose combination of an existing fixed-dose combo
2. Fixed-dose combinations that are given in the same dosage as two different drugs now used in treatment
3. Combining two substances in a fixed dose that have never been mixed before or in a different dosing regimen
4. Combination of fixed-dose drugs comprising one or more novel chemical substances(11)

The primary pivotal trial or dose results clinical trial's choice of design was categorized as either:

1. Factorial design: Two or more combinations (different ratios)
2. Ray design: Two or more combinations (same ratio)
3. Single combination: One combination tested



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The number of patients and the number of arms in the clinical trial had a substantial impact on the body of data. When a factorial design was used in place of a ray design, there were noticeably more patients and arms. Naturally, there were far fewer dosages tried for a single combination than for a factorial design. (12)

Using tactics for development It was discovered that the fixed-dose combination's drug status had an impact on whether dose-finding trials were carried out throughout development. No dosage-finding research was conducted for 57% of the fixed-dose combos including two authorized medications. This strategy is outlined in the pertinent EMA guideline for the studied period (2009 guidelines), and the current investigation provides evidence that this strategy is practicable. Additionally, the EMA's most recent 2017 guidelines have a section outlining the evidence base that backs the same strategy. When fixed-dose combos were allowed without completing all stages of clinical research, an analysis of the FDA indicated a similar result. The fact that additional effective dosage levels or ratios may have been discovered by examining the drug-drug interaction space is a drawback of employing the existing dose levels. (13) To determine how to most effectively apply the requirement of demonstrating how various elements contribute to the overall impact, the design of a clinical trial was considered. In more than half (47%) of the permitted fixed-dose combinations, only one dosage was examined. A factorial design was employed by the vast majority (47+44%), which may be viewed as a subset of a single combination (which is in turn a subset of factorial design). The 2009 EMA recommendations distinguish between the Single combination and Factorial design groups by recommending the use of multilayer factorial designs.

Finally, only a small percentage of sponsors (8%) decided to use the ray design. To obtain a tailored therapy while using a fixed-dose combination, a patient must have access to a variety of allowed combination dosages. Extremely thorough factorial design studies are necessary to obtain approval for these combo doses. This means that adopting fixed-dose combinations for treatment personalization is made more difficult by the widespread adoption of the factorial design. Exposure-response modelling and model-based adaptive optimum design are possible alternatives to the factorial design research that may eliminate the requirement for human participants. Exposure-response analysis of fixed-dose combinations has been shown to have an enormous false-positive rate, rendering the method inapplicable. On the other hand, it has been demonstrated that longitudinal exposure-response analysis can offer a modelling strategy that can lessen the requirement for patients while still delivering accurate findings.

According to the study, modelling was not used in 22% of PK-PD modelling, 36% of PK modelling, or 42% of clinical development programs. By applying PK-PD modelling, Early results from clinical trials may be used to guide dose decisions and provide details on expected effect sizes. The PK profile may be applied to certain groups by taking into account factors like weight and age. The fact that just approximately half (58%) of the development programs used either PK or PKPD modelling as a development approach was therefore unexpected. The study's conclusion highlights the use of intriguing strategies such as using previous information, forgoing dose-finding studies, and medication reprofiling in the development of fixed-dose combinations. Although the significant usage of factorial design research is a barrier to this strategy, personalizing therapy with fixed-dose combinations may be a viable strategy to ensure sustained growth in the development of fixed-dose combinations. Last but not least, People who create fixed-dose combinations should give the use of modelling more serious thought given the benefits of PK-PD modelling and the lack of modelling in the creation of fixed-dose combinations as indicated in this study. (6,13)

INTERACTION OF DRUGS

When components are mixed to produce a fixed combination product, unexpected interactions between the components may take place. This might lead to unfavorable effects or a lack of effectiveness.

For example, One or more active compounds in a combination may make other active substances more hazardous or disguise their effects. The potential for interactions between active ingredients and excipients in vitro and in vivo must be taken into account, and investigated, and any Hazards need to be justified in a risk-benefit analysis and recorded. (14)



**Balasubramanya et al.,****INDICATIONS**

The intended use of a fixed combination product should be such that each active ingredient contributes to the overall therapeutic benefit of the product. The dosage and ratios of each active component in the product should be suitable for all of the indicated purposes. An indication is a known biological condition or state, such as a disease or affliction. The many components of a specified mix can be used to treat various symptoms of a single ailment. For a particular combination to be effective, these symptoms must typically occur concurrently and be of a significant intensity. Since certain symptoms may also be present in other conditions and the other substances in the combo may not be successful in treating them, they shouldn't be treated individually. When monotherapy has failed in a variety of situations, fixed combination medications may be recommended as second-line therapy or as first-line therapy for patients who have never taken either of the medications. The applicant should conduct the clinical development in the manner in which they have declared they intend to use the fixed combination. (15)

PHARMACODYNAMIC AND PHARMACOKINETIC STUDIES

When developing a set combination medicine, the potential for interactions between its constituent parts must be considered. The applicant must provide data to back up their claims that such interactions don't exist or that they are well-defined and understood. This is vital to ensure the medication's efficacy and safety.

Pharmacodynamic studies

The pharmacodynamic effects of the various medicines may be enhanced or amplified while taking a fixed combination of medications. To find the best dosage combination that yields a good response in this situation, it might be necessary to try several dose combinations. Using the concentration-response data, the ideal fixed combination may be chosen. This kind of information can assist in guaranteeing that the drug is efficient and offers a favorable benefit-risk balance.

Pharmacokinetic studies

When developing a fixed combination medicine, it is often crucial to show that the individual constituents do not interfere with one another's pharmacokinetic properties. However, in other situations (such as when administered with a metabolism inhibitor), the fixed combination may be meant to have a pharmacokinetic interaction. Individuals with that disease should also be looked into if a condition affects the pharmacokinetics of one of the medications, as should high-risk groups including the elderly and those with liver or renal impairment. This is necessary to guarantee the medication's efficacy and safety.

Safety and efficacy

Fixed dose combination drug applications submitted by Article 10b of Directive 2001/83/EC that have already been granted EEA authorization through a national or community process shall employ individual compounds. Complete safety and efficacy data must be provided for the fixed combination. In general, knowledge of the specific compounds is not required. Information about the separate compounds may, however, be provided in the application if the applicant can justify why there isn't specific information on the combination. It is acceptable to make a distinction between studies required for fixed combinations that are essentially innovative and those that are analogous to combinations that are now widely used and thoroughly studied. When the fixed combination matches a frequently used one, It is possible to provide an accurate bibliographical data analysis. If the data are thorough and reliable, using this analysis might reduce the number of clinical trials necessary. It will also make it simpler to pick the doses for each chemical and the proposed dose range for the fixed combination. The fixed combination is essentially new (e.g. involving active substances that are not usually combined or an unusual quantitative composition of usually combined substances), the data required are comparable to those for a novel chemical entity, and prior knowledge of the chemicals should be considered.(16)

Utilising a combination product as opposed to combining the use of individual substances

The use of a combination product, as opposed to individual substances, can offer several advantages in clinical situations. For example, a predetermined combination product ensures the proper ratio of active chemicals, guards



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against potential product compatibility issues, and may make it easier to handle animals and maintain owner compliance.

RISK-BENEFIT ASSESSMENT

A risk-benefit analysis should be included in the dossier to balance potential advantages and downsides if the combination of active medications is appropriate. Combinations of substances with narrow therapeutic indices or critical dosage ranges may not be suitable for fixed combination products, as they require precise individual dosing. The use of redundant substances should be minimized, and each ingredient in a set combination must have a proven contribution to the combination. (17)

DOSSIER REQUIREMENTS FOR COMBINATION PRODUCTS**General requirements****New fixed combination products**

If at least one unique active component is included in the combination veterinary medicinal product, a comprehensive dossier by Article 8 of Regulation (EU) 2019/6 must be submitted. Regulation (EU) 2019/6's Article 20 says that it is feasible to give the findings of safety and residue testing, as well as fresh pre-clinical research and clinical trials, provided all of the active components in the combination product have been used in prior veterinary medical products that are permitted, with the combination product only. Providing scientific references for each unique active component is optional, but if the applicant decides to do so, they should do so with the appropriate pharmacological and toxicological information, along with the required safety, residue, pre-clinical, and clinical data for the combination product, this will be regarded as a valid justification for concealing such information about the merged product. Pharmacological and toxicological studies using the final formulation may be necessary to further investigate the interactions between the active components and excipients in the fixed combination product, depending on the nature and intensity of the interactions. (18)

Combination products that meet the criteria for generic or hybrid application

If a combination product satisfies the requirements for a generic or hybrid product, Articles 18 or 19 of Regulation (EU) 2019/6 are applicable. According to the particular formulation (e.g., modifications in excipients) and delivery method, information on the tolerance to and depletion of residues in the target animal species (e.g., local irritation) may be required. (19)

Specific Requirements**Part 1: Specific Requirements for safety and residues Documentation**

The pharmacological details of the combination product must be provided to illustrate the mechanism of action and explore potential interactions. Any omissions must be justified. Toxicological data for the combination may also be necessary if the excipients and/or active ingredients interact, whether there is any potential for hidden toxicity, etc. When a synergistic effect occurs, further in-depth toxicological information will be required. The integrated product must demonstrate its safety for users, consumers, and the environment. It's critical to evaluate the combination's safety about the individual product safety of the active components. Research on user safety that focuses in particular on the consequences on the person delivering the product or any other people who may be exposed during or after treatment (for example, children handling animals after treatment) should always be conducted on the final formulation. To undertake user safety tests as needed, the fixed combination product would be used, and the results would be provided in the dossier. The CVMP guideline on user safety for pharmaceutical veterinary medicinal goods (EMA/CVMP/543/03) describes user safety research and evaluations. It is necessary to undertake an Environmental Risk Assessment (ERA) to determine how the combined product may affect the environment. Data by VICH GL6 and GL38 (ERA stages I and II, respectively) may be submitted for the aforementioned drugs, only if scientifically warranted. To protect consumers, withdrawal times must be defined for animals used for food production. To establish withdrawal times, residue depletion tests for foodstuffs (based on species) must be carried out using the fixed combination/final formulation. It is necessary to prove the presence of the pharmacologically active ingredients and any important metabolites in the predetermined combination product in the animal's body or



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milk, eggs, or honey by the proper examinations. For injectable products (intramuscular or subcutaneous) designed for livestock, data on residual depletion at injection sites must be given.

Part 2: Specific requirements for pre-clinical and clinical Documentation

A fixed combination product's effectiveness and target animal safety should both be examined in the animal species for which it is designed. (20)

Pre-clinical data

To demonstrate the combination product's mode of action (e.g., additive or synergistic), explore potential connections, or categorically demonstrate that no interactions occur, pre-clinical evidence (pharmacokinetic and/or pharmacodynamic) must be provided. If the fixed combination is founded on pharmacokinetic interactions, these interactions ought to be studied in healthy animals of the target species.

Dose determination and dose confirmation studies

It's important to back up the recommended dosing regimen. If pharmacological research has conclusively shown that there are no interactions between the active ingredients, the basis for dose selection may be based on information for each unique active ingredient. If the potential benefit of the combination product depends on synergistic or additive activity, it may be required to test a variety of dose combinations for each component to determine the appropriate quantitative relationship between them in the fixed combination product. For dosage confirmation studies, the final formulation must always be utilized.

Tolerance

If an increased tolerance is the justification for the fixed combination, target animal safety testing should also include an untreated control group or a reference therapy.

Clinical data

When performing clinical trials, always utilize the final formulation of the combination product. It's critical to contrast the target animal safety and efficacy of the combination product with those of the individual active components.

Resistance

An evaluation of the possibility for the emergence of resistance will be required for antibacterial or antiparasitic fixed combinations.

Exceptions

If one of the active components of a combination drug doesn't necessarily have a therapeutic effect but instead only intensifies or completes the effect of the other component (for example, beta-lactams and beta-lactamase inhibitors), the efficacy of the combination product should be compared to the principal active ingredient's effectiveness when taken by itself. It should be shown that the active ingredient has the desired impact even in the absence of direct therapeutic activity (e.g. the fixed combination must be superior to the main component when given alone). The advantages of each active component in combinations of vitamins, minerals, and oligo-elements that are fixed may be difficult to ascertain. Such combinations are recognized as useful and safe in these circumstances provided the specified indications are limited to deficiency diseases when therapy with a specific combination is acceptable and the maximum doses do not exceed internationally and scientifically recognized restrictions. Combinations of vitamins and antibiotics are not covered by this exclusion. Additionally, a particular combination of nutrients and electrolytes may not meet the requirements of this advice. Any experimental data that contrasts the various effects of each medication in these conditions is meaningless. (20)



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SUMMARY AND CONCLUSION

In conclusion, (FDCs) are a vital component of modern pharmaceuticals, offering a multitude of advantages that include simplified treatment regimens, enhanced patient compliance, and the potential for cost reduction. They have emerged as powerful tools in addressing a wide spectrum of diseases, especially in regions with limited healthcare resources. The (EMA) oversight and stringent evaluation criteria ensure that FDCs meet the highest standards of safety, efficacy, and rationality. The demand for FDCs has grown significantly, particularly in lower- and middle-income countries, where cost-effective and simplified therapies are crucial. However, the development and approval of FDCs require meticulous attention to pharmacodynamic and pharmacokinetic interactions to guarantee their safety and effectiveness. Risk-benefit assessments play a pivotal role in the approval process, ensuring that the benefits of FDCs outweigh any potential drawbacks. As the pharmaceutical industry continues to evolve, the development of FDCs holds the promise of addressing unmet medical needs, improving treatment outcomes, and enhancing the overall quality of healthcare. Researchers, regulators, and healthcare professionals must continue collaborating and innovating in this field, ultimately advancing public health by harnessing the full potential of Dose Combinations. In a world where healthcare accessibility and efficiency are paramount, FDCs represent a critical step forward in providing safe, effective, and accessible treatments to diverse patient populations.

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Table 1 : The contents of FDC in Europe

CONTENTS	EUROPE UNION 
Authority	European medicine agency(EMA)
Committees	Committee for Human Medicinal Products
various registration methods	<ol style="list-style-type: none"> 1. Centralised procedure 2. Decentralised procedure 3. Mutual recognition procedure 4. National procedure
Types of application	1. Full dossier application





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	<ol style="list-style-type: none"> 2. Generic product application 3. Hybrid application 4. Biosimilar application 5. Bibliographic application 6. Fixed-dose application 7. Informed consent application
CTD presentation	eCTD
eCTD year implemented	2005
Application for marketing authorization and fee schedule	National fee(including hybrid applications): £103,059 Decentralised procedure
Approval time	~12months
No of copies	1
BCS	If all APIs fall into BCS Classes I or III, FDC products can be allowed.
TSE?BSE study data	Required
Braille code	It is necessary for labeling
Post approval changes	Type IA, IB, and II variations

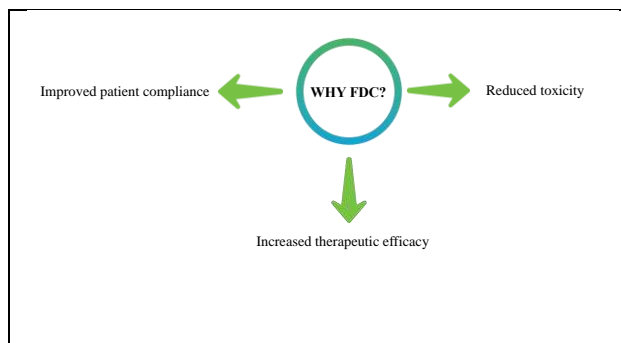


Figure 1: Advantages of FDC

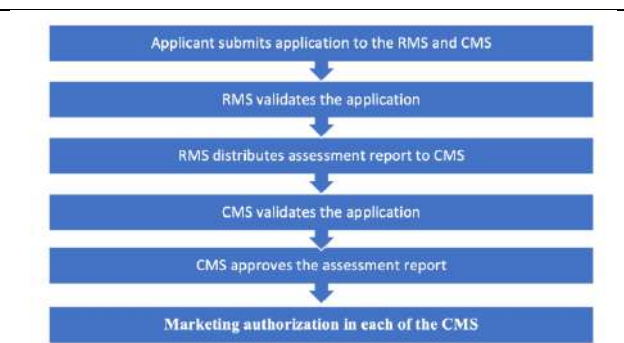
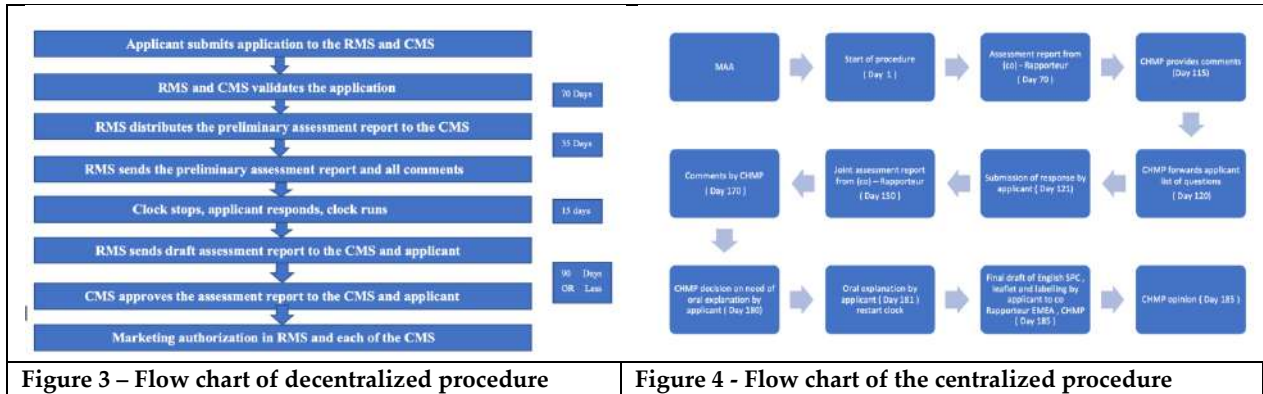


Figure 2: Flow chart of mutual recognition procedure





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Population Status and Distribution Pattern of Indian Peafowl (*Pavo cristatus* L.) in Specific Sites in Bharatpur Rajasthan

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ABSTRACT

The observations showed quite a fluctuation in the population and distribution of peafowl, *Pavo cristatus* in different areas of Bharatpur District. These are Village Kandholi in Tehsil Rupbas, Village Saman-Penghore in Tehsil Kumher, and Anirudh Nagar colony From September 2020 to August 2023. All the experimental sites showed the maximum population of peafowl in August due to the availability of suitable mating sites and reproduction, coinciding with the spring season. The fluctuation in the population and distribution was marked due to the behavior of *P. cristatus* i.e., variance in the availability of food, roosting, and site of reproduction. Anirudh Nagar Colony is an urban area that provides a man-made environment to the Indian Peafowl; therefore, the population of *P. cristatus* remained relatively small compared to other sites.

Keywords: Distribution, *Pavo cristatus*, population, roosting.

INTRODUCTION

The Indian peafowl, *Pavo cristatus* Linnaeus 1758 is a resident breeder of South Asia. The distribution of peafowl in India is patchy but ranges from the Himalayas in the north to peninsular India in the south. They belong to the family Phasianidae of order Galliformes, which is a group of more than 250 bird species including peafowls, jungle fowls, pheasants, partridges, turkeys, grouse, chickens, quails, etc (Johnsgard, 1986). The genus, *Pavo*, is derived from the Latin word *pawe*, meaning peacock, and the species name *cristatus*, refers to the crest (Sclater, 1860). Birds



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are the most essential part of our ecosystems and Indian Peafowl acts as a bio indicator of the changing climate (Nameer 2020). They are highly sensitive to changes in their environment *i.e.*, habitat destruction, and environmental pollution due to the activity of humans. Problems of bird survival are thus early warnings or signals of problems for man for their own survival in nature. However, the Red Data Book of the International Union for Conservation of Nature (IUCN) listed that about one-third of species of pheasants are endangered. Therefore, peafowl are the most sensitive birds that live near the human population and may be used as a sign of environmental values (Ambuel and Temple, 1983). Henceforth, to assess the suitability of the environment, the present study has been designed on the population and distribution of Indian peafowl at these sites. The abundance of bird species is largely influenced by the spatiotemporal distribution of some key environmental resources (Girma *et al.* 2017).

MATERIALS AND METHODS**Study area**

The present study was carried out from September 2020 to August 2023 in different areas of Bharatpur District. These are Village Kandholi in Tehsil Rupbas, Village Saman-Penghore in Tehsil Kumher and Anirudh Nagar colony. The locations have a large stretch of hilly area with rich biodiversity and agricultural fields, a large area of agricultural fields with dense vegetation, and Urban area with a dense human population respectively.

Research Methodology

In the present study, the population of Indian peafowl, *Pavo cristatus* was recorded at three experimental sites *i.e.* Saman village, Kandholi and Anirudh Nagar. The observations were recorded in the morning at every experimental site. The survey was carried out immediately after sunrise, normally from 06.00 to 09.00 am with a normal speed of walk. The survey was carried out throughout the year on a weekly basis. The point transect method was used for the survey as suggested by Verner, (1985). The movements of the birds were noted as precisely as possible so as to avoid pseudo-replication. Observations were taken with the help of binoculars, photography, and video graphy done by Nikon d3500 DSLR Camera. During observations different developmental stages (sub-adult, male, male with train, and female) of Indian peafowl were also counted for population estimation (Johnsingh and Murali, 1978 and Soliappan *et al.*, 2002). The observations on the population of peafowl were recorded at five places at every experimental site. The statistical calculations were presented as mean values of the population with standard error of the mean (SE) in the tables.

RESULTS**Population**

The population of Indian peafowl was recorded for three successive years (2020-21, 2021-22, and 2022-23) at three different places which are Village Penghore-Saman, Village Kandholi, and Anirudh Nagar Colony in Bharatpur district. At Village Penghore-Saman population of sub-adult, male, male with train (TM) and female was recorded highest (14.00 ± 0.71 , 14.00 ± 0.71 , 18.00 ± 0.71 and 24.00 ± 0.71 individuals, respectively) in the month of September 2020 during the experiment (Table 1). In contrast, the population of *P. cristatus* was recorded minimum as 1.00 ± 0.32 sub-adult, 1.00 ± 0.32 male, 4.00 ± 0.32 male with train, and 8.00 ± 0.45 female in the month of June 2023, respectively (Table 3). At Village Kandholi, the maximum population of sub-adult, male, male with train, and female was obtained as 10.00 ± 0.63 sub-adult, 8.00 ± 0.35 male, 15.00 ± 0.71 male with train and 22.00 ± 0.71 female, respectively in the month of September 2020 (Table 4). On the other hand, the minimum population of *P. cristatus* was recorded as 1.00 ± 0.32 sub-adult, 1.00 ± 0.32 male, 3.00 ± 0.32 male with train, and 7.00 ± 0.35 female in the month of January 2023, respectively (Table 6). As far as Anirudh Nagar Colony was concerned, the maximum population of sub-adult, male, male with train, and female was obtained as 8.00 ± 0.35 sub-adult, 7.00 ± 0.32 male, 14.00 ± 0.71 male with train, and 20.00 ± 0.71 female, respectively in the month of September 2020 (Table 7). On the other hand, the minimum population of



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P. cristatus was recorded as 0.00 ± 0.00 sub-adult, 1.00 ± 0.32 male, 0.00 ± 0.00 male with train, and 5.00 ± 0.45 female in the month of January 2023, respectively (Table 9).

Distribution

As far as distribution was concerned, among different locations, Indian peafowl, *Pavo cristatus* attained maximum values as 24.00 ± 0.71 female followed by 18.00 ± 0.71 male with train, 14.00 ± 0.71 male, 14.00 ± 0.71 sub-adult at Village Penghore-Saman. However, at other sites (Village Kandholi, and Anirudh Nagar Colony) remained statistically low.

DISCUSSION

The COVID-19 pandemic, caused by the novel corona virus SARS-CoV-2, prompted governments worldwide to impose lockdowns and travel restrictions in early 2020 to curb the spread of the virus. These lockdowns led to profound changes in human behavior and reduced human disturbances, such as industrial activity, transportation, and tourism, during the lockdown period resulting in a notable increase in Peafowl numbers. Therefore the number of Peafowl at every site was high during the lockdown period (2020-21) and remained statistically low in 2021-22 and 2022-23. Similar observations were recorded by Madhok and Gulati (2022) who studied that Avian species reclaimed urban habitat during India's COVID-19 lockdown there was a 16% increase in the number of bird species during the lockdown in the 20 most populous cities in India. The findings on population status and distribution pattern of Indian peafowl *P. cristatus* L. in district Bharatpur revealed that peafowl are distributed in both natural and man-made environments (crop fields and colonies). In a man-made environment (Anirudh Nagar Colony), the highest number of peafowl was recorded in the month of September. In September, most of the peafowl come out to search for suitable sites for their mating and reproduction. This hypothesis was considered by Yasmin (1995), Yasmin and Yahya (1996), Mateos (1998), Deeming and Wadland (2002), and Harikrishnan et al. (2010). In contrast, a minimum population was observed in the month of June possibly due to increased temperature. This population and distribution variation is attributed to their habitat and living style. Similar observations were recorded by Ramesh (2003) at Great Himalaya National Park, in Western Himalaya, and also by Das and Sivakumar (2009) at Chilla Raiyge, Rajaji National Park, in North India. The predation pressure and local people disturbances could cause the peafowl to concentrate in a particular area for foraging. Generally, the peafowls were observed and recorded from the agricultural fields and also from the areas inhabited by tall shrubby trees. It is because by the fact that the shrubby trees provide shade and the agricultural fields are the source of their feed.

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Table 1. Population of Indian Peafowl *Pavo cristatus* at village Penghore- Saman (Kumher) during year 2020-21

Month	Standard Week	Sub Adult	Male	Male with Train	Female	Total
September	36	14.00±0.71	14.00±0.71	18.00±0.71	24.00±0.71	70.00±0.84
	37	14.00±0.71	14.00±0.89	18.00±0.71	24.00±0.71	70.00±1.22
	38	13.00±0.71	13.00±0.71	17.00±0.71	22.00±0.71	65.00±2.83
	39	13.00±0.71	13.00±0.71	16.00±0.71	22.00±0.71	64.00±2.83
October	40	12.00±0.71	12.00±0.71	16.00±0.71	22.00±0.71	62.00±2.76
	41	12.00±0.71	12.00±0.71	15.00±0.71	20.00±0.71	59.00±2.76
	42	12.00±0.71	10.00±0.63	15.00±0.71	20.00±0.71	57.00±2.39
	43	11.00±0.71	10.00±0.63	14.00±0.71	20.00±0.71	55.00±1.90
November	44	11.00±0.71	10.00±0.63	14.00±0.71	18.00±0.71	53.00±1.90
	45	10.00±0.63	10.00±0.63	12.00±0.71	18.00±0.71	50.00±2.17
	46	10.00±0.63	9.00±0.61	12.00±0.71	17.00±0.71	48.00±2.13
	47	9.00±0.61	9.00±0.55	12.00±0.71	17.00±0.71	47.00±2.24
December	48	10.00±0.63	9.00±0.61	12.00±0.71	16.00±0.71	47.00±2.13
	49	9.00±0.61	8.00±0.35	10.00±0.63	15.00±0.71	42.00±1.47
	50	9.00±0.61	8.00±0.35	10.00±0.63	15.00±0.71	42.00±1.47
	51	8.00±0.35	7.00±0.45	8.00±0.35	14.00±0.71	37.00±0.84
January	52	8.00±0.35	7.00±0.45	8.00±0.35	14.00±0.71	37.00±0.84
	1	8.00±0.35	6.00±0.32	6.00±0.45	12.00±0.71	32.00±0.80
	2	6.00±0.32	6.00±0.32	6.00±0.45	8.00±0.35	26.00±1.28
	3	6.00±0.45	5.00±0.32	4.00±0.32	6.00±0.45	21.00±1.10
	4	5.00±0.32	4.00±0.32	2.00±0.32	4.00±0.32	15.00±0.32
February	5	5.00±0.32	4.00±0.32	3.00±0.32	6.00±0.45	18.00±0.55
	6	7.00±0.35	5.00±0.32	6.00±0.45	8.00±0.35	26.00±1.14
	7	7.00±0.35	6.00±0.45	7.00±0.35	10.00±0.63	30.00±1.38





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	8	8.00±0.35	6.00±0.45	8.00±0.35	12.00±0.71	34.00±0.84
	9	9.00±0.61	7.00±0.35	9.00±0.61	14.00±0.71	39.00±1.53
March	10	9.00±0.61	8.00±0.35	9.00±0.61	16.00±0.71	42.00±1.53
	11	11.00±0.71	8.00±0.35	10.00±0.63	16.00±0.71	45.00±1.32
	12	12.00±0.71	10.00±0.63	10.00±0.45	17.00±0.71	49.00±2.12
	13	12.00±0.71	10.00±0.63	10.00±0.45	15.00±0.71	47.00±2.12
April	14	10.00±0.63	10.00±0.63	10.00±0.45	16.00±0.71	46.00±2.02
	15	12.00±0.71	10.00±0.63	12.00±0.71	16.00±0.71	50.00±2.35
	16	14.00±0.71	9.00±0.61	12.00±0.71	18.00±0.71	53.00±2.48
	17	12.00±0.71	9.00±0.61	13.00±0.71	20.00±0.71	54.00±2.48
May	18	11.00±0.71	9.00±0.61	11.00±0.71	20.00±0.71	51.00±2.08
	19	11.00±0.71	9.00±0.61	10.00±0.63	18.00±0.71	48.00±1.80
	20	10.00±0.63	8.00±0.35	10.00±0.45	16.00±0.71	44.00±1.50
	21	10.00±0.63	8.00±0.35	9.00±0.61	14.00±0.71	41.00±1.47
	22	9.00±0.61	6.00±0.32	9.00±0.61	12.00±0.71	36.00±1.92
June	23	8.00±0.35	5.00±0.32	8.00±0.35	10.00±0.63	31.00±0.89
	24	6.00±0.45	2.00±0.32	8.00±0.35	10.00±0.63	26.00±1.07
	25	5.00±0.45	2.00±0.32	5.00±0.32	7.00±0.45	19.00±1.30
	26	3.00±0.32	2.00±0.32	4.00±0.32	9.00±0.61	18.00±1.28
July	27	4.00±0.32	4.00±0.32	4.00±0.45	10.00±0.63	22.00±1.30
	28	8.00±0.35	6.00±0.45	8.00±0.35	14.00±0.71	36.00±0.84
	29	10.00±0.63	8.00±0.35	10.00±0.63	16.00±0.71	44.00±1.80
	30	10.00±0.63	8.00±0.35	12.00±0.71	18.00±0.71	48.00±1.66
August	31	11.00±0.71	10.00±0.63	12.00±0.71	18.00±0.71	51.00±1.92
	32	12.00±0.71	10.00±0.63	14.00±0.71	20.00±0.71	56.00±2.35
	33	12.00±0.71	10.00±0.63	14.00±0.71	20.00±0.71	56.00±2.39
	34	13.00±0.71	11.00±0.71	15.00±0.71	22.00±0.71	61.00±2.02
	35	14.00±0.71	12.00±0.71	16.00±0.71	24.00±0.71	66.00±2.77

Table 2. Population of Indian Peafowl *Pavo cristatus* at village Penghore- Saman (Kumher) during year 2021-22

Month	Standard Week	Sub Adult	Male	Male with Train	Female	Total
September	36	12.00±0.71	11.00±0.71	16.00±0.71	22.00±0.71	61.00±2.07
	37	12.00±0.71	11.00±0.71	16.00±0.71	22.00±0.71	61.00±2.07
	38	10.00±0.45	10.00±0.71	15.00±0.71	21.00±0.71	56.00±1.22
	39	11.00±0.71	10.00±0.45	15.00±0.55	20.00±0.71	56.00±1.34
October	40	10.00±0.45	11.00±0.71	14.00±0.71	20.00±0.71	55.00±1.58
	41	10.00±0.45	10.00±0.55	14.00±0.71	2.00±0.71	54.00±1.10
	42	10.00±0.45	9.00±0.61	13.00±0.71	18.00±0.71	50.00±1.53
	43	9.00±0.61	8.00±0.35	12.00±0.71	18.00±0.71	47.00±1.50
	44	9.00±0.61	8.00±0.35	12.00±0.71	17.00±0.71	46.00±1.50
November	45	8.00±0.35	7.00±0.35	11.00±0.71	17.00±0.71	43.00±0.89
	46	8.00±0.35	7.00±0.35	10.00±0.45	16.00±0.71	41.00±0.89
	47	9.00±0.61	6.00±0.42	10.00±0.45	16.00±0.71	41.00±0.97
	48	8.00±0.35	6.00±0.42	10.00±0.45	15.00±0.71	39.00±0.60
December	49	8.00±0.35	5.00±0.32	9.00±0.61	14.00±0.71	36.00±0.81
	50	7.00±0.35	5.00±0.32	9.00±0.61	14.00±0.71	35.00±0.81





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	51	7.00±0.35	5.00±0.32	8.00±0.35	12.00±0.71	32.00±0.32
	52	7.00±0.35	6.00±0.42	8.00±0.35	12.00±0.71	33.00±0.49
January	1	6.00±0.42	5.00±0.32	7.00±0.35	10.00±0.45	28.00±0.68
	2	5.00±0.32	4.00±0.32	5.00±0.32	8.00±0.35	22.00±0.73
	3	5.00±0.32	3.00±0.32	4.00±0.32	8.00±0.35	20.00±0.49
	4	4.00±0.32	2.00±0.32	2.00±0.32	7.00±0.32	15.00±0.86
	5	4.00±0.32	2.00±0.32	3.00±0.32	8.00±0.35	17.00±0.80
February	6	6.00±0.42	3.00±0.32	5.00±0.32	10.00±0.45	24.00±0.80
	7	6.00±0.42	4.00±0.32	6.00±0.42	12.00±0.71	28.00±1.64
	8	8.00±0.35	5.00±0.32	7.00±0.35	12.00±0.71	32.00±0.32
	9	8.00±0.35	5.00±0.32	8.00±0.45	14.00±0.71	35.00±0.73
March	10	8.00±0.35	5.00±0.32	9.00±0.61	15.00±0.71	37.00±0.81
	11	10.00±0.45	6.00±0.42	9.00±0.61	14.00±0.71	39.00±0.97
	12	10.00±0.45	7.00±0.35	10.00±0.55	15.00±0.71	42.00±1.11
	13	11.00±0.71	7.00±0.35	10.00±0.55	15.00±0.71	43.00±1.16
April	14	10.00±0.45	8.00±0.35	9.00±0.61	16.00±0.71	43.00±0.87
	15	12.00±0.71	8.00±0.35	9.00±0.61	16.00±0.71	45.00±1.50
	16	12.00±0.71	9.00±0.61	12.00±0.71	18.00±0.71	51.00±2.37
	17	13.00±0.71	9.00±0.61	11.00±0.71	18.00±0.71	51.00±2.06
May	18	12.00±0.55	8.00±0.35	12.00±0.71	16.00±0.71	48.00±1.50
	19	10.00±0.45	10.00±0.55	11.00±0.71	15.00±0.71	46.00±1.22
	20	10.00±0.55	9.00±0.61	10.00±0.45	14.00±0.71	43.00±1.11
	21	8.00±0.35	9.00±0.61	10.00±1.45	14.00±0.71	41.00±0.87
	22	8.00±0.35	8.00±0.45	9.00±0.61	12.00±0.71	37.00±0.87
June	23	6.00±0.42	5.00±0.32	9.00±0.61	10.00±0.45	30.00±0.49
	24	4.00±0.32	3.00±0.32	8.00±0.35	12.00±0.71	27.00±0.66
	25	2.00±0.32	3.00±0.32	8.00±0.35	10.00±0.63	23.00±0.73
	26	1.00±0.32	2.00±0.32	7.00±0.35	10.00±0.45	20.00±0.97
July	27	3.00±0.32	4.00±0.32	7.00±0.35	14.00±0.71	28.00±0.66
	28	6.00±0.42	5.00±0.32	9.00±0.61	15.00±0.71	35.00±1.20
	29	8.00±0.63	6.00±0.42	10.00±0.45	16.00±0.71	40.00±1.07
	30	8.00±0.35	7.00±0.35	11.00±0.71	16.00±0.71	42.00±0.89
	31	7.00±0.35	8.00±0.35	12.00±0.71	18.00±0.71	45.00±1.05
August	32	8.00±0.35	8.00±0.45	12.00±0.71	18.00±0.71	46.00±1.16
	33	8.00±0.35	9.00±0.61	12.00±0.71	20.00±0.71	49.00±1.63
	34	10.00±0.45	9.00±0.61	14.00±0.71	20.00±0.71	53.00±1.98
	35	10.00±0.45	9.00±0.61	14.00±0.71	22.00±0.71	55.00±1.53

Table 3. Population of Indian Peafowl *Pavo cristatus* at village Penghore- Saman (Kumher) during year 2022-23

Month	Standard Week	Sub Adult	Male	Male with Train	Female	Total
September	36	8.00±0.35	8.00±0.45	12.00±0.71	20.00±0.71	48.00±0.97
	37	8.00±0.35	9.00±0.61	12.00±0.71	20.00±0.71	49.00±1.53
	38	9.00±0.61	8.00±0.35	12.00±0.71	18.00±0.71	47.00±1.53
	39	8.00±0.35	8.00±0.45	10.00±0.45	19.00±0.71	45.00±1.16
October	40	8.00±0.35	7.00±0.35	10.00±0.55	18.00±0.71	43.00±0.71
	41	7.00±0.35	7.00±0.35	10.00±0.71	18.00±0.71	42.00±0.71





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	42	7.00±0.35	7.00±0.35	11.00±0.71	19.00±0.71	44.00±1.05
	43	7.00±0.35	6.00±0.32	10.00±0.37	18.00±0.71	41.00±1.14
	44	6.00±0.32	6.00±0.32	10.00±0.55	16.00±0.71	38.00±1.64
November	45	6.00±0.32	6.00±0.32	9.00±0.61	16.00±0.71	37.00±1.56
	46	6.00±0.32	5.00±0.32	9.00±0.61	14.00±0.71	34.00±1.39
	47	5.00±0.32	5.00±0.32	8.00±0.35	14.00±0.71	32.00±0.80
	48	6.00±0.32	5.00±0.32	9.00±0.61	15.00±0.71	35.00±1.02
December	49	5.00±0.32	5.00±0.32	8.00±0.35	16.00±0.71	34.00±0.80
	50	4.00±0.32	4.00±0.32	8.00±0.35	14.00±0.55	30.00±0.37
	51	3.00±0.32	4.00±0.32	8.00±0.35	14.00±0.55	29.00±0.37
	52	2.00±0.32	4.00±0.32	7.00±0.35	12.00±0.55	25.00±0.49
January	1	2.00±0.32	4.00±0.32	7.00±0.35	10.00±0.32	23.00±0.45
	2	3.00±0.32	3.00±0.32	6.00±0.32	10.00±0.45	22.00±0.84
	3	2.00±0.32	1.00±0.32	5.00±0.32	9.00±0.61	17.00±1.11
	4	1.00±0.32	1.00±0.32	4.00±0.32	8.00±0.45	14.00±0.84
	5	2.00±0.32	2.00±0.32	3.00±0.32	8.00±0.45	15.00±0.55
February	6	5.00±0.32	3.00±0.32	5.00±0.32	9.00±0.61	22.00±1.11
	7	5.00±0.32	4.00±0.32	6.00±0.32	10.00±0.45	25.00±0.32
	8	4.00±0.32	4.00±0.32	6.00±0.32	10.00±0.45	24.00±0.55
	9	4.00±0.32	5.00±0.32	7.00±0.35	11.00±0.71	27.00±0.58
March	10	4.00±0.32	4.00±0.32	7.00±0.35	11.00±0.71	26.00±0.58
	11	5.00±0.32	4.00±0.32	7.00±0.35	12.00±0.55	28.00±0.58
	12	4.00±0.32	5.00±0.32	8.00±0.35	12.00±0.55	29.00±0.58
	13	4.00±0.32	5.00±0.32	8.00±0.35	13.00±0.71	30.00±0.86
April	14	4.00±0.32	5.00±0.32	9.00±0.45	14.00±0.55	32.00±0.84
	15	4.00±0.32	6.00±0.32	8.00±0.35	14.00±0.55	32.00±0.20
	16	4.00±0.32	5.00±0.32	9.00±0.61	15.00±0.71	33.00±1.369
	17	3.00±0.32	6.00±0.32	9.00±0.61	16.00±0.71	34.00±1.36
	18	4.00±0.32	4.00±0.32	8.00±0.35	16.00±0.71	32.00±1.11
May	19	4.00±0.32	4.00±0.32	8.00±0.35	14.00±0.71	30.00±1.11
	20	3.00±0.32	4.00±0.32	7.00±0.35	13.00±0.71	27.00±0.73
	21	3.00±0.32	4.00±0.32	8.00±0.35	13.00±0.71	28.00±0.66
	22	2.00±0.32	3.00±0.32	7.00±0.35	12.00±0.55	24.00±0.66
June	23	2.00±0.32	2.00±0.32	7.00±0.35	10.00±0.45	21.00±0.80
	24	2.00±0.32	2.00±0.32	6.00±0.32	10.00±0.45	20.00±0.77
	25	1.00±0.32	1.00±0.32	5.00±0.32	9.00±0.61	16.00±0.49
	26	1.00±0.32	1.00±0.32	4.00±0.32	8.00±0.45	14.00±0.55
July	27	3.00±0.32	2.00±0.32	3.00±0.32	9.00±0.61	17.00±0.80
	28	4.00±0.32	3.00±0.32	3.00±0.32	10.00±0.45	20.00±0.45
	29	5.00±0.32	4.00±0.32	5.00±0.32	12.00±0.55	26.00±0.55
	30	5.00±0.32	5.00±0.32	6.00±0.32	13.00±0.71	29.00±0.89
	31	6.00±0.32	6.00±0.32	6.00±0.42	15.00±0.71	33.00±1.46
August	32	7.00±0.35	6.00±0.42	7.00±0.45	15.00±0.71	35.00±0.87
	33	7.00±0.35	7.00±0.35	7.00±0.45	16.00±0.71	37.00±0.89
	34	8.00±0.35	7.00±0.35	8.00±0.45	16.00±0.71	39.00±0.89
	35	8.00±0.35	8.00±0.45	8.00±0.45	16.00±0.71	40.00±1.02





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Table 4. The population of Indian Peafowl *Pavo cristatus* at village Kandholi (Roopvas) during year 2020-21

Month	Standard Week	Sub Adult	Male	Male with Train	Female	Total
September	36	10.00±0.63	8.00±0.35	15.00±0.71	22.00±0.71	55.00±1.16
	37	10.00±0.63	9.00±0.35	14.00±0.63	22.00±0.71	55.00±0.80
	38	9.00±0.35	8.00±0.35	14.00±0.71	20.00±0.71	51.00±0.97
	39	9.00±0.35	8.00±0.35	12.00±0.71	20.00±0.71	49.00±1.16
October	40	8.00±0.35	7.00±0.35	12.00±0.45	19.00±0.71	46.00±0.86
	41	8.00±0.35	7.00±0.35	10.00±0.63	19.00±0.71	44.00±0.58
	42	8.00±0.35	6.00±0.35	10.00±0.63	18.00±0.71	42.00±0.92
	43	7.00±0.35	7.00±0.35	9.00±0.35	18.00±0.71	41.00±0.97
November	44	7.00±0.35	6.00±0.35	9.00±0.35	17.00±0.45	39.00±1.02
	45	7.00±0.35	6.00±0.35	8.00±0.35	17.00±0.71	38.00±1.02
	46	7.00±0.35	6.00±0.35	8.00±0.35	16.00±0.71	37.00±0.84
	47	6.00±0.35	5.00±0.45	8.00±0.35	16.00±0.71	35.00±0.97
December	48	6.00±0.35	6.00±0.35	7.00±0.35	16.00±0.71	35.00±0.86
	49	6.00±0.35	5.00±0.32	7.00±0.35	15.00±0.71	33.00±0.80
	50	5.00±0.32	5.00±0.32	7.00±0.35	15.00±0.71	32.00±1.16
	51	5.00±0.32	5.00±0.32	6.00±0.35	15.00±0.71	31.00±0.66
January	52	5.00±0.32	5.00±0.32	6.00±0.35	14.00±0.71	30.00±0.66
	1	4.00±0.32	4.00±0.32	6.00±0.35	12.00±0.71	26.00±0.66
	2	4.00±0.32	4.00±0.32	5.00±0.45	10.00±0.63	23.00±0.89
	3	3.00±0.32	2.00±0.32	5.00±0.45	9.00±0.35	19.00±0.86
February	4	3.00±0.32	2.00±0.32	3.00±0.32	8.00±0.35	16.00±1.16
	5	4.00±0.32	3.00±0.32	4.00±0.32	8.00±0.35	19.00±0.58
	6	5.00±0.45	4.00±0.32	4.00±0.45	9.00±0.35	22.00±0.80
	7	5.00±0.45	4.00±0.32	6.00±0.35	10.00±0.63	25.00±0.58
March	8	5.00±0.45	4.00±0.32	8.00±0.35	10.00±0.63	27.00±0.66
	9	6.00±0.35	5.00±0.45	9.00±0.35	12.00±0.71	32.00±0.84
	10	6.00±0.35	7.00±0.35	9.00±0.35	12.00±0.71	34.00±0.86
	11	7.00±0.35	7.00±0.35	10.00±0.63	14.00±0.71	38.00±0.71
April	12	7.00±0.35	8.00±0.35	10.00±0.63	14.00±0.71	39.00±0.73
	13	8.00±0.35	8.00±0.35	11.00±0.45	16.00±	43.00±1.14
	14	8.00±0.35	8.00±0.35	12.00±0.71	18.00±0.71	46.00±1.14
	15	8.00±0.35	8.00±0.35	12.00±0.45	18.00±	46.00±1.38
May	16	8.00±0.35	7.00±0.35	10.00±0.63	18.00±0.71	43.00±0.58
	17	9.00±0.35	7.00±0.35	10.00±0.63	18.00±0.45	44.00±0.37
	18	9.00±0.35	6.00±0.35	9.00±0.35	17.00±0.71	41.00±0.97
	19	9.00±0.35	6.00±0.35	10.00±0.63	17.00±0.71	42.00±1.05
June	20	7.00±0.35	6.00±0.35	9.00±0.35	16.00±0.71	38.00±0.37
	21	7.00±0.35	5.00±0.32	10.00±0.63	16.00±0.45	38.00±0.49
	22	6.00±0.35	4.00±0.32	10.00±0.63	15.00±0.71	35.00±1.39
	23	5.00±0.32	4.00±0.32	9.00±0.35	12.00±0.71	30.00±0.66
July	24	4.00±0.32	5.00±0.32	9.00±0.35	10.00±0.63	28.00±0.86
	25	3.00±0.32	2.00±0.32	8.00±0.35	11.00±0.89	24.00±1.20
	26	3.00±0.32	3.00±0.32	8.00±0.35	10.00±0.63	24.00±0.97
27	3.00±0.32	4.00±0.32	9.00±0.35	12.00±0.71	28.00±0.86	





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	28	6.00±0.35	6.00±0.35	9.00±0.35	14.00±0.71	35.00±0.86
	29	8.00±0.35	6.00±0.35	10.00±0.63	15.00±0.45	39.00±1.11
	30	7.00±0.35	6.00±0.35	11.00±0.45	16.00±0.71	40.00±1.39
August	31	7.00±0.35	7.00±0.35	12.00±0.71	17.00±0.71	43.00±1.67
	32	8.00±0.35	7.00±0.35	12.00±0.71	18.00±0.71	45.00±1.36
	33	8.00±0.45	6.00±0.35	13.00±0.71	18.00±0.71	45.00±1.20
	34	9.00±0.35	8.00±0.35	15.00±0.71	22.00±0.71	54.00±0.86
	35	9.00±0.35	8.00±0.35	15.00±0.71	20.00±0.71	52.00±1.24

Table 5. Population of Indian Peafowl *Pavo cristatus* at village Kandholi (Roopvas) during year 2021-22

Month	Standard Week	Sub Adult	Male	Male with Train	Female	Total
September	36	8.00±0.35	7.00±0.35	14.00±0.71	18.00±0.71	47.00±1.66
	37	8.00±0.35	8.00±0.45	14.00±0.71	18.00±0.71	48.00±1.83
	38	7.00±0.35	7.00±0.35	12.00±0.71	18.00±0.71	44.00±1.48
	39	7.00±0.35	7.00±0.35	12.00±0.71	17.00±0.71	43.00±1.38
October	40	6.00±0.32	6.00±0.32	12.00±0.71	16.00±0.71	40.00±1.67
	41	6.00±0.32	6.00±0.32	10.00±0.71	16.00±0.71	38.00±1.67
	42	5.00±0.32	5.00±0.32	10.00±0.55	15.00±0.71	35.00±1.76
	43	5.00±0.32	5.00±0.32	9.00±0.45	15.00±0.71	34.00±1.67
	44	4.00±0.32	5.00±0.32	9.00±0.45	15.00±0.71	33.00±1.22
November	45	5.00±0.45	4.00±0.32	8.00±0.35	16.00±0.71	33.00±0.92
	46	4.00±0.32	4.00±0.32	8.00±0.35	14.00±0.71	3.00±1.16
	47	4.00±0.32	5.00±0.32	8.00±0.35	14.00±0.71	31.00±1.24
	48	5.00±0.32	4.00±0.32	7.00±0.35	13.00±0.71	29.00±1.16
December	49	4.00±0.32	4.00±0.32	7.00±0.35	13.00±0.71	28.00±1.11
	50	4.00±0.32	4.00±0.32	7.00±0.35	12.00±0.71	27.00±1.02
	51	3.00±0.32	3.00±0.32	6.00±0.32	12.00±0.45	24.00±0.71
	52	3.00±0.32	3.00±0.32	6.00±0.32	10.00±0.45	22.00±0.71
January	1	3.00±0.32	2.00±0.32	6.00±0.32	10.00±0.55	21.00±0.77
	2	2.00±0.32	2.00±0.32	5.00±0.32	9.00±0.45	18.00±0.77
	3	2.00±0.32	1.00±0.32	4.00±0.32	8.00±0.35	15.00±0.97
	4	2.00±0.32	1.00±0.32	3.00±0.32	8.00±0.35	14.00±0.73
	5	3.00±0.32	1.00±0.32	4.00±0.32	8.00±0.35	16.00±0.58
February	6	4.00±0.32	2.00±0.32	6.00±0.32	10.00±0.35	22.00±0.71
	7	4.00±0.32	3.00±0.32	7.00±0.35	10.00±0.35	24.00±0.73
	8	5.00±0.32	3.00±0.32	7.00±0.35	9.00±0.55	24.00±0.73
	9	5.00±0.00±	4.00±0.32	8.00±0.35	10.00±0.71	27.00±1.11
March	10	6.00±0.32	4.00±0.32	8.00±0.35	11.00±0.71	29.00±0.73
	11	6.00±0.32	5.00±0.32	8.00±0.35	12.00±0.71	31.00±1.32
	12	7.00±0.35	6.00±0.32	9.00±0.45	12.00±0.71	34.00±1.20
	13	7.00±0.35	5.00±0.45	9.00±0.55	14.00±0.71	35.00±1.20
April	14	8.00±0.35	6.00±0.35	9.00±0.45	14.00±0.71	37.00±1.03
	15	7.00±0.35	6.00±0.32	8.00±0.35	16.00±0.71	37.00±1.11
	16	8.00±0.35	7.00±0.35	10.00±0.35	18.00±0.71	43.00±1.39
	17	7.00±0.35	6.00±0.32	12.00±0.71	17.00±0.71	42.00±1.66
May	18	7.00±0.35	6.00±0.32	12.00±0.71	16.00±0.71	41.00±1.66





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	19	6.00±0.32	5.00±0.32	10.00±0.55	16.00±0.71	37.00±1.22
	20	5.00±0.32	6.00±0.32	10.00±0.45	15.00±0.71	36.00±1.82
	21	5.00±0.32	5.00±0.32	9.00±0.45	14.00±0.71	33.00±1.45
	22	4.00±0.32	5.00±0.32	10.00±0.71	12.00±0.71	31.00±1.41
June	23	3.00±0.32	4.00±0.32	9.00±0.55	10.00±0.71	26.00±0.32
	24	2.00±0.32	3.00±0.32	8.00±0.35	12.00±0.71	25.00±0.97
	25	1.00±0.32	2.00±0.32	7.00±0.35	9.00±0.55	19.00±0.97
	26	2.00±0.32	2.00±0.32	7.00±0.35	8.00±0.35	19.00±1.07
July	27	2.00±0.32	4.00±0.32	8.00±0.35	13.00±0.71	27.00±0.97
	28	4.00±0.32	5.00±0.32	8.00±0.35	13.00±0.71	30.00±1.16
	29	5.00±0.32	6.00±0.32	9.00±0.45	15.00±0.55	35.00±1.14
	30	5.00±0.32	6.00±0.32	10.00±0.45	15.00±0.71	36.00±1.52
	31	6.00±0.32	7.00±0.35	10.00±0.71	16.00±0.71	39.00±1.66
August	32	6.00±0.32	7.00±0.35	11.00±0.71	16.00±0.71	40.00±1.66
	33	7.00±0.45	8.00±0.35	11.00±0.71	18.00±0.71	44.00±1.59
	34	8.00±0.35	8.00±0.45	12.00±0.71	22.00±0.71	50.00±1.85
	35	7.00±0.35	7.00±0.35	12.00±0.71	20.00±0.71	46.00±1.64

Table 6. Population of Indian Peafowl *Pavo cristatus* at village Kandholi (Roopvas) during year 2022-23

Month	Standard Week	Sub Adult	Male	Male with Train	Female	Total
September	36	7.00±0.35	7.00±0.55	13.00±0.45	17.00±0.71	44.00±1.32
	37	7.00±0.35	6.00±0.35	13.00±0.71	17.00±0.71	43.00±0.97
	38	7.00±0.35	6.00±0.35	13.00±0.71	16.00±0.45	42.00±0.66
	39	7.00±0.35	6.00±0.35	12.00±0.45	16.00±0.71	41.00±1.20
October	40	7.00±0.35	6.00±0.35	12.00±0.45	15.00±0.71	40.00±1.20
	41	6.00±0.35	7.00±0.35	11.00±0.45	15.00±0.45	39.00±0.58
	42	6.00±0.35	6.00±0.32	10.00±0.55	14.00±0.71	36.00±1.23
	43	6.00±0.35	5.00±0.32	10.00±0.55	14.00±0.71	35.00±1.56
	44	6.00±0.35	5.00±0.32	9.00±0.55	14.00±0.71	34.00±1.59
November	45	5.00±0.32	5.00±0.45	10.00±0.55	15.00±0.71	35.00±1.52
	46	6.00±0.35	4.00±0.32	9.00±0.55	13.00±0.71	32.00±1.20
	47	5.00±0.32	5.00±0.45	9.00±0.55	13.00±0.71	32.00±1.41
	48	5.00±0.32	5.00±0.45	8.00±0.45	12.00±0.71	3.00±1.30
December	49	4.00±0.32	5.00±0.32	9.00±0.45	12.00±0.71	3.00±0.55
	50	4.00±0.32	4.00±0.32	8.00±0.35	12.00±0.45	28.00±1.28
	51	3.00±0.32	3.00±0.32	8.00±0.35	11.00±0.45	25.00±1.07
	52	3.00±0.32	2.00±0.32	7.00±0.35	10.00±0.55	22.00±0.58
January	1	2.00±0.32	2.00±0.32	7.00±0.35	9.00±0.55	20.00±1.16
	2	2.00±0.32	1.00±0.32	5.00±0.55	9.00±0.55	17.00±1.14
	3	2.00±0.32	2.00±0.32	4.00±0.32	8.00±0.45	16.00±1.05
	4	1.00±0.32	1.00±0.32	3.00±0.32	7.00±0.35	12.00±0.86
	5	2.00±0.32	1.00±0.32	4.00±0.32	7.00±0.35	14.00±1.02
February	6	3.00±0.32	2.00±0.32	5.00±0.32	9.00±0.55	19.00±1.18
	7	3.00±0.32	3.00±0.32	6.00±0.35	9.00±0.55	21.00±0.97
	8	4.00±0.32	3.00±0.32	6.00±0.35	9.00±0.55	22.00±0.66
	9	4.00±0.32	4.00±0.32	7.00±0.35	9.00±0.55	24.00±0.73





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March	10	4.00±0.32	3.00±0.32	7.00±0.35	10.00±0.55	24.00±0.86
	11	5.00±0.32	4.00±0.32	8.00±0.35	11.00±0.45	28.00±1.07
	12	6.00±0.32	4.00±0.32	7.00±0.35	10.00±0.55	27.00±0.73
	13	6.00±0.35	5.00±0.32	8.00±0.35	12.00±0.71	31.00±0.81
April	14	7.00±0.35	5.00±0.32	8.00±0.35	13.00±0.63	33.00±1.39
	15	7.00±0.35	6.00±0.35	8.00±0.35	15.00±0.71	36.00±1.02
	16	8.00±0.35	6.00±0.35	9.00±0.55	15.00±0.71	38.00±1.17
	17	7.00±0.35	5.00±0.32	10.00±0.55	16.00±0.71	38.00±1.66
	18	6.00±0.32	5.00±0.32	10.00±0.55	15.00±0.71	36.00±1.38
May	19	6.00±0.35	5.00±0.32	9.00±0.55	15.00±0.71	35.00±1.24
	20	4.00±0.32	6.00±0.35	9.00±0.55	14.00±0.55	33.00±1.16
	21	4.00±0.32	5.00±0.32	8.00±0.35	14.00±0.71	31.00±1.23
	22	3.00±0.32	4.00±0.32	9.00±0.55	12.00±0.71	28.00±1.38
June	23	2.00±0.32	4.00±0.32	7.00±0.35	10.00±0.55	23.00±0.80
	24	1.00±0.32	3.00±0.32	6.00±0.35	8.00±0.35	18.00±0.68
	25	1.00±0.32	2.00±0.32	6.00±0.35	6.00±0.32	15.00±0.20
	26	2.00±0.32	2.00±0.32	5.00±0.32	6.00±0.35	15.00±0.37
July	27	2.00±0.32	4.00±0.32	7.00±0.35	12.00±0.71	25.00±1.20
	28	3.00±0.32	5.00±0.32	8.00±0.35	14.00±0.71	30.00±1.24
	29	4.00±0.32	6.00±0.35	10.00±0.55	14.00±0.55	34.00±0.97
	30	4.00±0.32	6.00±0.35	11.00±0.45	15.00±0.71	36.00±0.86
	31	5.00±0.32	7.00±0.35	11.00±0.45	15.00±0.71	38.00±1.07
August	32	6.00±0.35	7.00±0.35	10.00±0.55	16.00±0.71	39.00±1.39
	33	7.00±0.35	8.00±0.35	11.00±0.71	16.00±0.71	42.00±1.66
	34	8.00±0.35	9.00±0.55	10.00±0.55	17.00±0.71	44.00±1.85
	35	7.00±0.35	9.00±0.55	10.00±0.55	17.00±0.71	43.00±1.80

Table 7. Population of Indian Peafowl *Pavo cristatus* at Anirudh Nagar (Bharatpur) during year 2020-21

Month	Standard Week	Sub Adult	Male	Male with Train	Female	Total
September	36	8.00±0.35	7.00±0.32	14.00±0.71	20.00±0.71	49.00±1.50
	37	8.00±0.35	7.00±0.32	14.00±0.71	19.00±0.71	48.00±1.59
	38	7.00±0.32	7.00±0.45	13.00±0.71	18.00±0.71	45.00±1.14
	39	7.00±0.32	6.00±0.32	13.00±0.45	18.00±0.71	44.00±0.84
October	40	7.00±0.32	6.00±0.32	12.00±0.71	17.00±0.71	42.00±1.14
	41	6.00±0.32	6.00±0.32	12.00±0.71	17.00±0.71	41.00±1.64
	42	6.00±0.32	6.00±0.32	12.00±0.71	17.00±0.71	41.00±0.55
	43	6.00±0.32	5.00±0.32	11.00±0.71	17.00±0.45	39.00±1.14
November	44	6.00±0.32	5.00±0.32	11.00±0.63	16.00±0.71	38.00±0.32
	45	6.00±0.32	5.00±0.32	11.00±0.63	16.00±0.71	38.00±0.32
	46	5.00±0.32	5.00±0.32	10.00±0.71	15.00±0.71	35.00±1.30
	47	5.00±0.32	4.00±0.32	9.00±0.45	14.00±0.71	32.00±0.55
	48	5.00±0.32	4.00±0.32	9.00±0.45	14.00±0.71	32.00±0.55
December	49	5.00±0.32	4.00±0.32	9.00±0.45	14.00±0.71	32.00±1.14
	50	4.00±0.32	4.00±0.32	8.00±0.35	13.00±0.71	29.00±1.11
	51	4.00±0.32	3.00±0.32	8.00±0.35	12.00±0.71	27.00±1.20
	52	3.00±0.32	3.00±0.32	7.00±0.45	12.00±0.71	25.00±0.84





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January	1	3.00±0.32	3.00±0.32	7.00±0.45	12.00±0.71	25.00±1.18
	2	3.00±0.32	3.00±0.32	6.00±0.45	10.00±0.71	22.00±1.30
	3	2.00±0.32	3.00±0.32	6.00±0.45	9.00±0.45	20.00±1.18
	4	2.00±0.32	2.00±0.32	5.00±0.32	9.00±0.45	18.00±0.63
	5	3.00±0.32	2.00±0.32	3.00±0.32	10.00±0.71	18.00±0.71
February	6	5.00±0.32	4.00±0.32	7.00±0.45	9.00±0.32	25.00±1.00
	7	5.00±0.32	4.00±0.32	7.00±0.35	9.00±0.32	25.00±0.73
	8	5.00±0.32	4.00±0.32	7.00±0.55	10.00±0.71	26.00±0.45
	9	6.00±0.55	5.00±0.32	7.00±0.55	10.00±0.71	28.00±0.45
March	10	6.00±0.55	5.00±0.32	8.00±0.35	12.00±0.71	31.00±0.37
	11	8.00±0.35	6.00±0.55	8.00±0.35	13.00±0.71	35.00±1.05
	12	8.00±0.35	7.00±0.55	9.00±0.45	14.00±0.71	38.00±0.97
	13	9.00±0.45	9.00±0.45	8.00±0.35	15.00±0.71	41.00±1.36
April	14	9.00±0.45	9.00±0.45	8.00±0.35	14.00±0.71	40.00±1.36
	15	9.00±0.45	9.00±0.45	8.00±0.35	14.00±0.71	40.00±1.36
	16	10.00±0.71	10.00±0.71	9.00±0.45	15.00±0.55	44.00±1.14
	17	10.00±0.55	10.00±0.71	10.00±0.71	15.00±0.55	45.00±1.14
May	18	9.00±0.45	9.00±0.45	10.00±0.71	15.00±0.55	43.00±1.55
	19	9.00±0.32	10.00±0.71	9.00±0.45	14.00±0.71	42.00±1.58
	20	8.00±0.45	8.00±0.55	9.00±0.45	14.00±0.71	39.00±1.05
	21	7.00±0.32	7.00±0.55	10.00±0.71	13.00±0.63	37.00±0.84
	22	7.00±0.32	7.00±0.55	9.00±0.45	16.00±0.71	39.00±1.58
June	23	3.00±0.32	5.00±0.32	9.00±0.45	12.00±0.71	29.00±1.10
	24	3.00±0.32	4.00±0.32	8.00±0.35	10.00±0.71	25.00±0.97
	25	2.00±0.32	4.00±0.32	8.00±0.35	10.00±0.71	24.00±1.02
	26	2.00±0.32	3.00±0.32	7.00±0.55	10.00±0.71	22.00±1.26
July	27	2.00±0.32	4.00±0.32	8.00±0.35	11.00±0.71	25.00±0.66
	28	3.00±0.32	4.00±0.32	8.00±0.35	12.00±0.45	27.00±1.07
	29	4.00±0.32	5.00±0.32	9.00±0.45	14.00±0.71	32.00±1.10
	30	4.00±0.32	6.00±0.55	9.00±0.45	15.00±0.71	34.00±0.84
August	31	5.00±0.32	6.00±0.55	10.00±0.71	15.00±0.71	36.00±0.95
	32	6.00±0.55	6.00±0.55	12.00±0.55	18.00±0.71	42.00±0.63
	33	7.00±0.55	7.00±0.55	12.00±0.55	20.00±0.71	46.00±1.61
	34	7.00±0.55	7.00±0.55	12.00±0.55	21.00±0.71	47.00±1.48
	35	7.00±0.55	8.00±0.35	12.00±0.55	19.00±0.71	46.00±1.28

Table 8. Population of Indian Peafowl *Pavo cristatus* at Anirudh Nagar (Bharatpur) during year 2021-22

Month	Standard Week	Sub Adult	Male	Male with Train	Female	Total
September	36	7.00±0.32	8.00±0.45	12.00±0.45	16.00±0.71	43.00±1.52
	37	8.00±0.32	8.00±0.45	11.00±0.45	17.00±0.71	44.00±1.41
	38	6.00±0.32	6.00±0.35	10.00±	16.00±0.71	38.00±1.53
	39	6.00±0.32	5.00±0.32	8.00±0.45	14.00±0.71	33.00±1.48
October	40	5.00±0.32	6.00±0.32	8.00±0.45	14.00±0.71	33.00±1.00
	41	4.00±0.32	5.00±0.32	7.00±0.32	13.00±0.71	29.00±0.71
	42	5.00±0.32	4.00±0.32	8.00±0.145	13.00±0.71	30.00±1.05
	43	4.00±0.32	4.00±0.32	7.00±0.32	12.00±0.71	27.00±0.32





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	44	4.00±0.32	5.00±0.32	7.00±0.32	12.00±0.45	28.00±0.32
November	45	3.00±0.32	4.00±0.32	7.00±0.32	11.00±0.71	25.00±0.89
	46	3.00±0.32	5.00±0.32	8.00±0.45	10.00±0.45	26.00±0.89
	47	4.00±0.32	4.00±0.32	7.00±0.32	11.00±0.45	26.00±0.45
	48	3.00±0.32	4.00±0.32	7.00±0.32	11.00±0.45	25.00±0.55
December	49	3.00±0.32	3.00±0.32	6.00±0.32	10.00±0.45	22.00±0.84
	50	4.00±0.32	3.00±0.32	7.00±0.32	10.00±0.45	24.00±0.45
	51	3.00±0.32	4.00±0.32	6.00±0.32	11.00±	24.00±0.89
January	52	4.00±0.32	3.00±0.32	6.00±0.32	10.00±0.45	23.00±0.84
	1	3.00±0.32	2.00±0.32	5.00±0.32	10.00±0.45	20.00±0.55
	2	2.00±0.32	2.00±0.32	4.00±0.32	8.00±0.45	16.00±0.71
	3	1.00±0.32	2.00±0.32	4.00±0.32	9.00±0.32	16.00±0.55
	4	1.00±0.32	1.00±0.32	3.00±0.32	9.00±0.45	14.00±0.71
February	5	2.00±0.32	2.00±0.32	2.00±0.32	10.00±0.45	16.00±0.71
	6	4.00±0.32	3.00±0.32	6.00±0.32	8.00±0.45	21.00±0.63
	7	4.00±0.32	3.00±0.32	6.00±0.32	8.00±0.45	21.00±0.71
	8	4.00±0.32	3.00±0.32	6.00±0.32	9.00±0.45	22.00±0.95
March	9	5.00±0.32	4.00±0.32	6.00±0.32	10.00±0.45	25.00±0.55
	10	5.00±0.32	5.00±0.32	7.00±0.32	12.00±0.71	29.00±0.84
	11	5.00±0.32	5.00±0.32	6.00±0.32	12.00±0.45	28.00±1.05
	12	6.00±0.32	5.00±0.32	7.00±0.32	13.00±0.45	31.00±0.55
April	13	6.00±0.35	6.00±0.32	7.00±0.32	12.00±0.55	31.00±1.11
	14	6.00±0.35	6.00±0.32	8.00±0.45	14.00±0.63	34.00±1.36
	15	7.00±0.32	6.00±0.32	9.00±0.45	15.00±0.71	37.00±1.14
	16	7.00±0.32	7.00±0.35	9.00±0.45	16.00±0.55	39.00±1.02
May	17	6.00±0.32	7.00±0.32	10.00±0.71	15.00±0.71	38.00±1.58
	18	6.00±0.32	6.00±0.32	10.00±0.55	14.00±0.71	36.00±1.82
	19	5.00±0.32	6.00±0.32	9.00±0.45	14.00±0.84	34.00±1.48
	20	5.00±0.32	5.00±0.32	9.00±0.32	15.00±0.71	34.00±1.26
	21	5.00±0.32	5.00±0.32	10.00±0.55	13.00±0.71	33.00±1.05
June	22	4.00±0.32	6.00±0.32	9.00±0.45	12.00±0.71	31.00±1.26
	23	3.00±0.32	5.00±0.32	9.00±0.45	12.00±0.89	29.00±1.38
	24	3.00±0.32	4.00±0.32	8.00±0.45	10.00±0.89	25.00±1.10
	25	2.00±0.32	4.00±0.32	8.00±0.45	10.00±0.59	24.00±1.30
July	26	2.00±0.32	3.00±0.32	7.00±0.32	11.00±0.71	23.00±1.22
	27	2.00±0.32	4.00±0.32	8.00±0.45	12.00±0.45	26.00±0.89
	28	3.00±0.32	4.00±0.32	8.00±0.45	13.00±0.71	28.00±0.89
	29	4.00±0.32	5.00±0.32	9.00±0.45	14.00±0.71	32.00±1.48
	30	4.00±0.32	6.00±0.32	9.00±0.45	15.00±0.71	34.00±1.14
August	31	5.00±0.32	6.00±0.32	10.00±0.89	16.00±0.71	37.00±1.00
	32	6.00±0.35	6.00±0.32	12.00±0.71	18.00±0.55	42.00±1.77
	33	7.00±0.32	7.00±0.45	11.00±0.71	19.00±0.63	44.00±0.84
	34	7.00±0.32	6.00±0.32	10.00±0.89	2.00±0.95	43.00±0.89
	35	6.00±0.32	5.00±0.32	11.00±0.71	2.00±0.95	42.00±1.45

Table 9. Population of Indian Peafowl *Pavo cristatus* at Anirudh Nagar (Bharatpur) during year 2022-23





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Month	Standard Week	Sub Adult	Male	Male with Train	Female	Total
September	36	6.00±0.27	5.00±0.45	11.00±0.71	19.00±0.71	41.00±0.97
	37	7.00±0.45	6.00±0.45	11.00±0.71	18.00±0.71	42.00±0.84
	38	6.00±0.45	5.00±0.45	10.00±0.45	16.00±0.71	37.00±0.89
	39	6.00±0.27	5.00±0.45	8.00±0.45	14.00±0.71	33.00±0.97
October	40	5.00±0.45	5.00±0.45	7.00±0.45	13.00±0.45	30.00±1.30
	41	5.00±0.45	4.00±0.45	7.00±0.45	12.00±0.71	28.00±1.38
	42	4.00±0.45	4.00±0.45	7.00±0.45	12.00±0.71	27.00±1.41
	43	4.00±0.45	3.00±0.45	8.00±0.45	10.00±0.71	25.00±1.14
	44	3.00±0.45	4.00±0.45	6.00±0.27	11.00±0.45	24.00±1.24
November	45	3.00±0.45	4.00±0.45	6.00±0.27	10.00±0.71	23.00±1.02
	46	3.00±0.45	3.00±0.45	6.00±0.27	10.00±0.71	22.00±1.02
	47	3.00±0.45	4.00±0.45	6.00±0.45	9.00±0.45	22.00±0.84
	48	2.00±0.45	3.00±0.45	5.00±0.45	9.00±0.45	19.00±0.95
December	49	3.00±0.45	3.00±0.45	5.00±0.45	8.00±0.45	19.00±1.14
	50	2.00±0.32	2.00±0.45	5.00±0.45	8.00±0.45	17.00±1.10
	51	2.00±0.32	2.00±0.45	4.00±0.45	7.00±0.45	15.00±0.45
	52	2.00±0.32	3.00±0.45	4.00±0.45	6.00±0.27	15.00±0.92
January	1	2.00±0.32	2.00±0.32	4.00±0.45	6.00±0.27	14.00±0.86
	2	1.00±0.32	1.00±0.32	3.00±0.45	5.00±0.45	10.00±0.32
	3	1.00±0.32	0.00±0.00	2.00±0.45	4.00±0.45	7.00±0.84
	4	0.00±0.00	1.00±0.32	0.00±0.00	5.00±0.45	6.00±0.32
	5	1.00±0.32	2.00±0.45	1.00±0.32	6.00±0.27	10.00±0.37
February	6	2.00±0.45	2.00±0.32	3.00±0.45	6.00±0.27	13.00±0.82
	7	2.00±0.45	2.00±0.32	3.00±0.45	7.00±0.45	14.00±0.89
	8	3.00±0.45	2.00±0.45	4.00±0.45	7.00±0.45	16.00±1.14
	9	3.00±0.45	3.00±0.45	4.00±0.45	8.00±0.45	18.00±1.30
March	10	4.00±0.45	3.00±0.45	4.00±0.45	8.00±0.45	19.00±1.30
	11	4.00±0.45	4.00±0.45	5.00±0.45	9.00±0.45	22.00±1.14
	12	5.00±0.45	4.00±0.45	6.00±0.27	9.00±0.45	24.00±0.97
	13	6.00±0.27	5.00±0.45	6.00±0.27	10.00±0.45	27.00±0.84
April	14	6.00±0.27	5.00±0.45	7.00±0.45	10.00±0.45	28.00±0.97
	15	5.00±0.45	6.00±0.27	7.00±0.45	11.00±0.45	29.00±1.39
	16	5.00±0.45	6.00±0.27	8.00±0.45	12.00±0.45	31.00±1.07
	17	5.00±0.45	6.00±0.27	8.00±0.45	14.00±0.71	33.00±1.46
	18	5.00±0.45	7.00±0.45	9.00±0.45	13.00±0.45	34.00±1.52
May	19	4.00±0.45	6.00±0.27	7.00±0.45	13.00±0.71	30.00±1.16
	20	4.00±0.45	5.00±0.45	7.00±0.45	12.00±0.00±	28.00±1.30
	21	3.00±0.45	5.00±0.45	6.00±0.27	8.00±0.45	22.00±0.97
	22	3.00±0.45	4.00±0.45	5.00±0.45	7.00±0.45	19.00±1.26
June	23	2.00±0.55	4.00±0.45	4.00±0.32	6.00±0.27	16.00±0.97
	24	2.00±0.45	2.00±0.45	2.00±0.32	5.00±0.45	11.00±0.71
	25	0.00±0.00	2.00±0.45	0.00±0.00	4.00±0.45	6.00±0.84
	26	2.00±0.45	0.00±0.00	3.00±0.45	6.00±0.27	11.00±0.49
July	27	3.00±0.45	2.00±0.45	5.00±0.45	8.00±0.45	18.00±1.05
	28	3.00±0.45	3.00±0.45	6.00±0.27	10.00±0.71	22.00±1.16
	29	4.00±0.45	4.00±0.45	7.00±0.45	12.00±0.45	27.00±1.14
	30	4.00±0.45	5.00±0.45	8.00±0.45	14.00±0.71	3.00±1.34





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	31	5.00±0.45	5.00±0.45	9.00±0.32	14.00±0.71	33.00±1.38
August	32	6.00±0.27	6.00±0.27	10.00±0.71	15.00±0.71	37.00±1.76
	33	5.00±0.45	6.00±0.27	10.00±0.71	16.00±0.71	37.00±1.77
	34	5.00±0.45	7.00±0.45	11.00±0.45	16.00±0.71	39.00±1.67
	35	6.00±0.27	6.00±0.27	10.00±0.45	15.00±0.45	37.00±0.95





Design and Analysis of an Expert System for Identification Types of Cancer

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ABSTRACT

Cancer in the broad-brimmed sense refers to more than 277 different types of cancer disease. Scientists have identified various stages of cancers, indicating that several gene mutations are involved in cancer pathogenesis. The effects of drugs on patients with cancer can predict and even manage some aspects of side effects. In this study, our motive was to review molecular aspects of cancer. With the help of various molecular methods, we are able to determine the strength of gene expression and defective proteins, as well as sleuthing novel biomarkers. Cancer stages are contraindicated by the numbers 0 through 4, which are often written as Roman numerals 0 through IV. Higher numbers indicate a more-advanced cancer. For some types of cancer, cancer stage is indicated using letters or words, that epigenetic abnormalities in cancer consists a multitude of aberrations in virtually every component of chromatin involved in packaging the human genome. Since epigenetic silencing processes are mitotically heritable, they can play the same roles and experience the same selective processes as genetic modification in the development of a cancer.





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Keywords: Programming in logic, Artificial Intelligence, Expert System, Facts, Rules.

INTRODUCTION

In recent years, carcinogenesis performances have been detected by molecular genetic studies. The consequence of these studies led to an improved understanding of the role of genetic disorders in cancer formation. The full knowledge of the immune biology of cancer immune surveillance and immune editing will hopefully stimulate development of more impelling immunotherapeutic approaches to control or eliminate human cancers. For decades, scientists have been involved in dissecting the origins of human cancer, and the comparative roles of genetic versus epigenetic abnormalities have been hotly debated. A detonation of data indicating the importance of epigenetic processes, especially those resulting in the silencing of key regulatory genes, has led to the realization that genetics and epigenetic cooperate at all stages of cancer evolution. There are more than 100 types of cancer. Types of cancer are usually named after the organs or tissues where the cancers form. Before cancer cells signifies in tissues of the body, the cells go through abnormal changes called hyperplasia and dysplasia. In hyperplasia, there is an alteration in the number of cells in an organ or tissue that appear normal under a microscope. In dysplasia, the cells look anomalous under a microscope but are not cancer. Hyperplasia and dysplasia may or may not become cancer.

LITERATURE REVIEW

Liver Cancer -the incidence of hepatocellular carcinoma increases progressively with advancing age among populations, although it tends to level off in the oldest age groups. Patients with hepatocellular carcinoma are often unaware of its presence until the tumor reaches an advanced stage. The symptoms may include: the liver may rapidly enlarge, or a tumor may develop, or liver failure may occur. The reappearance of high serum globulin concentrations strongly suggests a diagnosis of hepatocellular carcinoma. Ultrasonography detects most hepatocellular carcinomas, but does not distinguish this tumor from other solid lesions in the liver. Approximately two-thirds of hepatocellular carcinomas are uniformly hyperechoic, with the remainder being partially hyperechoic and partially hypoechoic; small early tumors are hypoechoic. Mass screening of populations at high tumor risk is a challenging and costly task with relatively low yield. Long-term surveillance of individuals known to be at high risk (especially those chronically infected with hepatitis B or C) is more efficient and may be cost-effective. Ultrasound examination is used as an initial imaging screen in conjunction with measurement of serum α -fetoprotein levels, usually performed at 6-month intervals[1]. Bladder cancers occurring at a single site, the majority occurred on one of the bladder walls (40% on the lateral walls, 11% on the posterior wall, and 3% on the anterior wall). Less common subsites included the ureteral orifice (17%), followed by the trigone (13%), dome (9%), and neck (7%). Classic methods of diagnosing bladder neoplasms include cystoscopy (passing a tube through the urethra to examine the inner lining of the bladder), urine culture and cytology followed by transurethral biopsy/resection.

Histological analyzes of small tissue samples provide the diagnosis. Although many urinary markers have shown promise as diagnostic or screening tools for bladder cancer, none have yet been shown to be sufficient for the diagnosis or exclusion of bladder neoplasms. Screening procedures are currently not recommended for bladder cancer, even in high-risk groups, because of the high false-positive rate. Clinical trials of screening have not shown a beneficial effect on outcome or mortality[2]. Four population-based studies were designed to evaluate the effectiveness of colorectal cancer screening in more typical medical practice settings. The interest of the study conducted in Sweden (Kewenter, 1988) is limited because the screening test was only administered twice. The acceptability of the test at the first screening ranged between 53 and 67%; the positivity rate was 2.1% initially and 1.3% on average in subsequent rounds. Colorectal cancer mortality was significantly lower in the screening population compared with the control population (mortality ratio 0.82 to 0.86). The TNM (tumor, nodes, metastasis) system of the American Joint Committee on Cancer (AJCC) is currently recommended for the staging of colorectal cancer. It divides colorectal cancers into four stages depending on the depth of the primary "tumor", the presence





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and number of affected "nodes", and the presence of distant "metastases". TNM stage at diagnosis remains the best predictor of long-term prognosis for colorectal cancer. High radiations are passed in tubular form for a longer period in the treatment of such cancer[3]. Another promising new approach to cancer treatment is the use of monoclonal antibodies (mAb) to modulate the immune response and improve the body's ability to destroy cancer cells. However, to date, the use of anti-4-1BB mAbs such as urelumab has been limited due to intolerable side effects. The international team reengineered the 4-1BB molecule to create a recombinant antibody called trimer body that had potent stimulatory activity without associated toxicity. As part of their research, they used high-angle small-angle X-ray scattering (SAXS) on the B21 beam. This new approach may unlock the potential of immunotherapeutic antibodies in cancer treatment with minimal side effects[4]. The application of data mining techniques in the case of ovarian cancer. Ovarian cancer is the second leading cause of death among gynecological cancers in the world. Five data mining classification techniques, including support vector machine (SVM), C5.0, extreme learning machine (ELM), multivariate adaptive regression splines (MARS were used to achieve this goal), and random forest (RF). The Importance of Data Mining to Extract Hidden Knowledge from Multiple Heterogeneous Cancer Datasets. It presents methods, techniques, and tools that can help solve cancer diagnostic and prognostic problems of ovarian cancer through new diagnostic method such as the tubuler method[5].

Minor increases have been reported for malignant brain tumors which are listed since 1979, when the National Center for Health Statistics implemented a new format for reporting mortality data. The problem is the lack of substantial improvement over what treatment has been able to achieve for decades before. Improving diagnosis in health care requires a significant re-envisioning of the diagnostic procedures and widespread commitment to modification. A national commitment to cancer prevention that largely replaces reliance with the promise to a universal cure is now a long way to go. The evidence includes large and ongoing reductions in smoking, large-scale individual dietary change efforts to prevent cancer, and the use of sunscreens to reduce sun exposure. The death rate in 1994 was 2.7 percent higher than in 1982, the last year reported in 1986,1 but the recent decline is likely to be confirmed and substantially extended as a result of better prevention and earlier detection. and especially past reductions in tobacco use[6]. The study to investigate the protective effect of thyroid against gastric further reveal the mechanism involved through the integration of network pharmacology and in vivo experimental evidence. Due to the complexity of the etiology and pathogenesis of thyroid, there is no unified and effective treatment plan in Western medicine. Recent years have shown that traditional Chinese medicine has evolved in treating thyroid cancer and preventing its further progression to gastric cancer, relying on multi-access and multi-target encompassing intervention characteristics further to broader aspects. These results conveys that thyroid stopped the perpetual progression of gastric through the inhibition of epithelial-mesenchymal transmutation process[7].

Gastric carcinomas composed of well-differentiated and poorly differentiated components show some, but not all, of the molecular events previously described for each of the two types of gastric cancer. In addition to these genetic and epigenetic phenomena, well-differentiated and poorly differentiated gastric cancers also organize different patterns of interplay between cancer cells and stromal cells through the growth factor/cytokine receptor system, which plays an important role in cell growth, apoptosis, morphogenesis, angiogenesis, , progression and metastasis[8]. Due to the relatively low incidence and poor survival of pancreatic cancer, risk factors associated with the development of this disease have historically been investigated using case-control studies. Unfortunately, these study designs have weaknesses, including selection bias and recall bias. To overcome the problems of sample size in prospective studies, the pooling of data by consortia from multiple cohort studies, which have been published more frequently in recent years, is needed. Investigation of potential biomarkers including liquid biopsy to aid in the screening, diagnosis and treatment of pancreatic cancer is an area of intense research. All have been investigated in efforts to detect biomarkers in blood, breath and pancreatic juice. Pancreatic intraepithelial neoplasia is a non-invasive microscopic lesion that occurs in small pancreatic ducts. Currently, surgical resection is the only potential cure for pancreatic cancer, although recurrence rates are high with inevitably dismal long-term survival rates[9].The first step in evaluating patients for skin cancer includes a thorough history focusing on general medical and drug history, personal and family history of skin cancer, number of birthmarks including presence of dysplastic nail, and comprehensive social history, carcinogen or sun exposure. Curettage and electrodesiccation, cryosurgery, local



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chemotherapy, laser surgery, radiotherapy, immunotherapy. Primary radiotherapy is considered to treat skin cancer involving the nose, lower eyelids or ears. A limitation for radiotherapy is the lack of histological control of margins and errors, which often leads to under treatment or overtreatment. It is not clear whether using combinations of drugs is more helpful than using a single drug, but it may add to side effects such as hair loss, mouth ulcers, loss of appetite, nausea and vomiting, diarrhea, increased risk of infection, easy bruising or bleeding, fatigue. Dermoscopic examination of individual lesions allows visualization of deeper layers of the skin and can be useful in the hands of experts[10]. Findings of literature study are that an expert system could be designed for prognosis and diagnosis for assisting patient based on their symptoms.

METHODOLOGY

A logical programming language is PROLOG. It is crucial for artificial intelligence. PROLOG is primarily designed to be a declarative programming language, in contrast to many other programming languages. Logic is expressed as relationships in PROLOG (called facts and rules). The logic employed forms the basis of PROLOG. In the Prologue, certain information is presented. The system's knowledge base is comprised of this information. Facts in the prologue are presented in a certain way. Entities and their relationships are contained in facts. Comma-separated parenthesis is used to indicate entities (.). The commencement and the space between the parenthesis describe their relationship. A period follows each fact or rule (.). The logical variables that make up PROLOG features conform to a standard data structure. The terms "mathematical variable," "pattern-matching facility," "input and output" and "backtracking approach to investigate for proofs" are interchangeable. Instead of using software, the user asks a query to obtain the answer. The run-time system looks through the database of facts and rules to get the answer when the user asks a question; the working of the inference engine is shown in figure 1. On the same note, it is also feasible to design research that will provide the desired outcomes, particularly when these studies are much abstracted from the context of the entire body and the entire environment. In our study, we demonstrated that, under specific circumstances, we were able to demonstrate a full-proof outcome. A consistent characterization of population disposition of factors associated to the prevention, early detection, or treatment of cancer is presented in the Cancer Trends Progress Report using statistical techniques. At first the user will type "do.+enter", and with this the AIDr will start. Then the user will be asked a few questions about their symptoms, like what kind of symptoms are they having, the user will type "y.+enter" or "n.+enter" to choose if they are having that particular symptom or not then the system will check the database that what kind of cancer has similar symptoms. after matching the symptoms with the user, the system will show the cancer of that particular type.

Experimentation

The hypothesis to be tested based on the symptom's verification. In this regard, the disease cancer type is taken as hypothesis and the symptoms of this type of cancer taken as verifiable, which need to be verified to support the hypothesis; and hence the table 1 is designed accordingly.

RESULTS AND DISCUSSION

The diagnosis is advised by the so called AIDr (AI Doctor)[31] as an expert system which has been proposed. The experimentation carried out with Programming in logic (PROLOG) and the results are shown in the following figure 2, 3, 4. As we are progressing towards new technological advancements, we are unable to financially approve the latest equipment as there is always a new and better version of the current provided equipment we have, which may dissuade some patients from visiting us. Providing different specialties under one hospital like medical oncology, radiation oncology, surgical oncology, physical therapy and others. Several competitors are beginning to poach our patients by promising better treatment options or by rendering them with special facilities. Scientists are hiring more providers who have specialized backgrounds to be able to treat rarer and more invasive types of cancer.



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CONCLUSIONS

The science of data management uses all of its resources and makes the most effort to develop methods and techniques to use these data, with medical diagnostic reasoning being a very important application area of intelligent systems, in order to deal with the massive flow of biomedical data produced day after day and make important and valuable hidden knowledge inside. We can assess the level of gene expression, identify malfunctioning proteins, and find new cancer biomarkers by using a variety of molecular techniques and the suggested expert system. These results may aid in the treatment of cancer and raising public awareness of its complications. Additionally, a number of studies are currently being conducted to look into epigenetic mechanisms and how they relate to the onset and progression of many diseases, particularly cancer. However, identifying all the symptoms and AIDr advices, give us a comprehensive map for further efforts to identify cancer in the future and draw awareness in the society.

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Table 1 Knowledge Base of the Expert System

Disease/Cancertype/Hypothesis	Symptoms
[11]Skin Cancer	<ul style="list-style-type: none"> ✓ Non-healing sore that bleeds ✓ Scar growth ✓ Red patches ✓ Swelled like mole
[12]Lung Cancer	<ul style="list-style-type: none"> ✓ Hoarseness





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	<ul style="list-style-type: none"> ✓ Weight loss ✓ Infections such as bronchitis ✓ Wheezing
[13]Bladder Cancer	<ul style="list-style-type: none"> ✓ Weakness ✓ Bone pain ✓ Loss of appetite ✓ Swelling in the feet
[14]Blood Cancer	<ul style="list-style-type: none"> ✓ Fever ✓ Itchy skin ✓ Chest Pain ✓ Shortness of breath
[15]Pancreatic Cancer	<ul style="list-style-type: none"> ✓ Nausea ✓ Bloating ✓ Abdominal Pain ✓ Jaundice
[16]Thyroid Cancer	<ul style="list-style-type: none"> ✓ Difficulty swallowing ✓ Pain in neck and throat ✓ Lymph nodes in the neck ✓ May affect lungs and bones ✓ Change in voice
[17]Liver Cancer	<ul style="list-style-type: none"> ✓ Unusual tiredness ✓ nausea ✓ Loss of appetite ✓ jaundice ✓ Swollen abdomen
[18]Kidney Cancer	<ul style="list-style-type: none"> ✓ Fever ✓ tiredness ✓ Blood in urine ✓ Pain in back ✓ Weight loss
[19]Breast Cancer	<ul style="list-style-type: none"> ✓ redness ✓ Swollen lymph nodes ✓ irritation ✓ discomfort ✓ Breast pain
[20]Ovarian Cancer	<ul style="list-style-type: none"> ✓ Abdominal bloating ✓ Weight loss ✓ Frequent urination ✓ Back pain ✓ Fatigue
[21]Colorectal Cancer	<ul style="list-style-type: none"> ✓ Rectal bleeding ✓ constipation ✓ Abdominal discomfort ✓ Change in habits ✓ Fatigue
[22]Head and Neck Cancer	<ul style="list-style-type: none"> ✓ Red patch in mouth ✓ Sore throat ✓ Double vision ✓ Difficulty breathing





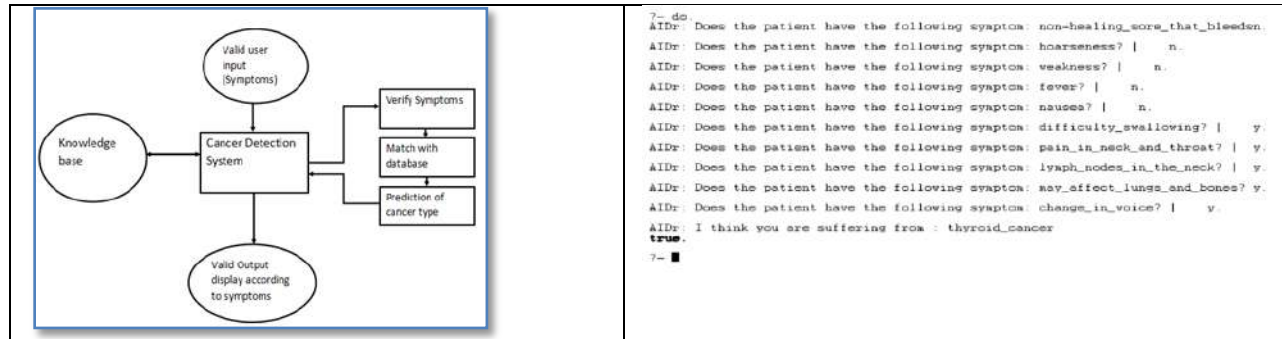
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	✓ Jaw pain
[23]Prostate Cancer	<ul style="list-style-type: none"> ✓ Pain in back ✓ Urinating often ✓ Abdominal discomfort ✓ Change in habits ✓ Pain in pelvic
[24]Endometrial Cancer	<ul style="list-style-type: none"> ✓ Abnormal discharge ✓ Weight loss ✓ Abdominal discomfort ✓ Back pain ✓ Unusual bleeding
[25]Uterine Cancer	<ul style="list-style-type: none"> ✓ Rectal bleeding ✓ Pain in abdomen ✓ Abdominal discomfort ✓ Urination problem ✓ Bleeding
[26]Penile Cancer	<ul style="list-style-type: none"> ✓ Change in skin colour ✓ ulcer ✓ Smelly discharge ✓ Area of skin becomes thicker ✓ Formation of lump
[27]Salivary Gland Cancer	<ul style="list-style-type: none"> ✓ Numbness in face ✓ Trouble swallowing ✓ Weak muscles ✓ Pain in jaw mouth ✓ Difference in size of face
[28]Cervical Cancer	<ul style="list-style-type: none"> ✓ Pain in the pelvic ✓ Swelling of legs ✓ Blood in urine ✓ Pain in back ✓ Abnormal bleeding
[29]Brain Cancer	<ul style="list-style-type: none"> ✓ Memory lapses ✓ Difficulty thinking ✓ nausea ✓ Muscle jerking ✓ Vision problem
[30]Parathyroid Cancer	<ul style="list-style-type: none"> ✓ Lump in the neck ✓ Pain in neck ✓ Pain in back ✓ Blood in urine ✓ Constipation





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```

?- do.
AIDr: Does the patient have the following syapton: non-healing_sore_that_bleedsn.
AIDr: Does the patient have the following syapton: hoarseness? | n.
AIDr: Does the patient have the following syapton: weakness? | n.
AIDr: Does the patient have the following syapton: fever? | n.
AIDr: Does the patient have the following syapton: nausea? | n.
AIDr: Does the patient have the following syapton: difficulty_swallowing? | y.
AIDr: Does the patient have the following syapton: pain_in_neck_and_throat? | y.
AIDr: Does the patient have the following syapton: lymph_nodes_in_the_neck? | y.
AIDr: Does the patient have the following syapton: ray_effect_lungs_and_bones? y.
AIDr: Does the patient have the following syapton: change_in_voice? | y.
AIDr: I think you are suffering froa : thyroid_cancer
true.
?-
    
```

Fig. 1Proposed Expert System overview.

Fig. 2 AIDr advices Thyroid Cancer

```

SVI-Prolog console for thread 5
?- do.
AIDr: Does the patient have the following syapton: non-healing_sore_that_bleedsy.
AIDr: Does the patient have the following syapton: soar_growth? | y.
AIDr: Does the patient have the following syapton: red_patches? | y.
AIDr: Does the patient have the following syapton: swelled_nole? | y.
AIDr: I think you are suffering froa : skin_cancer
true.

?- do.
AIDr: Does the patient have the following syapton: non-healing_sore_that_bleedsn.
AIDr: Does the patient have the following syapton: hoarseness? | y.
AIDr: Does the patient have the following syapton: weight_loss? | y.
AIDr: Does the patient have the following syapton: infections_such_as_bronchitiiy.
AIDr: Does the patient have the following syapton: vhezizing? | y.
AIDr: I think you are suffering froa : lung_cancer
true.

?- do.
AIDr: Does the patient have the following syapton: non-healing_sore_that_bleedsn.
AIDr: Does the patient have the following syapton: hoarseness? | n.
AIDr: Does the patient have the following syapton: weakness? | y.
AIDr: Does the patient have the following syapton: bone_pain? | y.
AIDr: Does the patient have the following syapton: loss_of_apetite? | y.
AIDr: Does the patient have the following syapton: swelling_in_feet? | y.
AIDr: I think you are suffering froa : bladder_cancer
true.
    
```

```

?- do.
AIDr: Does the patient have the following syapton: non-healing_sore_that_bleedsy.
AIDr: Does the patient have the following syapton: soar_growth? | n.
AIDr: Does the patient have the following syapton: hoarseness? | n.
AIDr: Does the patient have the following syapton: weakness? | n.
AIDr: Does the patient have the following syapton: fever? | y.
AIDr: Does the patient have the following syapton: itchy_skin? | y.
AIDr: Does the patient have the following syapton: chest_Pain? | y.
AIDr: Does the patient have the following syapton: shortness_of_breath? | y.
AIDr: I think you are suffering froa : blood_cancer
true.

?- do.
AIDr: Does the patient have the following syapton: non-healing_sore_that_bleedsn.
AIDr: Does the patient have the following syapton: hoarseness? | n.
AIDr: Does the patient have the following syapton: weakness? | n.
AIDr: Does the patient have the following syapton: fever? | n.
AIDr: Does the patient have the following syapton: nausea? | y.
AIDr: Does the patient have the following syapton: bloating? | y.
AIDr: Does the patient have the following syapton: abdoaiial_pain? | y.
AIDr: Does the patient have the following syapton: jaundice? | y.
AIDr: I think you are suffering froa : pancreatic_cancer
true.
    
```

Fig. 3 AIDr advices Skin, Lung and Bladder Cancer respectively.

Fig. 4 AIDr advices Blood and Pancreatic Cancer respectively.





Spectroscopic Elucidation and Biological Evaluation of Cu²⁺ and Mn²⁺ Metal Complexes Derived from Azomethine Ligand

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ABSTRACT

The synthesis and characterization of a novel Schiff base ligand, along with its solid metal complexes formed from the combination of 3-methoxysalicylaldehyde and p-methylbenzohydrazide (HL), were meticulously conducted using a modified Sandmeyer's method. Remarkably, these synthesized complexes displayed distinctive colors upon interaction with Cu²⁺ and Mn²⁺ ions in conjunction with HL. To elucidate the structures of these innovative azomethine compounds, a comprehensive array of analytical techniques was employed, encompassing FT-IR, UV-Vis Spectrometry, elemental analysis, ¹H-NMR, TG-DTA, ESR, Conductometric measurements and Vibrational spin magnetometry. Furthermore, the compounds underwent a rigorous assessment of their biological activity, revealing a noteworthy inhibitory effect against pathogenic microorganisms. Specifically, *Salmonella typhi*, *Enterococcus faecalis*, and *Escherichia coli* were targeted, and the compounds exhibited significant antimicrobial potential against these organisms. This outcome underscores the promising biological activities of the synthesized compounds, positioning them as potential candidates for further exploration and development in the realm of antimicrobial agents. Through a meticulously designed research endeavor, the study contributes



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to both the understanding of novel compound synthesis and their potential application in addressing bacterial infections.

Keywords: Synthesis, Characterization, Azomethine, Biological activity

INTRODUCTION

The investigation into Schiff base complexes involving a range of transition metal ions has yielded insights into their biological functionalities, pharmaceutical attributes, and coordination capabilities [1-3]. These intricate compounds have been used as photolysis catalysts [4] and to facilitate oxygen reduction on modified carbon cathodes [5]. Schiff base derivatives have shown useful in the biological extraction of metals [6], as well as in industries such as the paint industry and medicinal bioinorganic domains [7-9]. Furthermore, several molecules have found application in industrial settings as well as in the catalytic hydrogenation of unsaturated hydrocarbons [10]. Moreover, Schiff base have demonstrated utility in analytical contexts [11] for the identification of metal ions, showcasing their versatility. The practical applications of such complexes are intricately linked to their molecular structures. In this particular study, the author presents a fresh series of metal complexes involving Cu^{2+} and Mn^{2+} ions, forming complexes with a Schiff base (HL) ligand prepared from the p-methylbenzohydrazide and 3-methoxysalicylaldehyde. The characterization of those complexes has been achieved through diverse means, including vibrational spin magnetometry, FT-IR, UV-Vis Spectrometry, elemental analysis, ESR, $^1\text{H-NMR}$, Thermo gravimetric Analysis-Differential Thermal Analysis (TGA-DTA), and Conductometric measurements. These techniques collectively contribute to determining the bonding mode and geometric arrangements of the complexes. Furthermore, the study delves into the biological activities of both the ligand and the resulting metal complexes.

Materials and Methods

Instrumentation and Materials

A Fison: EA1108 element analyzer was used for the elemental analysis (CHNO). The FT-IR was obtained by making KBr discs and using an FT-IR-5300: JASCO instrument. An ACF200 Broker Germany Spectrometer was used to record $^1\text{H NMR}$ spectra at a frequency of 400Hz. A Prekin-Elmer lab India UV-Vis Spectrometer was used to collect ultraviolet spectra. The JES-FA Series device was used to collect an ESR spectrum. The PA:SPTQ600 instrument was used to obtain a thermal gravimetric analysis spectrum. Complex metal Thermo gravimetric analysis were carried out using the Perkin Elmer equipment located in the thermal analysis centre, with ethyl alcohol and sticko chin as solvents. Only Aldrich compounds were used throughout the study.

Synthesis of p-methylbenzohydrazide and 3-methoxysalicylaldehyde Schiff base (HL)

To synthesize the Schiff base ligand (HL), 1.50g (1 mole) of p-methylbenzohydrazide and 1.52g (1 mole) of 3-methoxysalicylaldehyde was dissolved in 25ml of pure methanol. This mixture was placed in a 50ml round bottom flask along with 1 ml triethylamine solution added. The resulting mixtures were subjected to reflux for duration of 3 hours using a water hot bath. Subsequently, the mixtures were allowed in to cool down to room temperature. During this process, distinct yellow-colored sharp needles precipitated out of the solution. These precipitates were then isolated and subjected to washing with methanol. Afterward, they were dried within the vacuum desiccators contain anhydrous CaCl_2 [12-13]. Scheme 1 shows the synthetic method of prepared the Schiff base (HL).



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Preparation of Schiff base metal complexes (M₁L and M₂L)

To prepare the metal complexes, Cu²⁺ and Mn²⁺ metal chloride salts were utilized. Initially, 3.0g (equivalent to 2 moles) of the freshly synthesized ligand were dissolved in a sufficient quantity of methanol. The metal complexes were prepared in a 1:2 ratio. An aqueous solution comprising 6.655g (1 mole) of metal chloride for one complex and 6.656g (1 mole) of metal chloride for the other complex was added to this solution, along with 1 ml of hydrochloric acid (HCl). The resultant mixture was refluxed for duration of 6 hours using a water bath. After the reflux process, allow the mixture to cool to room temperature. During this cooling process, distinct black, green, and pale yellow-colored sharp needle-like crystals precipitated out. Subsequently, these color metal complexes were isolated, washed sequentially with methanol and water, followed by recrystallization from ether. The crystals were then derided within a vacuum desiccator containing anhydrous CaCl₂. For characterization purposes, elemental analysis were conducted for both the newly prepared HL ligand and its metal (M₁L and M₂L) complexes. The Schiff base HL and its corresponding metal complexes (M₁L and M₂L) were subjected to analytical assessments, and the obtained data were organized in Table 1.

RESULT AND DISCUSSION

FT-IR spectra of HL ligand, M₁L and M₂L complexes

Table 2 sheds light on the observations made during the analysis of FT-IR spectrum of both the, and that of the M₁L and M₂L complexes. The distinctive FT-IR spectrums are visually represented in Figures 1, 2 and 3. A comparison was drawn between the FT-IR spectrum of the HL and that of the M₁L and M₂L complexes. Resulting data were compiled in a tabular format, including corresponding assignments. The FT-IR spectra of the HL revealed a board peak band at 1646 cm⁻¹ [14], which was attributed to the Schiff base group is $\nu_{C=N}$ stretching. Notably, in the complexes, that band were displaced to lower regions at 1606 cm⁻¹ and 1620 cm⁻¹[15], respectively, for M₁L and M₂L. This shift suggested that the Schiff base group $>C=N$ was involved in complexation, most likely due to a decrease in electron density on the nitrogen atom. This modification implied that the metal was coordinated through the nitrogen atoms. The disappearance of the $\nu_{(OH)}$ bond [16] at 3555 cm⁻¹ in the FT-IR spectrum of the metal chelates showed proton displacement from that of phenolic group during complexation. This observation pointed to the bonding of the metal ions with the ligand via a covalent linkage involving the oxygen in the phenolic group. Additionally, in the FT-IR spectrum of M₁L, M₂L complexes, and there was a broad peak bands [17] around 3425 cm⁻¹ to 3380 cm⁻¹respectively emerged, which could be attributed to OH stretching vibrations associated with water (H₂O) molecules participating in complexes formation. Presence of two weak peak bands appeared at 812.5 cm⁻¹ to 798.2 cm⁻¹ indicated the hydroxyl group wagging and rocking vibrations of coordinate water molecule. Distinctive the bands emerged in the M₁La nd M₂L complexes, absent in the HL. This band at 460 cm⁻¹ and 470 cm⁻¹ was associated with stretching of ν_{M-O} , while bands at 736 cm⁻¹ and 738 cm⁻¹ [18] corresponded to the frequencies of stretching of ν_{M-N} [19-21].

¹H NMR spectra of HL and their M₁L, M₂L metal complexes

The ¹H NMR spectrum of the HL and the M₁L, M₂L metal complexes were recorded in DMSO-D₆ as the solvent, and these spectra are presented in Figures 4, 5, and 6. Table 3 shows the chemical shift values for both the HL and M₁L, M₂L metal complexes. For the ligand HL, a singlet peak appears at 2.37 ppm [21], corresponding to the proton bond to the Schiff base group. Upon complexed, this peak shifts to lower field, specifically at 2.26 ppm for M₁L and 2.29 ppm for M₂L complexes. Such a shift indicate that the shielding effect on the Schiff base group. Notably, the phenolic proton [22] has a singlet signal at 11.52 ppm that disappears in complexes. The signal corresponding to the Schiff base protons moves from 2.37 ppm to 2.26 ppm and 2.29 ppm in the ¹H NMR spectra of the M₁L and M₂L complexes, respectively. This change emphasises the Schiff base groups shielding action. Furthermore, when compared to the equivalent Azomethine spectra, the aromatic ring proton, which is generally found in the 7.20-7.30 ppm region [22], becomes broader and less prominent. The aromatic ring protons at 7.20-7.30 ppm grow broader and less intense in the complex than in the Schiff base. Additionally, the appearance of a peak at 2.82 ppm in the ¹H NMR spectrum of the metal complexes M₁L and M₂L as suggests that the coordination of water molecules through interaction with the metal ion.



**Nageswara Reddy Gosu et al.,****Conductance for M₁L and M₂L complexes**

The M₁L and M₂L complexes molar conductance when dissolved in dimethylformamide at a concentration of roughly 10⁻³ M, was determined at a temperature of 27±2°C used a Systronic-303 reading conductivity meter. To conduct this test, a measured quantity of solid complexes were transferred into a standard 25 ml borosil flask and, then dissolved in dimethylformamide. The solutions were brought to the flask marked level using DMF. Subsequently, the M₁L and M₂L complexes solution was transferred into a dry and clean 100 ml beaker flask. The molar conductance's of these complex was found to be less than the 21 ohm⁻¹ cm² mol⁻¹, which indicates their non-electrolytic in nature. This implies that the complexes do not dissociate into ions when dissolved in the solvent. Table 4 summarises the molar conductances values of M₁L and M₂L complexes.

UV-Vis spectral data of HL and their M₁L, M₂L complexes

The electronic spectrum of the HL and their corresponding M₁L, M₂L complexes have been provided, with their respective transitions detailed in Table 5. For the ligand, a distinctive signal band appears at 283 nm, attribute to the transition $\pi-\pi^*$. Upon complexation, this band experiences a shift towards higher wavelength regions. Additionally, novel bands arise in the complexes, indicative of charge transfer transitions. Notably, d-d transitions may be seen in the visible area of the complexes higher concentration spectrum.

ESR spectrums of M₁L and M₂L complexes

The Electronic spin resonance spectrum of the complexes in their polycrystalline state display a single broad peak signal, attributed to dipolar broadening and an enhanced spin-lattice relaxation effect. Anisotropic spectra obtained for these complexes in DMF at low nitrogen temperature (LNT) have been presented in Figure 7 and 8. Four minor intensity peaks have been observed within this low-temperature spectrum, which are thought to be caused by the g_{\parallel} component. Table 6 shows the spin Hamiltonian, orbital reduction, and bonding parameters for the M₁L and M₂L complexes. The values of g^{\perp} and g_{\parallel} are computed from this spectra using the 2,2-diphenyl-1-picrylhydrazyl free radical as a g marker. According to Neiman and Kvelson [23], g values less than 2.30 imply covalent bond character, whereas values more than 2.30 indicate ionic bond character of the M-L bond in complexes. Using this criterion, the presence of covalent bond character between the M and L complexes can be inferred [24]. The pattern of $g > g > 2.0023$ found for the complex shows that the unpaired electron localises within the complex in the d_{z^2} and $d_{x^2-y^2}$ orbital of the Cu⁺² ions. It is worth noting that the G for these M₁L and M₂L complexes is more than 4, showing that interactions between M-M centre do not exist in the DMF medium.

ESR parameters such as $A^{\perp*}$, A_{\parallel}^* , g^{\perp} , and g_{\parallel} , as well as d-d transition energies, contribute to bonding parameters (α^2), evaluating orbital reduction parameters (K^{\perp} , K_{\parallel}), and dipolar interactions (P) [25]. The presence of out-of-plane Pi-bonding is indicated by the observed connection of $K^{\perp} > K_{\parallel}$. The present chelates α^2 values, which range from 0.410 to 0.480, support the covalent character of these complexes. The method proposed by Giordano and Bereman involves obtaining bonding group information from dipolar term P values. A decrease in P values from the ion value (0.0360 cm⁻¹) indicates strong covalent bonding. The P values found for the current complexes, which range from 0.0290 to 0.0310 cm⁻¹, are compatible with metal ion bonding to oxygen and nitrogen donor atoms, respectively. The form of the ESR spectra, together with electronic spectrum data and ESR, suggests that these complexes have an octahedral geometry [26].

Magnetic moment of M₁L and M₂L complexes

Magnetic susceptibility value of that M₁L complex at room temperature align within the range of 1.76 BM, as presented in Table 7. At ambient temperature, these results indicate significant orbital contributions and effective magnetic susceptibility in octahedral compounds. Magnetic susceptibility for low-spin octahedral complexes often exceeds 1.76 B.M in magnetically dilute substances. The magnetic characteristics of the Mn²⁺ complex provide information on its shape. In the M₂L complex, magnetic susceptibility value measures 5.44 B.M [27]. Remarkably, the magnetic susceptibility of the M₂L complex closely approach the spin-only value.



**Nageswara Reddy Gosu et al.,****TGA-DTA spectra of M₁L and M₂L complexes**

The thermo gravimetric analysis data for the M₁L and M₂L complexes have been compiled in the Table 8. Representative thermo grams are depicted in Figures 9 and 10. These complexes exhibit stability up to temperature range from 800°C to 900°C. Decomposition process transpires in two stages. The initial stage of decomposition, occurring in the temperature ranges of 90°C to 175°C, involves the endothermic loss of H₂O molecules, leading to the formation of anhydrous intermediates [28]. Subsequently, the second stage of decomposition takes place, manifested by the decomposition of the intermediates. This stage shows two exothermic peaks within the temperature range of 270°C to 310°C [29-30]. At elevated temperatures, the corresponding metal oxides are formed as stable end products. The estimated weights were compared to the experimental percentage mass loss. According to the thermal gravimetric data, the complexes exhibited a stability order of M₂L > M₁L. This provides insights into relative thermal stability of the complexes, with the M₂L complex demonstrating higher stability compared to the M₁L complex.

Biological activity

In the course of this present investigation, the author embarked on evaluating the antibacterial studies of the HL and its corresponding M₁L and M₂L complexes against *E. coli*, *E. faecalis*, and *S. typhi*. This was accomplished using the serial paper disc method, with the results tabulated in Table 9. The biological studies assessment of the M₁L and M₂L complexes underscore several key observations. A compared analysis of the HL and its M₁L, M₂L complexes reveals the M chelate exhibit elevated antibacterial studies compared to the free HL. Intensified antibacterial studies of the M chelates can be attributed to impact of the metal ion. This phenomenon can be explain through overtone the chelation theory and the concept theory. Due to the overlapping HL orbital and the partial shared of positive charges from the metal M ion with donor groups during chelation, the polarity of the M ion is significantly reduced. Furthermore, it was noted that delocalization of e^- across the entire chelates ring augments lipophilicity of the complexes. Heightened lipophilicities [31] facilitates the penetration of the M₁L and M₂L complexes into lipid membranes, effectively obstructing the metal sites on microorganism enzymes. The zone of inhibition for the M-L complex has been documented in the Table 9, encapsulating the inhibitory effects observed against the tested microorganisms.

CONCLUSION

The outcomes of the aforementioned study yield several significant conclusions. It can be deduced that the Schiff base formed through the reaction of 3-methoxysalicylaldehyde with the alkylamine, specifically p-methylbenzohydrazide, serves a highly effective complexed agent for a range of transition metal ions. The bidentate nature of the ligand during complexation has been discerned through the comprehensive spectral investigations carried out. Remarkably, all the metal complexes display a neutral charge and exhibit noteworthy thermal stability. It is worth noting that predicting the ultimate structures of the complexes is a complex task, and no single technique can be solely relied upon for this purpose. Instead, a combination of various spectral and analytical methods is essential to provide a comprehensive understanding of the structural characteristics of these complexes.

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Nageswara Reddy Gosu *et al.*,**Table 1: Analytical data of the HL and M₁L, M₂L metal complexes.**

		HL	M ₁ L	M ₂ L	
Molecular weight		284.34	665.53	656.939	
Co lour		Yellow	Black Green	Pale Yellow	
Yield		76	73	68	
M.P		182-184	292-294	320-322	
Elemental Analysis	C %	Calculated	67.53	57.68	58.44
		Found	67.47	57.60	57.90
	H%	Calculated	5.61	5.11	5.18
		Found	5.91	4.99	5.30
	N %	Calculated	9.83	8.40	8.51
		Found	9.72	8.03	8.72
	O%	Calculated	16.87	19.22	19.47
		Found	16.31	19.10	19.55
	M%	Calculated	-	9.53	8.35
		Found	-	9.51	8.31

Table 2: The important FT-IR bands of the HL ligand and its metal complexes

Compound	OH(Water)	ν _{OH} (Phenolic)	ν _{C=N}	ν _{Ar-H}	ν _{M-O}	ν _{M-N}	ν _{C-H}
HL	-	3555	1646	3068	-	-	2844
M ₁ L	3425	-	1606	3032	470	736	2837
M ₂ L	3381	-	1620	3061	460	738	2843

Table-3: ¹H NMR Spectrum of the ligands and its metal complexes in DMSO-d₆ in ppm

Compound	H-C=N	CH ₃	OH	OCH ₃	Ar-H	O=C-NH
HL	2.37	1.18	11.52	3.83	7.26	7.76
M ₁ L	2.26	1.66	-	3.63	7.26	-
M ₂ L	2.29	1.65	-	3.60	7.26	-

Table 4: Conductance data for M₁L and M₂L complexes: Cell constant: 1.00

Metal complex	Conductance Ohm ⁻¹	Specific Conductance Ohm ⁻¹ cm ⁻¹	Molar Conductance Ohm ⁻¹ cm ² mol ⁻¹
M ₁ L	0.0054 × 10 ⁻³	0.0054 × 10 ⁻³	5.40
M ₂ L	0.0047 × 10 ⁻³	0.0047 × 10 ⁻³	4.70

Table 5: Electronic spectral data

Complexes	λ _{max} of the complex in nm	λ _{max} of the ligand in nm
M ₁ L	289.2	283



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M ₂ L	285.5	283
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Table 6 : Spin Hamiltonian and orbital reduction parameters of M₁L and M₂L complexes in DMF solution

Parameters	g_{\parallel}	g_{\perp}	g_{ave}	G	A_{\parallel}^*	A_{\perp}^*	A_{ave}^*	d-d	K_{\parallel}	K_{\perp}	P^*	α_2
M ₁ L	2.20464	2.0999	2.1348	2.0476	0.019	0.001	0.0069	16000	0.889	0.982	0.032	0.421
M ₂ L	2.24734	2.0699	2.1290	3.5369	0.011	0.001	0.0072	24600	0.724	0.845	0.029	0.414

Table 7: Magnetic moments of M₁L and M₂L complexes.

Metal Complexes	Effect in B.M.		Number of unpaired electron
	Theoretical	Observed	
M ₁ L	1.73	1.76	1
M ₂ L	5.92	5.44	5

Table 8: Thermal analytical data of the HL ligand and its M₁L, M₂L metal complexes

Complex	Molecular weight in gms	Weight of the complex take in mgs	Temperature Range during weight loss in °C	%of fraction of weight	Probable assignment
M ₁ L	665.54	13.8020	80-190 280-810 Above 810	5.4091 82.6396 11.95119	Loss of 2H ₂ O molecule. Loss of two L molecules. Remaining residue Corresponds to CuO.
M ₂ L	656.938	9.0200	90-180 310-520 Above 520	5.4799 83.7217 10.7982	Loss of 2H ₂ O molecule. Loss of two L molecules. Remaining residue Corresponds to MnO.

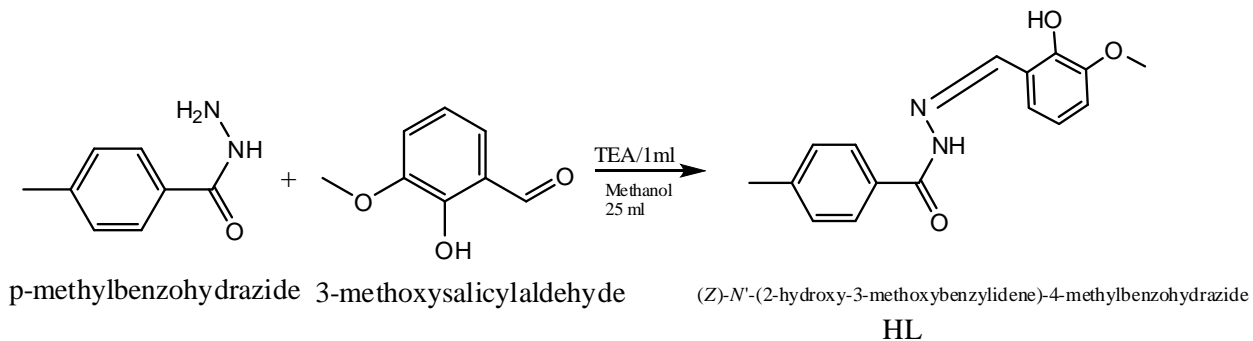
Table 9: Antibacterial Activity of the Metal complexes Total Area of Zone of clearance in mm

Compound	<i>S. Typhi</i>	<i>E. Faecails</i>	<i>E. coli</i>
HL	12	14	15
M ₁ L	18	19	20
M ₂ L	16	18	20





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Scheme 1: Synthesis of Schiff base HL.

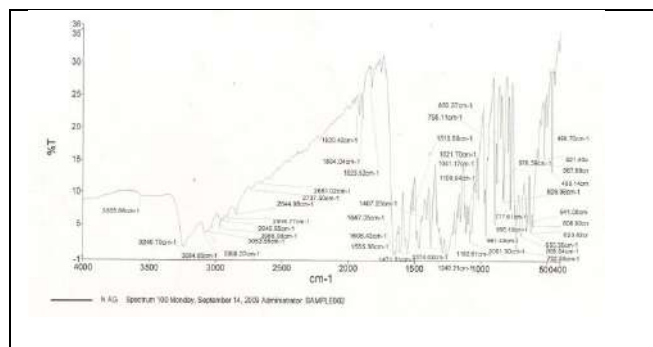


Figure 1: FT-IR Spectrum of HL Ligand

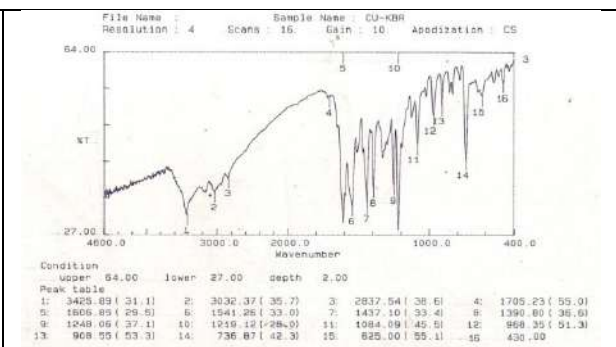


Figure 2: FT-IR Spectrum of M:L complex

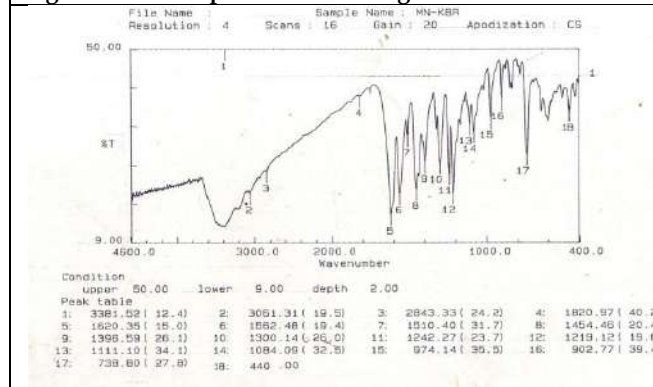


Figure 3: FT-IR spectrum of M:L Complex.

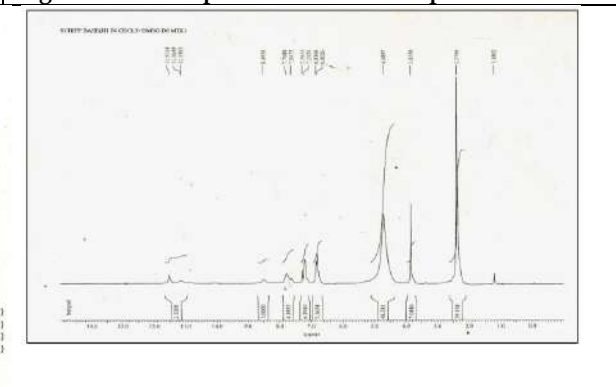


Figure 4: ¹H NMR Spectrum of HL

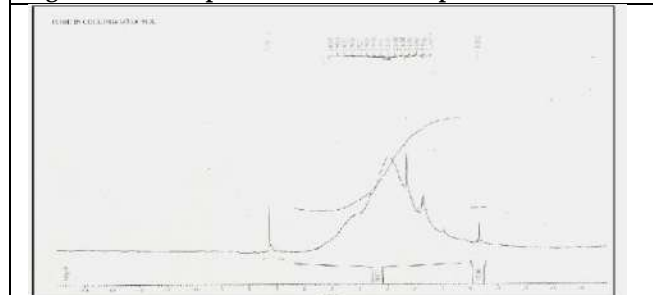


Figure 5: ¹H NMR Spectrum of M:L complex

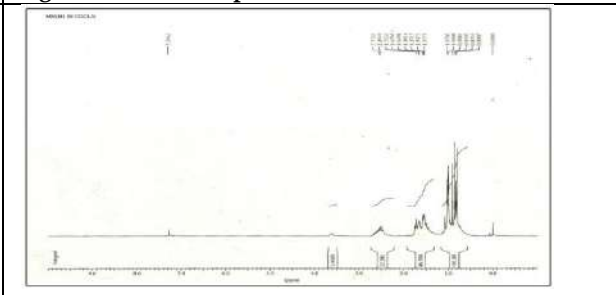


Figure 6: ¹H NMR Spectrum of M₂L complex





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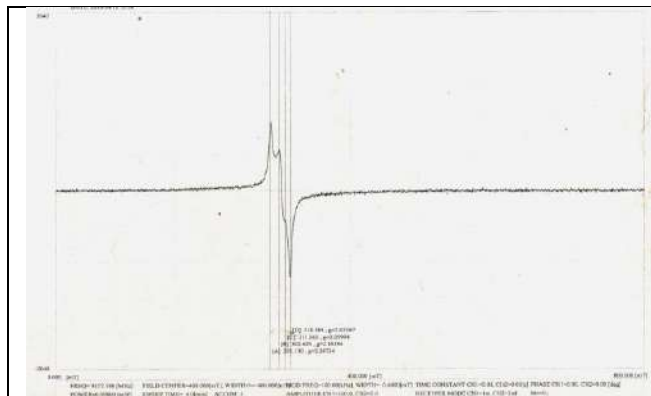


Figure 7: ESR Spectrum of M₁L complex

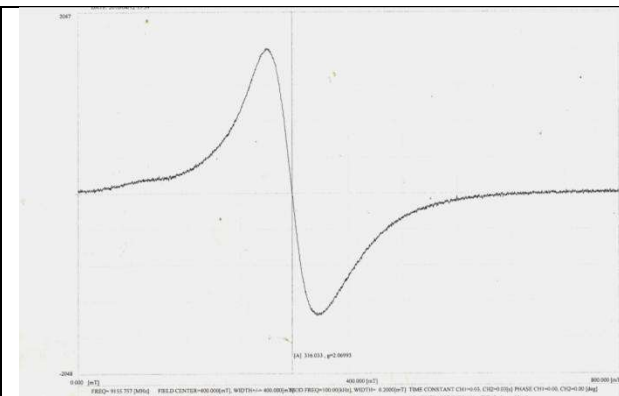


Figure 8: ESR spectrum of M₂L complex

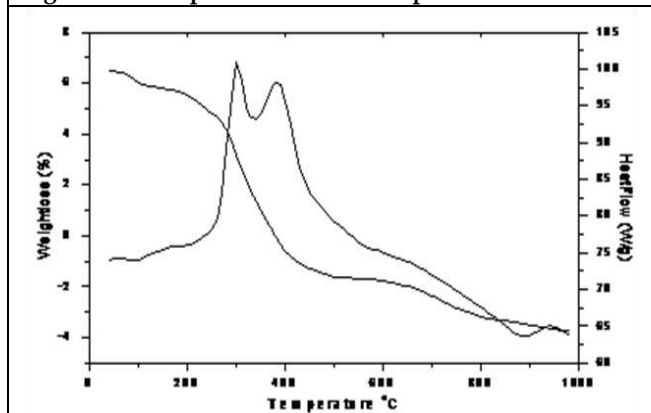


Figure 9: TG & DTA Spectrum of M₁L complex.

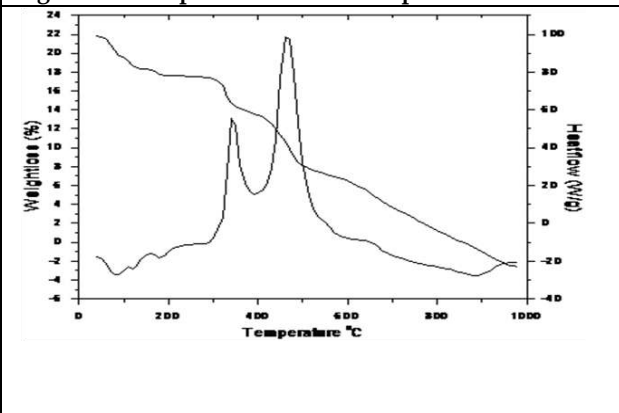


Figure 10: TG & DTA spectrum of M₂L complex





Comparable Effects of Isolated and Combined Assisted and Resisted Sprint Training Programmes on Speed Endurance among College Women Athletes

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ABSTRACT

The purpose of the current study was to examine the effects of isolated and combination assisted and resisted sprint training programmes on speed endurance performance of college-aged female athletes. Sixty (N=60) female college athletes who were studying various colleges affiliated to Bharathidasan University in Tiruchirappalli, Tamil Nadu, India and participated inter collegiate athletic meet were chosen at random to serve as the study's subjects. The subjects were between the ages of 18 and 21. The participants were divided randomly into four groups of fifteen each, namely the Control Group, the Assisted Sprint Training Group, the Resisted Sprint Training Group, and the Combined Assisted and Resisted Sprint Training Group (CG). Assisted sprint training was used in Group I, resisted sprint training was used in Group II, combined assisted and resisted sprint training was used in Group III, and control training was used in Group IV. Three sessions per week were allowed during the training period, which was limited to twelve weeks for each of the three experimental groups. The training schedule for mixed assisted and resisted sprint training was limited to alternate weeks for a total of twelve weeks. Speed Endurance was chosen as the dependent variable, and it was assessed by 150 meters run test. The complete specified variable was examined on each individual both before and right after training. Analysis of covariance was used to statistically assess the data collected from the experimental groups prior to and following the experimental period (ANCOVA). The Scheffe's Post hoc test was used to ascertain the paired mean differences whenever the 'F' ratio for adjusted post test means was found to be

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significant. For each scenario, the degree of confidence was set at 0.05. The study's findings revealed that all three experimental groups—Assisted Sprint Training Group (ASTG), Resisted Sprint Training Group (RSTG), and Combined Assisted and Resisted Sprint Training Group (CARSTG)—had significant differences in Speed Endurance. Also, the study's findings demonstrated that combined assisted and resisted sprint training (ARSTG) improved Speed Endurance more than assisted sprint training (ASTG) and resisted sprint training (RSTG).

Keywords: Assisted Sprint Training, Resisted Sprint Training, Combined Assisted and Resisted Sprint Training, Speed Endurance

INTRODUCTION

The word sprinting is defined as the fast-paced movement of the legs and arms in rapid succession while maintaining control. There are many different aspects, as well as, many different distances in sprinting [1]. There is more to sprinting than just being the first one to the finish line. Over the course of the clinic, we will spend a great deal of time on the physical, mental, and biomechanical aspects of the sprinting world[2]. Sprints are high-intensity, short bursts of activity, performed at great speed and one of the most effective forms of training possible for building strength, speed and power whilst developing lean muscle mass and losing fat[3]. Primary Muscle. Sprint training is an excellent way to build muscle, burn fat and calories, and raise your metabolic rate, and it was the favored training method of sports legends such as Jerry Rice and Walter Payton[4]. Assisted and resisted training are specific types of facilitation and overload. They are concepts that are widely used in other types of training such as whole-body vibration (facilitation) and weight lifting (overload) [5]. Speed of movement can best be attained by practicing speed with lighter weight, whereas improved strength can best be attained with a maximum overloading of a muscle[6].

METHODOLOGY

Subjects and Variables

For this study sixty (N=60) college female athletes who were studying various affiliated colleges to Bharathidasan University, Tiruchirappalli, Tamil Nadu India were selected randomly as subjects. The age of the subjects was ranged between 18-21 years. The subjects were assigned at random into four groups of fifteen each (n=15) namely, Assisted Sprint Training Group (ASTG), Resisted Sprint Training Group (RSTG), Combined Assisted and Resisted Sprint Training Group (CARSTG), and Control Group (CG). Group-I underwent Assisted Sprint Training, Group-II underwent Resisted Sprint Training, Group-III underwent Combined Assisted and Resisted Sprint Training and Group-IV acted as Control. Speed Endurance was chosen as the dependent variable, and it was assessed by 150 meters run test

Training Protocol

The training programmes were scheduled for one session a day each session lasted between one hour approximately including warming up and warming down. During the training period, the experimental groups underwent their respective training programme three days per week (alternative days) for twelve weeks in addition to their college curriculum. The group- I concentrated on assisted sprint training, group-II on resisted sprint training, group-III on combined assisted and resisted sprint training. The assisted sprint training exercises included in this training programme was downhill sprinting, assisted towing and high-speed treadmill sprinting. The resisted sprint training exercises included in this training programme was weighted vest, sprint parachutes and harness running. The combined sprint training group performed the assisted and resisted sprint training methods. The training distance



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comprised of 30-50 meter and the initial intensity was fixed at 60% and it was increased once in two weeks by 5%. The subjects performed these training at maximum relaxed speed with the specified intensity. The rest intervals between repetitions were 2 minutes, where they stay with active and between sets, they performed other balance or trunk activities for 5 minutes. All the three groups had the same volume, intensity and frequency of training.

Experimental Design and Statistical Technique

The experimental design in this study was random group design involving 60 subjects, who were divided at random in to four group of fifteen each. The collected data from the four groups prior to and post experimentation on speed endurance was statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Since four groups were involved, whenever the obtained 'F' ratio value was found to be significant for adjusted post test means, the Scheffe's test was applied as post hoc test to determine the paired mean differences, if any.

RESULTS

The Analysis of covariance (ANCOVA) on Speed Endurance of Experimental Groups and Control group have been analyzed and presented in Table -1. Table-1 shows that the pretest means and standard deviation on speed endurance of ASTG, RSTG, CARSTG and CG are 27.93 ± 2.86 , 28.67 ± 2.49 , 28.20 ± 4.28 and 28.07 ± 4.07 in that order. The attained 'F' ratio assessment of 0.12 was not as much of the essential table score of 2.76 for the quantity of freedom 3 and 56 at 0.05 level of assurance, which shows that the casual mission of the subjects was a success because the pre check scores on speed endurance among groups didn't vary drastically. The post-test means and standard deviation on speed endurance of ASTG, RSTG, CARSTG and CG are 36.40 ± 2.49 , 28.07 ± 2.82 , 40.93 ± 3.00 and 28.47 ± 4.37 respectively. The attained 'F' ratio assessment of 29.81 on speed was as much of the essential table score of 2.76 for the quantity of freedom 3 and 56 at 0.05 level of assurance. It implies that momentous variation existed between the groups during the post test phase on speed endurance. The adjusted post-test means on speed endurance of ASTG, RSTG, CARSTG and CG are 36.57, 37.80, 40.94 and 28.55 respectively. The attained 'F' ratio assessment is 41.58 of speed was as much of the essential table score of 2.78 for the quantity of freedom 3 and 55 at 0.05 level of assurance. The outcome of the study tells that, major differences be present among experimental and control groups on speed endurance. To determine which of the paired means had a significant difference, Scheffe's test was applied as Post hoc test and the results are presented in Table-2. The table-2 shows the pair wise comparison on speed endurance of different groups.

1. The results indicated that there were significant differences ($CI=3.33$) were found in ASTG and CARSTG(4.38), ASTG and CG (8.01), RSTG and CG(9.25)&CARSTG and CG(12.39).
2. The results indicated that there was no significant differences ($CI=3.33$) ASTG and RSTG (1.24),& RSTG and CARSTG (3.14).

The graphical representation of pre and post assessment means values are represented in the Fig.1. The graphical representation of adjusted post assessment means values are represented in the Fig.2.

CONCLUSIONS

From the analysis of the data, the following conclusions were drawn. Significant differences in achievement were found between AST group, RST group, CARST group and CG in Speed Endurance. The experimental groups namely, AST group, RST group, and CARST group had significantly improved in Speed Endurance. The CARST group was found to be better than the AST group, RST group and Control group in increasing Speed Endurance.





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Table – 1: Analysis of Covariance for Experimental Groups and Control Group on Speed Endurance

Certain Variables	Adjusted Post test Means				Source of Variance	Sum of Squares	df	Mean Squares	'F' Ratio
	ASTG	RSTG	CARSTG	CG					
Pre-Test Mean	27.93	28.67	28.20	28.07	Between	4.58	3	1.53	0.12
SD	2.86	2.49	4.28	4.07	With in	739.60	56	13.21	
Post Test Mean	36.40	28.07	40.93	28.47	Between	1282.73	3	427.58	29.81*
SD	2.49	2.82	3.00	4.37	With in	803.20	56	14.34	
Adjusted Post Test	36.57	37.80	40.94	28.55	Between	1250.80	3	416.93	41.58*
					With in	551.49	55	10.03	

* Significant at.05 level of confidence

Table value for df (3, 56) at 0.05 level = 2.76 Table value for df (3, 55) at 0.05 level = 2.78

(ASTG =Assisted Sprint Training Group, RSTG = Resisted Sprint Training Group, CARSTG= Combined Assisted and Resisted sprint Training Group, CG- Control Group)

Table – 2: The Scheffe’s test for the differences between the adjusted posttests paired means on Speed Endurance

Certain Variables	Adjusted Post test Means				Mean Difference	Confidence Interval
	ASTG	RSTG	CARSTG	CG		
	36.57	37.80			1.24	3.33





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Speed Endurance	36.57		40.94		4.38*	3.33
	36.57			28.55	8.01*	3.33
		37.80	40.94		3.14	3.33
		37.80		28.55	9.25*	3.33
			40.94	28.55	12.39*	3.33

* Significant at.05 level of confidence



Fig-1: Pre and Post Test Means Diagram on Speed Endurance

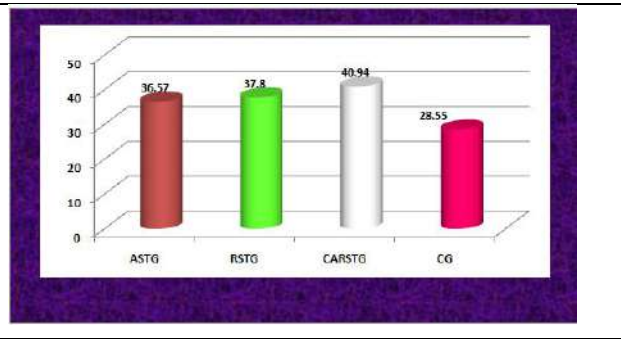


Fig-2: Adjusted Post Test Means Diagram on Speed Endurance





Comparative Phytochemical Screening and Antioxidant Mechanism of Methanolic Rhizome Extract of *Zingiber officinale* and *Curcuma amada*

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ABSTRACT

The present study was carried out the phytochemical screening and antioxidant analysis of *Zingiber officinale* and *Curcuma amada* were assessed. Various secondary metabolites was found from the methanolic rhizome extract of these two plants i.e alkaloids, flavonoids, saponins, phenols, tannins, glycosides, terpenoids, steroids, quinines, carbohydrate, protein and amino acids. Quantitative analysis of methanolic crude extract shows the presence of highest amount of flavonoid, phenolics and tannin in *Zingiber officinale* whereas in *Curcuma amada* the presence of tannin and saponin were highest in compare with other phytochemicals. Antioxidant activity was performed using DPPH assay, Nitric Oxide Scavenging activity and Superoxide scavenging activity with various extract concentrations (20, 40, 60, 80 and 100 µg /ml). It shows that methanolic rhizome extract of *Zingiber officinale* and *Curcuma amada* shows highest activity in DPPH scavenging assay (78.33 ± 0.39 & 69.15 ± 0.29) and Nitric Oxide Scavenging activity (NO) and Superoxide scavenging activity (SO) shows less capacity than DPPH (45.38 ± 0.2 & 37.59 ± 0.29 respectively) in *Zingiber officinale*. Where in *Curcuma amada* was found that Superoxide scavenging activity shows more activity than Nitric Oxide Scavenging activity (35.53 ± 0.35 & 48.52 ± 0.51 respectively).

Keywords: Phytochemical screening, *Zingiber officinale*, *Curcuma amada*, antioxidant, DPPH





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INTRODUCTION

Perennial ginger (*Zingiber officinale*), which is frequently used in herbal medicine, grows from an underground rhizome. Modern scientific study has found that ginger has several positive health effects, including its antioxidant properties, ability to stop the manufacture of inflammatory chemicals, and direct anti-inflammatory actions. One of the most well-known spices in the world, ginger rhizome has been used for its therapeutic properties in complementary medicine for more than 2,500 years [1]. China, Nepal, India, Bangladesh, the United States, Taiwan, Jamaica, Nigeria, and Indonesia are among the countries where it is grown. It has been used to treat a wide range of illnesses like throat infections, asthma, inflammation, palpitations, constipation, indigestion, arthritis, hypertension, migraines, and many more in Ayurvedic, Tibb-Unani, Chinese, Islamic, Africans, and other medicinal systems [2]. Ginger's a food spice, which the American Diabetic Association has also endorsed as a dietary supplement. Nutraceutical food is a dietary product that provides necessary health benefits such as prevention of disease and treatment [3]. A perennial, rhizomatous, aromatic herb in the Zingiberaceae family, *Curcuma amada* Roxb. Due to the flavour of the rhizome resembling raw mango, this plant is also known as "Amahaldi," "Amba ada," and "Mango ginger" [4,5]. It was first found in the Indo-Malayan region and afterwards spread over Asia's tropics to Africa and Australia. Aromatic herbs and therapeutic plants are utilised as food additives.

For a very long time, pharmaceutical businesses have used unprocessed plant extracts to create treatments for corrective medicine [6]. Research on medicinal plants has a bright future in both academia and industry [7]. More natural resources are used by the pharmaceutical sector to produce more than half of all new medications [8]. Many medicinal plants can prevent a variety of diseases from developing in the first place, and conventional therapies and approaches have recently demonstrated that diseases can be controlled [9]. The therapeutic properties of plants and herbs are influenced by the presence of bioactive constituents like flavonoids, alkaloids, saponins, glycosides, tannins, steroids, terpenoids, and phenolic compounds, among others [10]. Humans are affected in a certain physiological way by this. As a result of the adverse consequences brought on by the synthetic molecular medications employed in allopathic treatment, individuals eventually began to accept herbal or traditional treatments [11]. Aside from humans, herbal medicinal plants can treat the illnesses of the rest of the world's living things. According to [12], fresh ginger was used in ancient India and China to treat asthma, heart palpitations, swelling, loss of appetite, coughing, rheumatism, fever, diarrhoea and sore throats. It has been used for millennia to aid in digestion, avoid motion sickness and seasickness, inhibit vomiting, and ease other symptoms of the common cold, fever, headache, and even painful menstrual periods. It is also thought to increase circulation and enhance blood flow [13]. The therapeutic qualities of ZO have been thoroughly researched in recent decades using cutting-edge scientific techniques, and numerous bioactive substances have been extracted from various plant components [14]. According to [13], it contains significant amounts of Zingiberene, sesquiphellandrene, geranial, and ar-curcumene. Its extracts and active compound exhibited antimicrobial, anticonvulsant, analgesic, anti-inflammatory, antiulcer, gastric antisecretory, antidiabetic, nephroprotective, hepatoprotective, antitumor, anticancer, antispasmodic, antithrombotic, hypocholesterolemic, antiallergic, antiserotonergic, anticholinergic, antioxidant, larvicidal, immunomodulatory activities and other beneficial activities [14].

Also regarded as possible cancer-prevention and anticancer medicines are gingerol and its derivatives. Less than 10% of medical drugs are currently used in Western countries for the prevention and treatment of gastrointestinal problems. This represents a 50% usage rate. According to [15], the threat of intestinal disorders, the low cost, and the accessibility of herbal remedies were the main factors driving this rise in the use of medicinal plants. One of the most popular spices in the world is ginger, and extracts from it are suggested in many nations' pharmacopoeias for a number of gastrointestinal illnesses, as explained below by [16]. More than forty natural substances, including paradols, dihydroparadols, gingerols, shogaols, 3-dihydroshogaols, gingerdiols, mono and diacetyl derivatives of gingerdiols, and diarylheptanoids, have been isolated from ginger. Numerous pharmacological properties of ginger have been identified, including anti-bacterial [17], antioxidant [18], antiviral [19], antiulcer [15], hypoglycemic, and hypolipidemic effects [20], as well as benefits for nausea relief [21]. In the GIT, ginger has additionally demonstrated



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anticancer properties [22]. Scientific research on the purported therapeutic effects and careful examination for potential toxicity are now necessary due to the rise in the intake of plant extracts intended to treat gastrointestinal diseases. There aren't many research showing ginger's effectiveness as a gastroprotective agent, as observed by [21]. Mango-ginger, also known as *Curcuma amada* Roxb, is a main component in pickles, sauces, chutneys, and salads and has a peculiar aroma reminiscent of raw mangoes. A pitta imbalance, indigestion, flatulence, gout, skin conditions, cramps, damaged wounds, chronic ulcers, pruritus, fever, constipation, hiccup, anorexia, bronchitis, sprains, halitosis, and inflammations can all be treated with this plant's rhizomes [23,24]. According to [4], this plant is grown in several Indian states, including Odisha, however commercial multiplication has not yet been documented. Since ancient times, *C. amada* has been used in Ayurveda and Unani traditional medical systems as a coolant, appetiser, alexteric, antipyretic, aphrodisiac, diuretic, emollient, expectorant, and laxative as well as to treat biliousness, itching, skin conditions, bronchitis, asthma, hiccups, and inflammation caused by injuries [23]. This plant's rhizome, along with table salt, is used to treat colds and coughs as well as to improve the quality of blood. According to [25], its rhizome has also been utilised for the treatment of cuts, wounds, and itching.

MATERIALS METHODS

The disease-free and fresh rhizome of *Z. officinales* and *C. amada* plant sample was collected from local market. The collected plant rhizome was rinsed with clean tap water to remove the debris, dust, and soil from the surface. The cleaned rhizome was scissored and shadow-dried and pulverized by an electric pulverizer. The Soxhlet apparatus-based extraction method was followed to extract the phytochemicals present in the rhizome of *Z. officinales* and *C. amada* by following standard methodology. In brief, about 100g of rhizome sample was extracted with 500ml of methanol with the help of soxhlet apparatus. Then, methanol extract was evaporated, and obtained fine extract was completely and gradually in the oven and subjected to phytochemical properties analyses.

Qualitative analyses of phytochemicals

The phytochemical profiles (Qualitative analysis: alkaloids, flavonoids, saponins, phenols, tannins, glycosides, terpenoids, steroids, quinones, carbohydrates, proteins and amino acids [26])

Quantitative phytochemical analysis

Rhizome powder sample was used for quantitative phytochemical analysis in terms of tannin, saponin, phenolic, and flavonoid as described by [27] and alkaloid content was estimated using the procedure described by [28]. The content of saponin, alkaloid, and flavonoid was expressed as mg/g in dry weight of rhizome sample. Quantitative analysis for phenolics and tannins was carried out based on gallic acid (GAE) and tannic acid (TAE), the standard curve was prepared and the data were presented in mg standard equivalent weight/g of the dry weight of rhizome and leaf sample of *Z. officinale* and *C. amada*.

Antioxidant activity**Diphenyl 1 picryl hydrazyl free radical scavenging activity**

This scavenging effect on the DPPH radical was determined according to the methods developed earlier [29, 30]. Different extract concentrations (20, 40, 60, 80, and 100 µg /ml) were combined with 5 ml of a 0.004% DPPH methanolic solution. Each mixture was left in the dark for 30 minutes while a UV spectrophotometer measured the samples' absorbance at 517 nm. Daily preparations of fresh DPPH solution were made, and between measurements, they were kept at 4°C in the dark in an amber light bottle. The control and standard underwent the identical method, with the exception that the control did not have any sample added to it, and the standards had 20, 40, 60, 80, and 100 µg of sample substituted with 20, 40, 60, 80, and 100 µg /ml of BHT, catechin, and gallic acid instead. A lower absorbance indicates higher radical scavenging power. DPPH radical scavenging activity was calculated by following equation.

$$\text{DPPH Radical scavenged (\%)} = \left[1 - \frac{A_t}{A_o} \times 100 \right]$$





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where A_t is the absorbance of the sample and A_o is the absorbance of the control at 517 nm.

Nitric oxide radical scavenging activity

Nitric oxide (NO) was generated from sodium nitroprusside (SNP) and was measured by the Griess reagent. The idea behind it is that SNP in aqueous solution at physiological pH naturally produces NO, which reacts with oxygen to form nitrite ions, the amount of which can be calculated using the Griess Reagent. As NO scavengers compete with oxygen, NO generation is reduced. Different amounts of extract (20, 40, 60, 80, and 100µg/ml) dissolved in acetone were combined with two millilitres of SNP (10 mM) in phosphate buffer saline (PBS) at a pH of 7.4. The mixture was then incubated at 25°C for two and a half hours. The Griess reagent (1% sulphanilamide, 0.1% naphthylethylenediamine dichloride, and 2 ml orthophosphoric acid) was added to the samples from the previous steps. Pink will start to emerge. Absorbance was reset at 546 nm. Ascorbic acid was taken as standard [31]. Nitric oxide scavenging activity was calculated by following equation.

$$\text{Nitric Oxide scavenged (\%)} = \left[1 - \frac{A_t}{A_o} \times 100 \right]$$

where A_t is the absorbance of the sample and A_o is the absorbance of the control at 546 nm.

Super oxide radical scavenging activity

1 ml of Nitroblueterazolium (156 Mm), 1 ml Nicotinamide adenine dinucleotide (reduced) (468 Mm) and 0.1 mL of Phenazine methosulphate solution (PMS) in 0.1 M of phosphate buffer solution (pH 7.4) were added to 0.1 ml extract of different concentrations (20, 40, 60, 80 and 100µg) and of 20, 40, 60, 80 and 100µg then incubated at 25°C for 5 min and absorbance was read at 560 nm against blank containing all reagent except PMS. Ascorbic acid was taken as standard [32]. Super oxide radical scavenging activity was calculated by following equation.

$$\text{Superoxide Radical scavenged (\%)} = \left[1 - \frac{A_t}{A_o} \times 100 \right]$$

where A_t is the absorbance of the sample and A_o is the absorbance of the control at 560 nm.

RESULT AND DISCUSSION

Due to their safety and lack of adverse effects, herbal medications are frequently utilised in developing and even industrialised nations. They are also widely used, especially in many Asian and African nations [33]. One of the nations that heavily relies on herbal medicine to suit its healthcare demands is India. In this country, the market for herbal pharmaceuticals is estimated to be worth \$1 billion and the export of plant-based crude drugs is estimated to be worth \$80 million. India, unlike China, has not been able to encourage the use of its enormous herbal resources throughout the developed world despite their growing interest in herbal therapy [34].

Qualitative analysis

Methanolic extract of *Z. officinales* rhizomes contains alkaloid, flavonoids, steroids, phenols, glycosides, terpenoids, quinines, carbohydrates, protein and amino acids with exception for saponins were in Table-1. According to [35] stated that the methanolic extract of *Z. officinale* contains atleast all the phytochemicals except saponin. [36] explained the presence of alkaloid, saponins, tannins, flavonoids, terpenoids and phlobatannins and absence of steroids. Methanolic extract of *C. amada* rhizome contains alkaloids, flavonoids, saponins, phenols, tannins, glycosides, terpenoids, steroids, quinons, carbohydrate, proteins & amino acids. According to phytochemical analysis of [37] describes the presence of alkaloids, flavonoids, saponins, tannins, carbohydrates, protein and fibre in the rhizome extract of mango ginger. [38] also stated the presence of phenols, flavonoids, tannins and saponins in the aqueousmethonolic extract of *C. amada*. [39] also observed the presence of different phytochemicals like tannin, saponins, flavonoids, alkaloids and phenolics were present in water, acetone, methanol, ethanol and chloroform solvent.



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Quantitative analysis

Quantitative analysis of *Z. officinales* found the presence 35.12 ± 1.05 mg/g DW alkaloid, 95.56 ± 2.87 mg/g DW of flavonoid, 86.25 ± 2.59mg GAE/g DW of phenol, 62.12 ± 1.86mg TAE/g DW of tannin, 28.11 ± 0.84 % of carbohydrate and 33.16 ± 0.99 % of protein were shown Table-2. In *Z. officinales* the presence of more phenolic and flavonoid contains was observed by [40]. Quantitative analysis of methanolic rhizome extract of *C. amada* was estimated and found the presence of 17.17 ± 0.52 mg/g DW alkaloid, 14.91 ± 0.45 mg/g DW of flavonoid, 25.12 ± 0.75 mg/g DW of saponin, 9.51 ± 0.29 mg GAE/g DW of phenol, 91.56 ± 2.75 mg TAE/g DW of tannin, 16.59 ± 0.5 % of carbohydrate and 6.19 ± 0.19 % of protein were shown in Table-2.[41] observed the presence of highest amount total flavonoid in methanolic extract than other extracts.[39] showed the presence of tannin which known for anti-oxidant activity and the presence of flavonoid useful in development of living organism.

Antioxidant activity

The DPPH Assay was showed that the highest percentage of RSA increases while increasing in the concentration of extract upto 100 µg/ml (78.33±0.39), while the highest IC50 value was recorded 144.1µg /ml and gradually decrease in the antioxidant capacity was observed in Nitric oxide radical scavenging assay where concentration of extract in 100 µg/ml (45.38±0.2) and IC50 value was 287.16 µg /ml in methanolic extract of rhizome of *Zingiber officinale*. In Superoxide radical scavenging assay shows least amount of antioxidant capacity in 100µg/ml(37.59±0.29) where IC50 value was 351.58 µg /ml in methanolic extract of rhizome of *Zingiber officinale*were shown in Fig-1. Like this trend also observed in *C. amada* where highest amount of antioxidant capacity was observed in DPPH assay in concentration upto 100µg/ml (69.15±0.29) where IC50 value was 166.9 µg /ml. Gradually decreased in Superoxide radical scavenging assay in 100µg/ml (35.53±0.35) and IC50 value was 296.62 µg /ml observed as compare to DPPH. In Nitric oxide radical scavenging assay observed the least amount of antioxidant capacity in 100µg/ml (48.52±0.51) where IC50 value was 246.97 µg /ml observed and were shown in Fig-2. According to [42], solvent extraction outperformed water extraction in terms of antioxidant activity using three different methodologies.

Following is the order of free radical scavenging activity by DPPH and antioxidant activity by reducing power. 80 percent methanol > 80 percent ethanol > 80 percent methanol >30 degree water > 100 degree water > acetonic extract. According to *Z. Mushtaq et al.*, 2019 The inhibition of ethanolic extracts (66.04%) and methanolic extracts (55.57% and 53.29%) of hybrid ginger was less than that of ginger powder. In [43] stated “The extract showed significant activities in Superoxide anion scavenging activity assay, Hydroxyl radical scavenging activity assay, Nitric oxide scavenging activity assay, DPPH free radical scavenging assay, and hydrogen peroxide antioxidant assays compared to the standard antioxidant in a dose dependent manner and remarkable activities to scavenge reactive oxygen species (ROS) may be attributed to the high amount of hydrophilic phenolics. The IC50 values of all parameters were determined while ascorbic acid was used as standard. Conclusion: The results obtained in the present study indicate that *Z. officinale* extract is a potential source of natural antioxidant.” Plants that have an antioxidant function in the production of new medicinal products are useful to the pharmaceutical industries, [44]. Various free radicals, including the hydroxyl radical, have been linked to a number of disorders, including atherosclerosis, carcinogenesis, and neurological and cardiovascular diseases [45]. Antioxidant molecules work to lower these free radicals [45].The research of [46] indicates that there was an increased level of antioxidant activity from methanol extracts. These findings correspond to those of [47] who investigated the antioxidant activity of a ginger alcohol extract from Vietnam and found that radical inhibition by DPPH was up to 90.1%.The aqueous extracts of ginger were discovered to have strong antioxidant properties by [48] in Finland, where the IC50 value for the suppression of DPPH radical was 9 mg/mL. The DPPH radical was more inhibited by the cumin methanol extract than by the ginger and hexane extracts, but less so than by the ginger extracts.





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Table 1: Different tests performed for the qualitative phytochemical analysis of methanolic rhizome extract of *Zingiber officinales* and *Curcuma amada*.

Qualitative analysis of methanolic rhizome extract of <i>Z. officinale</i> and <i>C. amada</i>			
Phytochemicals		<i>Z. officinale</i>	<i>C. amada</i>
Alkaloids	Mayer's test	+	+
	Wagner's test	+	+
	Hager's test	+	+
Flavoids	Shinoda test	+	+
	Alkaline reagent test	+	+
	Ferric chloride test	+	+
Saponins	Foam test	-	+
	olive oil test	-	-
Phenols	Ferric chloride test	+	+
	Lead acetate	+	+
Tanins	Bromine water test	+	+
	wohler's test	+	+
	Braymer's test	+	+
Glycosides	Liebermann's test	+	+
	Salkoowski's test	+	+
Terpenoids	Salkoowski's test	+	+
Steroids	Liebermann's test	-	-
	Salkoowski's test	+	+
Quinones	Sulphuric Acid test	+	+
Carbohydrates	Molich's test	+	+
	Burfoed's test	+	-
	Benedict's test	+	+





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Protein and amino acids	Millon's test	+	-
	Ninhydrin test	+	-
	Copper Sulphate test	+	+

Table 2: Shows the value of quantitative phytochemical analysis of methanolic rhizome extract of *Zingiber officinales* and *Curcuma amada*. Value in column shown mean with Standard deviation (\pm SD), % percentage, GAE gallic acid equivalent, TAE tannic acid equivalent.

Phytochemicals	<i>Z. officinale</i>	<i>C. amada</i>
Alkaloid (mg/g DW)	35.12 \pm 1.05	17.17 \pm 0.52
Flavonid (mg/g DW)	95.56 \pm 2.87	14.91 \pm 0.45
Saponin (mg/g DW)	-	25.12 \pm 0.75
Phenolics (mg GAE/g DW)	86.25 \pm 2.59	9.51 \pm 0.29
Tannin (mg TAE/g DW)	62.12 \pm 1.86	91.56 \pm 2.75
Carbohydrate (%)	28.11 \pm 0.84	16.59 \pm 0.5
Protein(%)	33.16 \pm 0.99	6.19 \pm 0.19

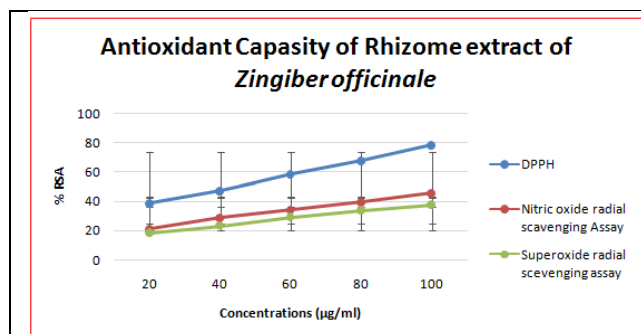


Fig. 1 : Graph showing the antioxidant capacity of methanolic rhizome extract of *Zingiber officinales*.

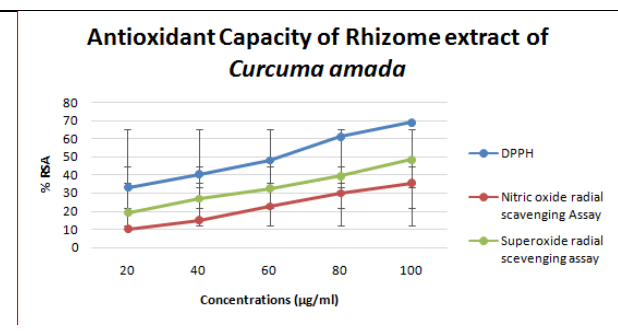


Fig. 2 : Graph showing the antioxidant capacity of methanolic rhizome extract of *Curcuma amada*.





Biocompatible Synthesis of CdSO₄ Doped Reduced Graphene Oxide(Cs-Rgo) Nanomaterials : Structural, Optical and Morphological Characterization

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ABSTRACT

Graphene oxide is a material that can be used to make capacitors, batteries, actuators, biosensors, and other devices because of its exceptional mechanical and electrical capabilities, thermal conductivity, specific surface area, and configurable band gap. Graphene oxide and reduced graphene oxide were created in this study using a green synthesis method. Due to the risky and explosive nature of hydrazine and its derivatives, a simple, inexpensive green synthesis method has been used in this work for the reduction of graphene oxide (GO). The graphene oxide that was employed in this work was initially created by oxidising graphite using a modified Hummer's process. The work investigates the use of fruit extract from *Citrus sinensis L.* to produce reduced graphene oxide (rGO) from graphene oxide in a sustainable and environmentally friendly manner. In the large-scale synthesis of rGO, the current study suggests that *Citrus sinensis L.* juice is a suitable replacement for potentially harmful reducing agents including sodium borohydride, hydrazine, and dimethyl hydrazine. To change the characteristics of the



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rGO nanomaterial, cadmium sulphate was doped into it. SEM, TEM and AFM were employed to assess the structural morphology and particle size of cadmium sulphate doped rGO (CS-rGO). The UV-visible absorption spectroscopy was used to assess the optical characteristics.

Keywords: graphene oxide; modified Hummers process; green synthesis; fruit extract; doping;

INTRODUCTION

The requirement for the sustainable expansion of green chemistry is increased by the growing environmental crisis being addressed by renovation [1,2]. Exploring materials with desirable qualities that are also derived from natural resources is therefore urgently needed [3,4]. Since many years ago, graphene and its derivatives have been employed as a successful material to address environmental issues. The newest member of the carbon family is graphene, which has a 2D layered structure and sp^2 hybridised conjugated carbon network. It is a single atom thick planar sheet that is filled with a honeycomb crystal lattice [5]. Because of its superior mechanical, electrical, thermal, and optical capabilities, graphene will be examined in various fields, including nanoelectronics, sensors, batteries, nanocomposites, supercapacitors, and hydrogen storage. Mechanical exfoliation [6], chemical vapour deposition [7], liquid-phase exfoliation [8], and chemical approach via reduction of graphene oxide (GO) [9] are efficient synthesis techniques for high-quality single-layer graphene. The most widely used technique for using reducing agents such as hydrazine [10], sodium borohydride [11] and hydroquinone [12] is chemical reduction. Therefore, the reductants are extremely poisonous and bad for the environment. By using a reduction technique to raise the cost, irreversible aggregation of graphene oxide (GO) in a soluble solution, hazardous waste of chemical agents is produced. Chemical techniques are used in all these graphene issues to restrict use. In order to overcome these difficulties, plants are being subjected to novel techniques like the biological reduction method and green synthesis method, and fruit juice or pathogens serve as environmental reducing agents [13]. Poonam Rani *et al.* have synthesised rGO from GO as a precursor and peel extract of *lemon* as a reducing agent by green chemistry approach [14]. Prema Thanapackiam *et al.* reported on comparative studies of graphene oxide and reduced graphene oxide nanomaterials. [15]. Doping reduced graphene oxide makes it into a semiconductor with a tuneable bandgap [16]. Cadmium sulphate doped reduced graphene oxide, also known as CS- rGO, could help to partially restore conductivity. The CS-rGO exhibits good electron conductivity and behaves like a semiconductor. It was the first time that cadmium sulphate was utilised as a dopant in this experiment. In this study, the impact of cadmium sulphate is examined with respect to the structural, electrical, morphological studies of rGO nanomaterial.

EXPERIMENTAL METHODS

Materials

The chemicals used were all of analytical quality and did not require further purification. They included graphite (99% acid treated), sodium nitrate (98%), potassium permanganate (99%), hydrogen peroxide (40% wt.), sulphuric acid (98%), hydrochloric acid (35%), and cadmium sulphate. Double-distilled water was utilised throughout the experiment.

Synthesis of graphene oxide

In this procedure, 4 g of powdered graphite, 8 g of P_2O_5 , and 12 ml of H_2SO_4 were combined and agitated for 6 hours. Then, 12 ml H_2SO_4 and 8 g $K_2S_2O_8$ were added, and stirring was carried out for an additional 6 hours. It was then allowed to cool before being diluted with 300 ml of double-distilled water. This mixture was filtered using a Whatman 41 filter before being dried in a hot air oven for two hours at 60 °C. Then, while stirring continuously for two hours, 2 g of this peroxidized graphite powder was gradually added to a combination of 92 ml H_2SO_4 and 12 g $KMnO_4$ together with 2 g of $NaNO_3$. Fig.1 shows the steps of preparation and prepared graphene oxide nanopowder. This liquid was diluted, and then 10 ml of 30% H_2O_2 was added drop wise. After a few minutes, 500 ml of distilled



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water was added along with this solution. While it was being filtered, it was rinsed with diluted HCl. The resulting brown suspension was then heated to 60 °C in a hot air oven before being sonicated for 10 minutes with a few drops of H₂O₂. The exfoliated GO nanoparticles are the acquired resulting solid. In order to store it for future experiments and characterizations, it was further dried in a hot air oven. In order to prepare a large amount of GO, the entire process was repeated. [17].

Synthesis of cadmium sulphate doped reduced graphene oxide (CS-rGO)

Reducing graphene oxide from graphene oxide particles has been achieved by an eco-friendly and simple experimental approach that makes use of efficient bio-extracts. In this experiment, extract from *Citrus sinensis* L., commonly referred to as orange fruit, was used. I purchased it from a local store, and I used a sanitised plastic container to squeeze out the juice. Then, to dilute it, 100 millilitres of double-distilled water was added. One mole of cadmium sulphate and one hundred milligrammes of graphene oxide were then added to the extract solution exactly. The Ultra Probe Sonicator, Model: SM150W, was used to sonicate the mixture for around thirty minutes. A black liquid was being smeared everywhere. Subsequently, the mixture was placed in an IFB 20SC2 20 L Convection Microwave Oven and centrifuged for 30 minutes at 4000 rpm, then for 10 minutes at 800 W. Consequently, rGO-doped cadmium sulphate nanomaterial (CS-rGO) was produced. The synthesised CS-rGO nanomaterial is shown in figure

Instrumentation

Using a PhilipsXL-20 electron microscope equipped with an energy dispersive X-ray analyser (EDAX), the sample's surface morphology was determined. The Nanosurf easy2 scan BT02218 profilometer was used to conduct the atomic force microscopy (AFM) examination. A Nicolet6700 FTIR spectrometer was used to analyse the synthesised sample in the 4000-400 cm⁻¹ band for the presence of functional groups. Using HRTEM: Jeol/JEM 2100, the sample's change in stacking properties and particle size were examined. A thin layer of amorphous carbon coating was applied to the sample before it was placed on a copper 200-mesh TEM grid and ready for examination. The Origin Lab 9.0 software was used to create all of the graphics.

RESULTS AND DISCUSSION**Functional groups of cadmium sulphate doped rGO**

FT-IR spectroscopic examination was performed using an FT-IR spectrometer, and the sample's recorded FTIR spectrum is shown in figure 3. A carboxylic acid group with O-H stretching vibrations is shown by the signal at 3136 cm⁻¹. Stretching vibrations of the C-C atom are visible in the peaks at 2921 and 2851 cm⁻¹. Alkene (C=C) group is associated with the peak at 1609 cm⁻¹. O-H bending mode is represented by the 1399 cm⁻¹ peaks. The dopant cadmium sulphate in rGO exhibits asymmetric stretching, symmetric stretching, asymmetric bending, and asymmetric bending, which are represented by the peaks at 1116, 1034, 618, and 460, respectively. The CdSO₄ doped rGO sample's numerous functional groups are listed in table 1 [18,19].

UV-visible spectral studies

Due to photo generated electron hole carriers in the particles, UV visible absorption spectroscopy is a valuable tool to monitor the size dependant optical characteristics of the nanomaterials. The absorbance spectra of rGO doped with CdSO₄ is seen in Figure 4. The cut-off wavelength is determined to be 282 nm from the graph. In the case of rGO, a sharp peak was seen at 273 nm, while in the case of rGO doped with CdSO₄, the cut-off wavelength is seen to be higher, indicating that the sample is more conductive. In the case of CdSO₄ doped rGO, the observation shows that the absorption is high and closely resembles the individual peaks of the material's components, indicating a strong coupling between the CdSO₄ doped with rGO (CS-rGO) sheets. For making nano porous heterojunction solar cells, this sample is hence helpful. From corresponding electronic changes inside the sample, absorption in the near UV range results. By applying the formula $E_g = 1240/\lambda$, where λ is the cut-off wavelength, optical band gap (E_g) was calculated. The result was 4.39 eV for cadmium sulphate doped rGO[15]. Due to the dopant's presence in the host





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reduced graphene oxide (rGO), CS-rGO nanomaterial has a lower band gap value than reduced graphene oxide. The values of the extinction coefficient (k), reflectance (R) and refractive index (n) of the sample have been determined by using the following relations [20,21].

$$k = \alpha\lambda/4\pi$$

$$n = \left(\frac{1}{T} + \left(\frac{1}{T} - 1 \right) \right)$$

$$R = (n - 1)^2 / (n + 1)^2$$

Figures 5, 6, and 7 show the graphs of these parameters, and, vs wavelength, respectively. The outcome shows that for CS-rGO nanomaterial, the extinction coefficient is of the order of 10^{-5} and rises as the wavelength increases. Refractive index value is seen to be rising up to 500 nm and remaining constant between 500 and 900 nm in wavelength. The sample's reflectance value is low in the UV area and steady in the visible-IR range.

SEM analysis

Using a scanning electron microscope (SEM), the surface morphological behaviour of CdSO₄ doped rGO was investigated. Figure 8 shows SEM micrographs of the sample at various magnifications. where it can be seen that there are several exfoliated layers that have been layered on top of one another to produce bulk sheets that are thick and opaque in appearance. The host CS-rGO nanomaterial's dopant cadmium sulphate material is indicated by the tiny white spots and different shapes. The sheets overlapping and merging aggregation appears to be reducing the surface area [22,23].

EDAX analysis

EDAX is an analytical method for examining the chemical make-up of several elements in a sample and figuring out how abundant they are in relation to one another. Figure 9 displays the CS-rGO nanomaterials EDAX spectrum as it was captured. The EDAX spectrum provides unequivocal confirmation of the presence of cadmium sulphate in the rGO sample. Sharp peaks in the spectrum confirm that components like Cd, O, S, and C are present. The values of the various elements' weight percentages and atomic percentages in the sample are shown in table 2. Thus, it is proven that the dopant CdSO₄ is present in the rGO nanomaterial as ions [24].

TEM images

HRTEM: Jeol/JEM 2100 was used to examine the hetero-structural morphology of the synthesised CdSO₄ doped rGO nanomaterial. Particle size and distribution morphology of the material can both be covered by TEM investigation. The sample's HRTEM images taken at various magnifications (10 nm, 20 nm, 50 nm, 100 nm, and 200 nm) are shown in figure 10. The findings show that the CS-rGO nanomaterial contains rGO sheets and layers as well as nanoparticles with sphere-like shapes. The thickness of the sheets is approximately 25 nm, while the nanoparticle size is less than 10 nm. CdSO₄ is beneficial for electronic charge transfer in rGO material [25,26].

AFM Study

An effective method, atomic force microscopy (AFM) allows for the imaging of nearly any surface, including polymers, ceramics, composites, glass, and biological samples. Adhesion strength, magnetic forces, and mechanical properties are just a few of the various forces that may be measured and localised using AFM. Figure 11 shows two-dimensional and three-dimensional topographical images of the CdSO₄ doped rGO nanomaterial show that the sample is made up of sheets and agglomerated granular-sized particles [27,28].





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CONCLUSION

In this work, green synthesis was used to create cadmium sulphate-doped reduced graphene oxide (CS-rGO) nanomaterial. The advantages of this activity include its low cost, avoidance of dangerous reducing chemicals, lack of hazardous waste, and excellent purity of the usable nanomaterial. The presence of all the anticipated functional groups is confirmed by the IR spectra. Utilising the UV-visible optical data, the linear optical characteristics of the CS-rGO nanomaterial, including absorbance, extinction coefficient, refractive index, and reflectance, were assessed. SEM, TEM and AFM examinations were used to analyse surfaces. The TEM pictures of the CS-rGO sample show that there are well-dispersed cadmium sulphate particles on the nanosheets.

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Table 1: FTIR data and functional group assignments for cadmium sulphate doped rGO nanomaterial

Wave number (cm ⁻¹)	Spectroscopic assignments
3136	O-H stretch
2921, 2851	C-C stretching
1609	Alkene (C=C)
1399	O-H bending
1116	Asymmetric stretching of sulphate ion
1034	Symmetric stretching of sulphate ion
618	Asymmetric bending sulphate ion
460	Symmetric bending of sulphate ion

Table 2: Values of wt% and atomic weight % of elements in CS-rGO nanomaterial

ELEMENT	LINE TYPE	WT%	ATOMIC WEIGHT%
C		52.10	61.68
O	K series	27.75	30.59
S	K series	7.58	4.17
Cd	L series	11.67	3.55

Figure 1: Synthesized GO solution and GO powder

Figure 2: Synthesised CdSO₄ doped rGO powder





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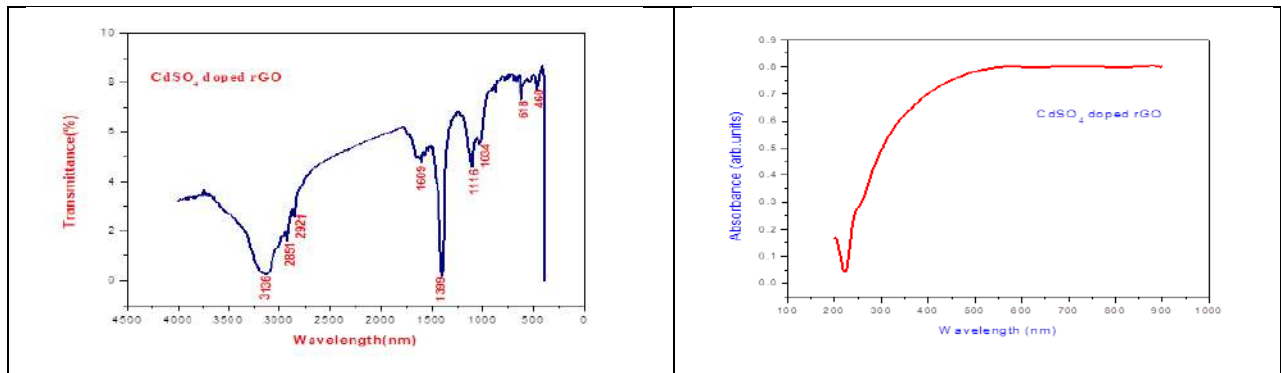


Figure 3: FTIR spectrum for CdSO₄ doped rGO nanomaterial

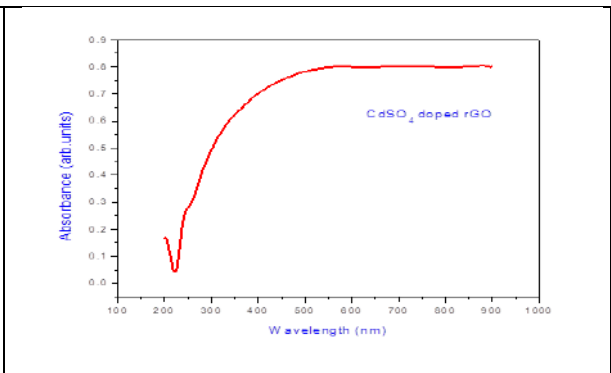


Figure 4: UV-visible absorption spectrum of CdSO₄ doped rGO nanomaterial

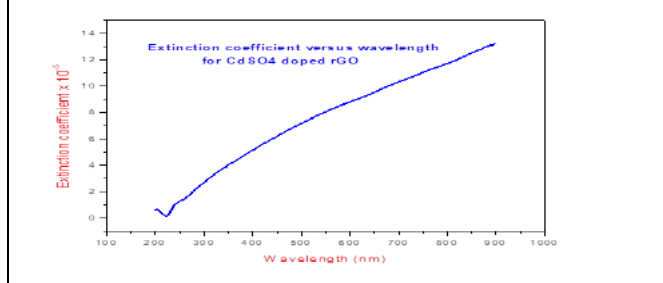


Figure 5: Plot of extinction coefficient versus wavelength for CdSO₄ doped rGO nanomaterial

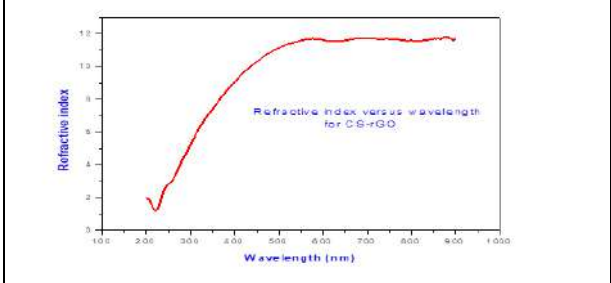


Figure 6: Plot of refractive index versus wavelength for CdSO₄ doped rGO nanomaterial

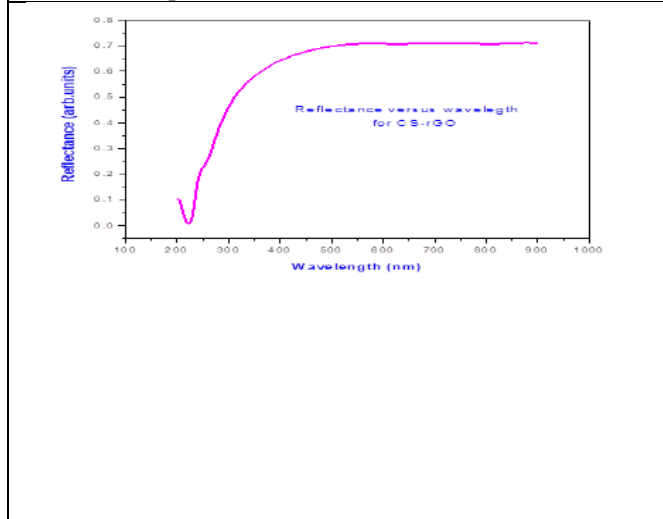


Figure 7: Plot of reflectance versus wavelength for CdSO₄ doped rGO nanomaterial

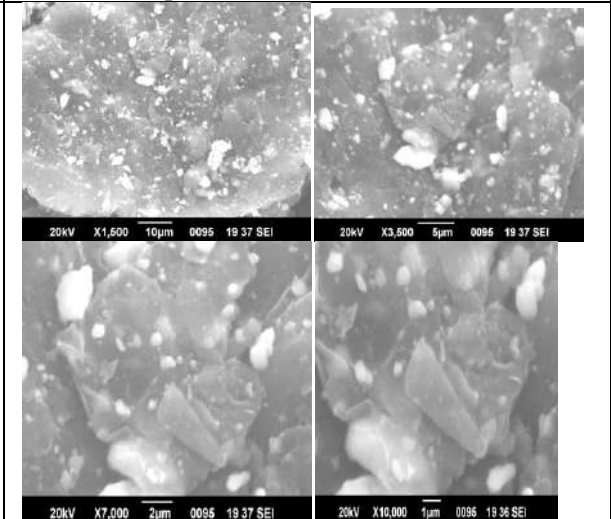


Figure 8: SEM images of CdSO₄ doped rGO nanomaterial





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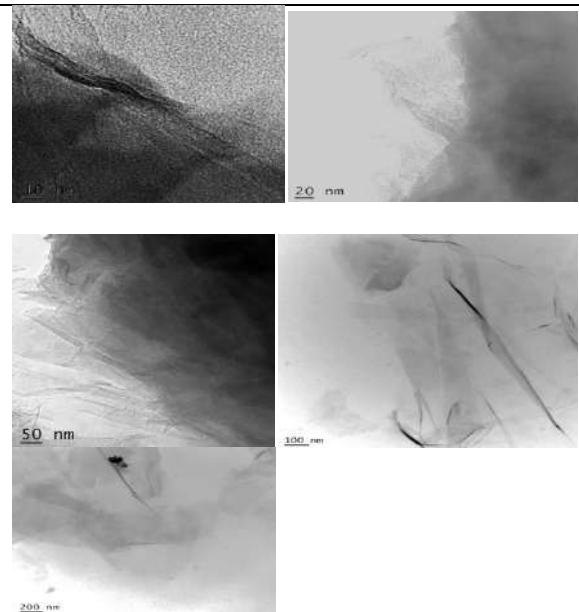
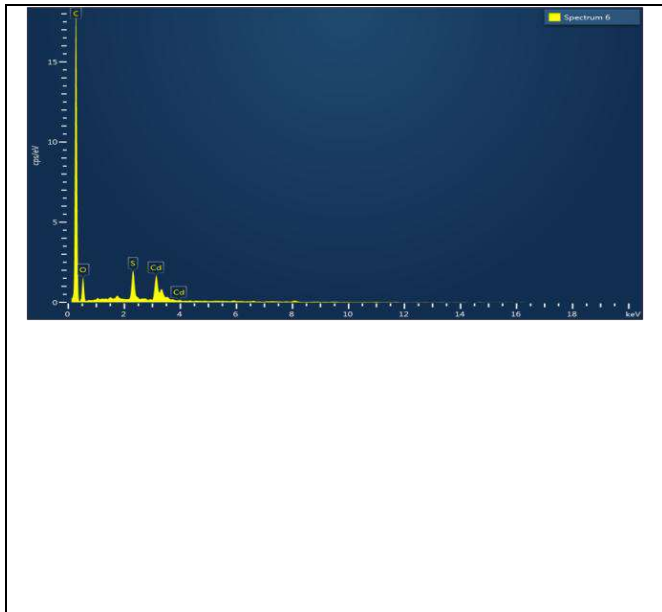


Figure 9: EDAX study for CdSO₄ doped rGO nanomaterial

Figure 10: TEM images of CdSO₄ doped rGO nanomaterial

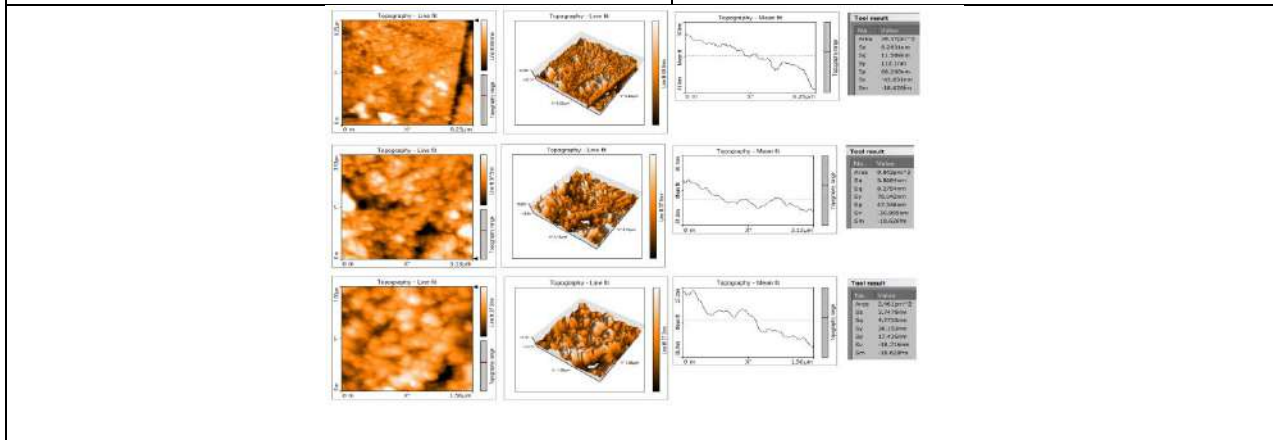


Figure 11: AFM images for CdSO₄ doped rGO nanomaterial





The Effect of Integrated Nutrient Management Approach in Vegetable Crops

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ABSTRACT

Integrated nutrient management (INM) provides a good opportunity to increase vegetable and crop production. INM is a good source to maintain soil fertility power and basic nutrient supply of plants to increase vegetable production through optimization of benefits from all origins of all essential nutrients of plants. Integrated Nutrient Management (INM) is a scheme under which the safest system for the decomposition of vegetable residues is so that the balanced and integrated use of organic and chemical fertilizers to maintain the nutrient and soil fertility power for the vegetable By which high quality fertilizer can be produced and the yield of vegetables and crops increase. Integrated nutrient management involves providing the plant with an optimal level of nutrients needed to keep yield and productivity at a good level. A variety of organic materials such as farm yard manure (FYM), compost, vermi-compost, green manure, crop residues, and industrial wastes have been used in vegetable systems to provide essential nutrients to plants.

Keywords: INM, Vegetable, organic, FYM

INTRODUCTION

Vegetables are widely acknowledged as a crucial supplement for maintaining excellent health and ensuring nutritional security. They are important sources of vitamins, minerals, carbs, proteins, and roughages. An individual's daily need for a balanced diet may be easily satisfied by eating 125 grammes of leafy vegetables, 100 grammes of root and tuber vegetables, and 75 grammes of miscellaneous vegetables per day. Radish, carrot, chilli,



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cabbage, and other vegetables serve an important function in delivering nutrients to humans. Organic matter such as FYM, vermicompost, and chicken manure are now required for integrated nutrition management. Chemical and fertilizer-based agricultural technologies have been introduced to meet the ever-increasing demands for food supply from an ever-increasing population Kumar et al. (2020). The organic production system aims at supporting and sustaining healthy ecosystems, soil, farmers, food production, the community, and the economy. Reduction and elimination of the adverse effects of synthetic fertilizers and pesticides on human health and the environment is a strong indicator that organic agriculture is gaining worldwide attention. Organic fertilizers are environmentally friendly, since they are from organic sources Islam et al. (2017). India has emerged as the second largest producer country in the world. The current level of vegetable production is not complete with increasing population.

The level of vegetable production is convenient at the present time, but keeping in mind the future demand, we will require good resource management. It is estimated that in the year 2025, vegetable need / require will be 225 million tonnes against the limit of increase of cultivable area Bhat et al. (2018). So, all the need to fulfillment of higher yield production of vegetables and crop also, we should be going to INM approach. In present day, heavy doses of chemical products are used by farmers for getting higher yield but these synthetic products decrease the soil fertility, causes effects on both environment and human health. Therefore, Integrated nutrient management creates a good platform for future vegetable production, crop production and soil fertility, which supplies the essential nutrients of crops, Nutrient supply, Can be done with organic manure, compost / vermi-compost, crop residues, green manure, bio-fertilizer etc. Integrated nutrient management (INM) provides a good platform to increase soil fertility and crop productivity. Maintain required crop production through development of profit from all sources of plant nutrients in an incorporated manner adjustment or maintenance of mud fertility Kumar et al. (2019). Vermicompost is known as a good soil fertilizer that makes it the best organic soil fertilizer and more environment friendly than inorganic fertilizers. It can raise the amount of production of fruits and vegetables and save them from harmful pest and disease without polluting the environment Joshi et al. (2015).

Why INM is need in vegetable crops

The texture of the soil is deteriorated as a result of continuing use of chemical fertilizer. The recent high fertilizer amount and less receives power of the agricultural community has made it necessary to rethink about alternatives. Unlike inorganic- organic fertilizer are available locally at lower rate Kumar et al. (2018).

Concept of Integrated nutrients management

These continuous and disequilibrium use of fertilizer is more affect the agricultural growth. The major cause for the agricultural production would be management of soil organic carbon and balanced use of organic inputs such as crop residues, animal manure, folic acid, green manure also known as integrated plant resource management. Since bio- manure cannot fulfill the total nutrient requirement of new agriculture, hence integrated use of nutrient from bio sources and fertilizer would be the need of the time.

Components of Integrated nutrient management**Organic Manure**

One of the most important and frequently used organic fertiliser components in INM is organic manures. Farmyard manure, compost, vermin compost, sheep dung, chicken manure, night soil, oil cakes, and animal excrement are all examples of organic manures. According to estimates, India produces 17.82 million tonnes of organic manures per year, which is 8.0 million tonnes less than what is needed to produce 2.30 million tonnes of food. Organic manures' nutrient content cannot be compared to that of inorganic fertilisers. However, compared to other nutrient sources, poultry manure, vermicompost, and oil cakes all contribute significantly to preserving soil fertility by altering the physico-chemical composition of the soil Bhat et al. (2018).

Farm yard manure (FYM)

It is composed of dung and urine of animals. FYM is applied to vegetable crops as organic manure. Since there are many helpful microorganisms in FYM that secrete chemicals that act as growth regulators and promote soil structure



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or soil fertility as well as plant growth, FYM provides all of the needed nutrients to the plant. Additionally, it is enhancing microbial activity, cation exchange capacity, and water holding capacity. It contains, on an average NPK (0.5%, 0.2%, and 0.5%) Rani et al. (2021)

Compost

It is developed after decomposed of bio- matter is called compost. Farm wastes like paddy straw, mustard stump or other like materials are commonly used by farmer for making compost. In difference, compost made from Night soil is known as town compost. Farm compost contains NPK 0.5 %, 0.5 %, and 0.5 %. Town compost are contains NPK (1.4 %, 1.00 %, and 1.4 %).

Vermi-compost

These are developed using Earthworm. The earthworm consumes organic matters and excretes it as cast. This cast use as vermin-compost. On an average it contains NPK (3 %, 1 %, and 1.5 %)

Bio fertilizer

Azotobacter and Phosphate solubilises these two are the main bio-fertilizer in vegetables cultivation. Azotobacter is independent nitrogen fixing bacteria which fixes 25- 30 kg N/hect. It also produces hormone like Indole Acetic Acid and Vitamins like biotin and B-group is also formed. The application of azotobacter with organic matter ensures good germination, development and production.

Inorganic fertilizer

It is an inorganic matter which is manufacture unnaturally. Fertilizers are affluent resource of nutrient and use in growth and crop production to supply a main nutrient in soil is scarce. It is very fast release the nutrient and help in early establishments and development of plants.

Goals of Integrated nutrient management

1. To cut expenditure on cost of by use farm bio manure and crop residue etc.
2. To use the potential profit of bio manures and crop residue.
3. To prevent loss of the nature.
4. To meet the socio-economic necessity of the farmer without harms the base of soil. Vinay et al. (2020).

Advantages of Integrated Nutrient Management:

1. Integrated nutrient management is economically profitable.
2. Helps in the management of nutrient, benefiting the earth productivity via favourable impact on biological properties of soil.
3. It give guarantee to regular supply of secondary nutrients
4. The quality and yield are improved due to their positive effect on soil properties.
5. INM not only raise the production but it also helps in maintain the soil fertility.
6. INM increased the yield of crops but has exhibited beneficial residuary impact on crops.

CONCLUSION

The strapping and over usage of in organic fertilizers had effected, human and soil health, besides creating serious effect of environmental pollution. The farmers are also seeing for lower cost input alternative mainly of NPK fertilizer, which constituted a main component. Hence the use of INM becomes crucial for higher vegetable and crop production, soil health and quality. In future, produce more vegetables for increasing population under limited plant resource. Sustainability advocates an integrated use of various production resources in a manner to description





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productivity on another to protection earth health and quality. The high crop produces through INM will not only be higher in bulk but also rise in quality in terms of nutrition.

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INM in some commercial vegetable crops

Crop	INM Option	
Brinjal (<i>Solanum melongena</i>)	75% recommended dose of fertilizers + FYM @ 7.5 t ha ⁻¹ + pressmud @ 4.5 t ha ⁻¹ + vermicompost @ 1.5 t ha ⁻¹ + biofertilizers (<i>Azospirillum</i> and <i>Phosphobacteria</i>) can be resorted to, for higher yields and quality of brinjal.	Poonkodi et al.(2019)
Tomato (<i>Lycopersicon esculentum</i>)	<i>Application of FYM @ 8t/ha gives highest yield production (9.57t/ha)</i>	Hussein et al. (2018)



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Bell pepper (Capsicum annum)	Basal applications of N equivalent (150 kg/ha) through 50 % each FYM and poultry manure were found most superior in improving the physicochemical properties of the soil.	Ganiger et al. (2012)
Okra (Abelmoschus esculentus)	Highest yield of okra was recorded in the treatment comprising 100% recommended NPK + vermicompost @ 10 t ha ⁻¹ ,	Sharma et al.(2009)





The Relationship of Social Media Addiction, Online Impression Management and Fear of Missing out in Indian Youth

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ABSTRACT

Humans have basic desire for connection, and interpersonal contact is necessary to meeting these needs. Interpersonal communication has seen a transformation in recent years as a result of the rise of technological advances, particularly the growth of social media. People who communicate online, just like those who do so in person, are always looking to learn more about one another so that they may anticipate what to expect and how to respond. People may be planning their actions and behaviors deliberately or unconsciously because they want to control the impressions they are about to give others. They spend more time on platforms because they are concerned about losing out on new advancements causing them to experience FOMO. The aim of this research was to test the relation of social media addiction with online impression management and FOMO. A survey was administered collecting the data of 130 young adults. After conducting a correlation analysis, a strong relationship was discovered among the variables.

Keywords: Social media addiction, online impression management, FOMO, social media, young adult

INTRODUCTION

Social networking sites (SNS) are networks in which people may make online profiles of them, interact with friends, and connect with individuals who share their passions. SNSs are “web-based services that allow individuals to: construct a public or semi-public profile within a bounded system, articulate a list of other users with whom they share a connection, and view and traverse their list of connections and those made by others within the system”[1].



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Instead of networking, which calls for the creation of fresh networks, the emphasis is on existing networks. In 1997, the first SNS called “Six Degrees” was released. In 2004, “Facebook” was created as a private online community for the students of Harvard but it soon become available and popular worldwide. Similar to addictions to other substances, SNS addiction includes the signs of dependency such as “modifying one's mood” (using SNSs results in a positive change in sentimental conditions), “salience” (preoccupation with the SNS usage), “tolerance” (constantly using SNSs), “withdrawal symptoms” (experiencing uncomfortable emotional and physical symptoms when SNS use is restricted), and so on. Additionally, researchers have proposed that the etiology of addictions is influenced by a variety of “biological, psychological, and social” variables [2, 3], and this may also be relevant to SNS addiction. In this study, we will be focusing on “fear of missing out” (FOMO) which is a psychological perspective, “online impression management” (OIM) which is a social perspective and their relationship with “social media addiction” (SMA).

Social Media Addiction

SMA may be observed as a type of “Internet addiction” where people have an excessive need to utilize SNS [4]. People who have this addiction display excessive anxiety and are prompted by an overwhelming feeling to access and utilize SNS [5]. According to findings, SMA indicators might include issues with mood, cognitive, bodily symptoms and mental health issues. Numerous researches on the link among SNS use and psychological health showed that extended usage is detrimental to overall wellness as well as related to psychological conditions like anxiety, depression, and distress [6, 7, 8, 9]. Among college kids, SNS use was strongly correlated with signs of depression [10,11]

Online Impression Management

“Virtually everyone is attentive to, if not explicitly concerned about how he or she is perceived and evaluated by other people” [12], the act of impression management is based on this concern. To understand “theatrical performances” we engage in during regular social contact to influence how others see us, Goffman developed the theory of impression management [13]. It asserts that individuals make an effort to control how others see them by controlling their behavior and language. Because SNSs, like Facebook and Instagram are devoted to establishing and controlling impressions along with participating in relationship maintenance and relationship-seeking behaviors, they are of significance for researchers [14].

Fear of Missing Out

“Fear of Missing Out” also known as FOMO is defined as, “a pervasive apprehension that others might be having rewarding experiences from which one is absent, and it is characterized by the desire to stay continually connected with what others are doing” [15]. High FOMO individuals need frequent social interaction and knowledge about what other individuals are up to [16, 17]. A fundamental psychological desire that governs how people act is an urge to fit in, to feel near to and linked to people [18]. According to research [15], one's FOMO tends to rise if their psychological demand for connection isn't being met. SM, which allows users to constantly keep in contact with their peer group, serves as a handy outlet for this increased FOMO.

Hypotheses

H1: There will be a significant positive correlation between Online Impression Management and Social Media Addiction

H2: There will be a significant positive correlation between Fear of Missing Out and Social Media Addiction

METHODOLOGY**Materials**

SMA was measured using the, “Social Media Addiction Scale” developed by Şahin [19]. The measure consisted of 29 questions. The second scale used to measure OIM was “Presentation of Online Self Scale (POSS)” made by Fullwood and colleagues [20]. Scale consists of 21 questions. FOMO was measured by “Fear of Missing Out Scale: FoMOs”



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developed by Przybylski and colleagues [15]. The measure has 10 questions. The responses of all the scale were recorded on a likert scale of 5 point. The scales consisted of good reliability and validity [15,19,20].

Sample and Data Collection

The sample of the study consists of young-adult age group from India. Convenience sampling technique was used in this research. Data was collected using Google forms. The form was prepared using the scales and contained instructions on how to response. A total of 130 participants consented to being part of the study out of which 70 participants were females and 60 were males.

Statistical Method

Descriptive Statistics and Correlation was employed in the study. 0.01 level was used to test the significance.

RESULTS

In the result tables displayed, SMA is “social media addiction”, OIM is “online impression management” and FOMO is “fear of missing out”. The mean, SD, minimum and maximum values of the variables are displayed in Table 1. The inter-correlations among the variables are displayed in Table 2. There is correlation between SMA and OIM at .740 and between SMA and FOMO at .532 as per the analysis.

DISCUSSION

While the consequences of “Internet addiction” have been thoroughly studied across many years, research on SNS and its related categories has only recently begun. Despite several signs of addiction, such as unfavourable effects, fixation, and withdrawal, a review of SMA studies in 2014 concluded that its validity was still up for question [8]. The objective of this study was to examine the relationship of SMA with OIM and FOMO. To investigate this, a quantitative research was carried out. This method of research is concerned with collecting and analyzing data and then presenting it numerically [21]. Data was gathered with the use of Google forms. 130 people participated in the study. The collected data was analyzed using SPSS. The mean and SD for SMA was 72.26 and 17.36, for OIM was 52.63 and 10.84 and for FOMO was 19.12 and 7.31 respectively. To determine the relationship between SMA, OIM and FOMO a test of Pearson correlation was conducted. Correlation is defined as, “a relation existing between phenomena or things or between mathematical or statistical variables which tend to vary, be associated, or occur together in a way not expected by chance alone” [22]. Pearson is a type of bivariate correlation that examines relation among two variables. Correlation between SMA and OIM was at .740 which means it is a significantly positive relationship which confirms H1. In order to manage impression, people engage in the usage of SNS more than they should which causes both variables to move in the same direction. Similar results were found in researches conducted previously where OIM was strongly connected to SMA [23,24]. The correlation between SMA and FOMO was at .532 which means it is a significantly positive relationship which confirms H2. People experience apprehension on missing out any information on SNS. They constantly use their accounts to stay updated which is why both variables move in the same direction. Previous studies have found similar results suggesting a good relation among SMA and FOMO [25, 26].

CONCLUSION

The goal of this paper was to determine the relationship of SMA with OIM and FOMO. As per the analysis conducted, a strong correlation was found between the variables. Researchers should further investigate in this field since SNS is a fast growing phenomenon in these times of advanced technology. The area of research should be broadened to deeply understand the effects of these variables on the overall well-being of people.





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Table 1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SMA	130	29	145	72.26	17.368
OIM	130	33	97	52.63	10.841
FOMO	130	10	50	19.12	7.319
Valid N (listwise)	130				

Table 2: Correlations

		SMA	OIM	FOMO
SMA	P Correlation	1	.740**	.532**
	Sig. (2-tailed)		.000	.000
	N	130	130	130
OIM	P Correlation	.740**	1	
	Sig. (2-tailed)	.000		-
	N	130	130	
FOMO	P Correlation	.532**		1
	Sig. (2-tailed)	.000	-	
	N	130		130

** . Correlation is significant at the 0.01 level (2-tailed).





A Study on Consumer Perception towards Organic Products in Coimbatore City

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ABSTRACT

This study attempted to gain knowledge about consumer perception towards organic products consumption and how socio-economic variables related to consumer decision-making while purchasing an organic food. The primary data will be used from selected consumers on Simple Random sampling techniques, with the help of questionnaire. According to the findings, the majority of consumers, particularly those living in cities, Choose an organic food product. Promotion of organic products are in short supply in the research area, there is a high demand for them. The main reasons are a lack of organic producers, a lack of suitable market facilities, a small number of retailers, a lack of knowledge, and so on

Keywords: Organic products, consumer satisfaction, Usage, Perception.

INTRODUCTION

There's no common description of "organic" due to the fact that different countries have different standard for products to be certified "organic". In simplest words organic foods are minimally reused to maintain the integrity of the organic without artificial constituents, preservatives or irradiation. Organic products are attained by processes friendly to the terrain, by civilization ways that consider both the attributes of the final product and the product styles. A wide range of consumers of organic product were addressed and scanned to gain their compliances and fancies towards organic products. All organic products consumers aren't having the same system of approach towards organic food. latterly the statistical process guides us to comprehend the relation and the model of the consumer gets trends in organic food in India. The description of the word "Organic", an ecological operation product system that promotes and enhances biodiversity, natural cycles and soil natural exertion. Ajzen and



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Fishbein(1980), in their study, mention that ‘consumers with a positive station ’ towards organic foods might not inescapably show an intention to buy them; also, consumers don't agree to pay a decoration price for organic food products(Grunert & Juhl, 1995). On the other hand, some exploration regarding green consumers tries to explore the contributing motives in order to prognosticate consumer opinions and intentions to buy organic products. The most astronomically anatomized motives and factors affecting consumer purchases of organic products are health(Ghali-Zinoubi & Toukabri, 2019), environmental issues(Kim & Choi, 2005; Mei, Ling, &Piew, 2012; Prakash, Singh, & Yadav, 2018), produce safety, and its quality(Ghali- Zinoubi&Toukabri, 2019). Health issues are the main motive in some experimenters’ works. Sumathi and Gabriel(2017) argue that consumers perceive organic products as environmentally-friendly food products; similar food products are fresh, aseptic, and healthy. For the once many times, people have come more health-conscious and started approaching dietitians, nutritionists, gymnasiums, etc. The raised concern to maintain a healthy life has also shaped consumer stations towards food; thus, food without unsafe complements, preservatives, flavor and coloring has come popular(Shaharudinetal., 2010). According to a recently forming perception, aseptic and nutritive food gave good results for mortal 274 Exploring the Link Between Entrepreneurial Capabilities, Cognition, and Actions Marta Gancarczyk& Anna Ujwary- Gil(Eds.)

OBJECTIVES OF THE STUDY

1. To understand the consumer ‘s knowledge, perception and attitude towards organic products.
2. To analyze the factors influencing consumer behavior towards organic products.
3. To examine the consumers ‘willingness to pay for organic products

METHODOLOGY

The study is based on primary study. The primary data will be used from selected consumers on Simple Random sampling techniques, with the help of questionnaires. A sample of 30 consumers of organic products in Coimbatore city. To understand the demand factor in organic products and the consumers’ perception towards it in Coimbatore city.

DATA ANALYSIS AND INTERPRETATION

The above table 1 reveals that the 50 percent of Respondents were belonging to Male, remaining of the 50 per cent of the respondents were Female. Both male and female respondents were purchased organic products. The table 2 shows that 63.3 % of the respondents are married, 30% of respondents are unmarried, 6.7 % of respondents are widow. The table 3 shows that preferences for organic products among respondents in the study area. All the respondents preferred organic products and they are consuming the same, in the opinion that using of organic products, maintenance of good health. From the above table it is found that most of the respondents are aware of the organic products. Few respondents were not aware of organic products because the reasons for consuming organic products are credibility and availability.. The above table representing that 80% of respondents are satisfied in using organic products. 20% of respondents are not satisfied because of more expensive to buy the organic products than non-organic products. Many people believe that organic products do not allow the use of ant chemical. From the above table it is found that 63.3 % are afford to buy the organic products, but 36% of respondents can't afford for organic products due their less income. The table 7 represents 66.7 % respondents are gained Good Experience in the usage of an organic products in their daily basis, 16.7 % not satisfied, 16.7 % respondents are not experienced in using organic products. The table 8 shows that 43.3 % of respondents are using organic products, 20% of respondents are not experience is using organic products it is seen that the consumers prefer to buy organic food products, there are various factors impacting the preference. The table explains whether there is opinion on organic products, 13.3 % respondents said is only average opinion on organic products, 50% of respondents said that it is affordable to use the products, 36.7 % said its id costly to buy the organic products, hence it is based on their experiences to use the organic products. The table explains that the 43.3 per cent of the respondents said they are purchasing the organic



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product, monthly once, 26.7 per cent respondents are buying 6 month once and few respondents are not using the organic product in their lives.

FINDINGS

The above analysis inference was drawn and the findings emerged out of study are:

- In this study both male and female respondents were purchased organic products.
- Most of the respondents are married i.e.63.3 %.
- All the respondents preferred organic products and they are consuming the same, in the opinion that using of organic products, maintenance of good health.
- It is found that most of the respondents are aware of the organic products. Few respondents, they are not aware of organic product.
- Majority of respondents are satisfied in using organic products, for their healthy life.
- Our study shows that 63.3 % are afford to buy the organic products.
- It revealed that most of the respondents said that 66.7 % experienced in using the organic products in their daily basis.
- Majority of respondents are using organic products in their daily basis for healthy life.
- Only 50 per cent of respondents said that it is affordable to use the products.
- Most of the respondents are said they are purchasing the organic product monthly once, because the product demand is increasing and cost also increased.

CONCLUSION

Thus, this study concluded that consumer behaviour is important when purchasing any product, not only organic products. So the supply of organic shops and products is limited, but the demand for it is high, so farmers and the government are thinking about improving or growing production of organic et system, which helps to enhance the standard of living for farmers while also being beneficial for the environment. The sale of organic products is on the rise. Organic food marketers must be imaginative and dynamic in order to keep up with the changing purchasing habits of urban inhabitants in the Organic food goods market.

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Krishnaveni *et al.*,**Table 1: The Classification of Respondents Based on Gender**

Gender	Frequency	Percent
Male	15	50.0
Female	15	50.0
Total	30	100.0

Source: Primary data

Table 2: The classification of Respondents on their Marital Status

Marital status	Frequency	Percent
Married	19	63.3
Unmarried	9	30.0
Widow/Separated	2	6.7
Total	30	100.0

Source: Primary data

Table 3: Preference for Organic products, among respondents

Preference organic product	Frequency	Percent
Yes	30	100.0
No	0	0
Total	30	100.0

Source: Primary data

Table 4: Aware of Organic products, among respondents

Aware of organic food	Frequency	Percent
Yes	26	86.7
No	4	13.3
Total	30	100.0

Source: Primary data

Table 5: Satisfaction of Organic products, among respondents

Satisfaction	Frequency	Percent
Yes	24	80.0
No	6	20.0
Total	30	100.0

Source: Primary data

Table 6: Affordable of Organic products, among respondents

Affordable	Frequency	Percent
Yes	19	63.3
No	11	36.7
Total	30	100.0

Source: Primary data

Table 7: Experience in Organic products, among respondents

Experience	Frequency	Percent
Good	20	66.7





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Satisfied	5	16.7
No Experience	5	16.7
Total	30	100.0

Source: Primary data

Table 8: Usage in Organic products, among respondents

Usage	Frequency	Percent
Good	13	43.3
Satisfied	4	13.3
Comfortable	7	23.3
No Experience	6	20.0
Total	30	100.0

Source: Primary data

Table 9: Opinion on Organic products, among respondents

Opinion	Frequency	Percent
Average	4	13.3
Affordable	15	50.0
Costly	11	36.7
Total	30	100.0

Source: Primary data

Table 10: Purchasing of Organic products, among respondents

Purchasing	Frequency	Percent
Weekly	4	13.3
Monthly	13	43.3
6Months Once	8	26.7
Not Yet Used	5	16.7
Total	30	100.0

Source: Primary data





Qualitative and Quantitative Analysis of the Unexplored fern, *Thelypteris meeboldii* from Southern Western Ghats, Tamil Nadu

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ABSTRACT

The present study was to screen the presence of phytochemicals in the petroleum ether, chloroform, ethyl acetate and methanol of fern *Thelypteris meeboldii* species by composed with qualitative and quantitative screening methods. In qualitative analysis, the presence of pharmacologically active phytochemicals such as alkaloids, flavonoids, glycosides, steroids, tannins, terpenoids, saponins, phenols, volatile oils and resins were screened. The methanol fern extract performed well to show positivity rather than other studied fern extracts. Methanol extract showed strong positivity for 6 phytochemicals out of 10 phytochemicals tested. In quantitative analysis the important secondary metabolites such as total phenols, total tannins, total alkaloids, total flavonoids, total saponins and total terpenoids content were quantified.

Keywords: phytochemicals, qualitative, quantitative, *Thelypteris meeboldii*, methanol.





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INTRODUCTION

Pteridophytes are an old class of non-seed-bearing plants that are considered to be important in biogeography due to the abundance of extinct and endemic taxa they include. The pteridophytes are typically found in a latitudinal gradient, with the largest diversity occurring primarily in mountainous regions of the tropics (Kornas, 1993). They have a small distribution in temperate zones and are mostly found in tropical and subtropical climates (Pallavi et al., 2011). Ferns have observable characteristics that could reveal how environmental changes have an impact on them. The ferns are plants with a dynamic link to their environment in addition to being taxonomically peculiar (Verma and Khullar, 2010). More than 2,000 years of human history have seen the use of plants as folk medicine and there is a wealth of literature on the therapeutic value of different fern species (Kirtikar and Basu, 1935; Nayar, 1957; Chopra et al., 1958; Kumar and Roy, 1972; Watt, 1972). Seldom have systematic studies of fern's therapeutic uses been conducted that are not pharmacologically assessed (Kandhasamy et al., 2008; Kaushik and Dhiman, 1995; Dixit and Bhatt, 1974; Manickam and Irudayaraj, 1992). There is a huge demand for exploitation of pteridophytes for their economic utility in day-to-day life because of their enormous economic importance (Benjamin and Manickam, 2007). Within the recent years, infections have increased to a great extent and the infection causing microbes developed resistance to therapeutics, such as antibiotics and antimicrobial drugs, has increased the demand for more effective antimicrobial agents. Various groups of medicinal plants have a potential to cure different disorders such as cuts, burns and skin diseases, which is due to their antimicrobial activities. The use of the extracts of these medicinal plants alone, or in combination with the available antibiotics, might contribute to more successful treatment of infections induced by multi drug resistant microorganisms. Recently, some fern species (Pteridophytes) have been identified to possess therapeutic potential, mainly due to the presence of various bioactive phytochemicals, such as phenolics and steroids (Ho et al., 2010; Chai et al., 2013; Antonysamy et al., 2014, 2020). Therefore, it is of great interest to carry out a screening of the selected fern species in order to validate their use in folk medicine. Systematic screening of them may result in the discovery of novel active compounds.

MATERIALS AND METHODS

Collection and Identification of Plant materials

Healthy and matured plant material for the present study was collected from Valparai Hills, Western Ghats. The collected specimen was identified and authenticated by Dr. M. Johnson, Director, Centre for Biotechnology, St. Xavier's College, Palayamkottai, Trichy with reference no (CPB2095). The collected specimen was identified as *Thelypteris meeboldii* (Rosenst.) Holttum.

Preparation of sample

The fronds of selected fern used for phytochemical screening were washed multiple times with tap water and further with distilled water to remove fine impurities. Leaves were shade-dried for 30 days to remove all the moisture content and to preserve maximum of the bioactive compounds. The dried fronds were cut down into small pieces of size up to 1-2 cm. The cut down parts were crushed using a laboratory blender and then sieved through a mesh size of 3 mm in order to remove the coarse materials. The fine powder was then packed in an airtight container, labelled and stored for further studies.

Preparation of extract

Organic solvents in the increasing order of polarity (Petroleum ether, Chloroform, Ethyl acetate, Methanol) were used to extract the powder sample of *Thelypteris meeboldii* according to the method described by Harbone, 1998. The sample were sequentially extracted using a soxhlet apparatus at a temperature (40-50°C) and was subjected to detect the presence of different phyto constituents.



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Phytochemical screening of the extracts was carried out according to standard procedure. The Qualitative phytochemical analysis was carried out for the frond extract of *Thelypteris meeboldii* according to the polarity to identify the phytochemicals present in the different extracts. The tests performed were alkaloids, glycosides, volatile oils, steroids and resins (Shakoor *et al.*, 2013); phenols, flavonoids and saponins (Kalpana Devi *et al.*, 2014); tannins, anthraquinones and terpenoids (Shinde *et al.*, 2016).

Quantitative phytochemical screening

Alkaloids, Phenols, Tannins, Flavonoids, Saponins and Terpenoids reported in the methanolic extracts of *T.meeboldii* was quantified using the following standard procedures.

Determination of total alkaloids

5 g of the sample was weighed into a 250 ml beaker and 200 ml of 10% acetic acid in ethanol was added and covered and allowed to stand for 4 h. This was filtered and the extract was concentrated on a water bath to one-quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the precipitation was complete. The whole solution was allowed to settle and the precipitated was collected and washed with dilute ammonium hydroxide and then filtered. The residue is the alkaloid, which was dried and weighed (Harborne 1973). Triplicate results were recorded.

Determination of total phenols

100 mg of the extract of the sample was weighed accurately and dissolved in 100 ml of triple distilled water (TDW). 1 ml of this solution was transferred to a test tube, then 0.5 ml 2N of the Folin-Ciocalteu reagent and 1.5 ml 20% of Na_2CO_3 solution was added and ultimately the volume was made up to 8 ml with TDW followed by vigorous shaking and finally allowed to stand for 2 hours after which the absorbance was taken at 765 nm. The results were expressed in mg of gallic acid equivalent (GAE) per g of dry weight of plant powders (Hagerman *et al.*, 2000).

Determination of total tannins

Tannin content of the methanol extract of the fern was estimated by following the standard procedure (Hagerman *et al.*, 2000; Fagbemi *et al.*, 2005). The 1 ml of methanol fern extract was mixed with Folin-Ciocalteu's reagent (0.5 ml), followed by the addition of saturated Na_2CO_3 solution (1ml) and distilled water (8 ml). The reaction mixture was allowed to stand for 30 min at room temperature. The supernatant was obtained by centrifugation and absorbance was recorded at 725 nm using UV-Visible Spectrophotometer. Increasing concentrations of standard tannic acid was prepared and the absorbance of various tannic acid concentrations was plotted for a standard graph. The tannin content was expressed as mg tannic acid equivalent per 100 gram of the sample.

Determination of total flavonoids

The method is based on the formation of the flavonoids-aluminium complex which has an absorptivity maximum at 415nm. 100µl of the plant extracts in methanol (10 mg/ml) was mixed with 100 µl of 20% aluminum trichloride in methanol and a drop of acetic acid, and then diluted with methanol to 5ml. The absorption at 415 nm was read after 40 minutes. Blank samples were prepared from 100 ml of plant extracts and a drop of acetic acid, and then diluted to 5ml with methanol. Increasing concentrations of standard quercetin solution was prepared and the absorbance of various quercetin concentrations was plotted for a standard graph. All determinations were carried out in triplicates (Kumaran and Karunakaran, 2006).

Determination of total saponins

An amount of 10 g of each extract was taken and 50 ml of 20% aqueous ethanol was dissolved. The samples were heated and continuously stirred for four hours at 55°C under water bath. The mixture was filtered and the residue re-extracted with another 200 ml 20% ethanol. The combined extracts were reduced to 40 ml over water bath at about 90°C. The concentrate was transferred into a 250 ml separatory funnel and 20 ml of diethylether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process



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was repeated. 60 ml of n-butanol was added. The combined n-butanol extracts were washed twice with 10 ml of 5% aqueous sodium chloride. The remaining solution was heated in a water bath. After evaporation the samples were dried in the oven to a constant weight; the saponin content was calculated (Obdoni and Ochuko, 2001).

Determination of total terpenoids

Powder form of 10 g of each extract was soaked in alcohol for a day. Later on it was filtered and petroleum ether was used for purpose of extraction. The extracted material was calculated and considered as terpenoids (Sharma *et al.*, 2015).

RESULTS AND DISCUSSION

Qualitative phytochemical analysis

The study was undertaken to evaluate the phytochemical constituents of the selected fern extract of *T.meeboldii* to confirm the presence of bioactive compounds. The phytochemical test was conducted using different solvents based on the increasing order of polarity such as Petroleum ether, chloroform, ethyl acetate and methanol. The preliminary phytochemicals of *T.meeboldii* were recorded and tabulated. Panda *et al.* (2014) screened the phytochemicals of *Thelypteris interrupta* commonly found in Odisha using methanol and chloroform as solvent. Methanol extracts showed the presence of major phytoconstituents such as alkaloids, tannins, anthroquinone, steroids and terpenoids as compared to chloroform. Rekha (2017) did preliminary phytochemical analysis on the fern, *Christella dentata*. Aqueous and ethanolic extracts of leaves, petiole and rhizome of *Christella dentata* revealed the presence of various metabolites like ketose, carbohydrate, protein, cardiac glycosides, steroids, flavonoids, phenols, saponin, terpenoids, alkaloids, tannin, coumarin, acids and quinone. Occurrence of different secondary metabolites and their concentration was much lesser in the leaves. Rhizome revealed the presence of most of the metabolites analysed and at higher concentrations. Shubhangi *et al.* (2018) studied the phytochemicals of *Christella dentate* leaf using methanol as solvent. The phytochemicals such as alkaloids, flavonoids, phenols, phytosterols, saponins, tannins and mucilages were found to be present and terpenoids and steroids were found to be absent. Vijayakumari *et al.* (2022) evaluated the phytochemicals of aerial part of *Christella parasitica* using petroleum ether, ethyl acetate and distilled water as solvents. Steroids, tannins, quinones, terpenoids, phenols and phlobatannins were present in all the extracts. Alkaloids, saponins, flavonoids and glycosides were absent in distilled water. Similar result was recorded in our present study that the methanolic extract of *T. meeboldii* showed the presence of seven phytochemicals *viz.*, alkaloids, phenols, flavonoids, saponin, terpenoid, resin and steroid whereas ethyl acetate extract showed six phytochemicals, chloroform extract showed five and petroleum ether showed only four phytochemicals.

Quantitative phytochemical analysis

The amount of phytochemicals which were found in the methanol fern extract was quantitatively determined by following standard procedure. Among the six phytochemicals quantified, alkaloid content was highest followed by phenol and flavonoid (Table 2). Ahmed *et al.* (2015) studied the total phenolic content and total flavonoid content in the methanolic extract of *Adiantum caudatum*. The total phenolic content of the methanolic extract of *A. caudatum* was 27.7 µg of gallic acid equivalents/ ml and the total flavonoid content was 13.2 µg of rutin equivalents/ ml. As phenolics (including many flavonoids) contain polar phenolic hydroxyl group/s, their high extraction into methanol is quite reasonable. The TPC is higher than the TFC, supporting the fact that most flavonoids are also phenolics. Madhav and Meena (2020) studied the quantitative estimation of phytochemicals from *Ampelopteris Prolifera* using hexane, chloroform, ethyl acetate, methanol and 50 % aqueous methanol as solvents. The highest amount of phenolic was detected in 50% methanol extract (114.27±10.37 mg GAE/g). The highest amount of flavonoid was detected in ethylacetate extract (151.47±3.57 mg CE/g extract). The highest amount of hydrolyzable tannin was detected in 50% methanol extract (31.21±2.14 mg TAE/g extract). The highest amount of condensed tannin was detected in ethylacetate extract (337.50±5.00 mg CE/g extract) and the highest amount of sugar was detected in methanol extract (809.74±7.86 mg GE/g). The present study revealed that *T. meeboldii* contains maximum amount of phenol, flavonoid and tannins and least amount of alkaloids. Tannins are known to possess antioxidant property, which is essential in





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protecting cellular oxidative damage. It was described that tannins enhance glucose uptake activity and inhibit adipogenesis, thus being potential drugs for the treatment of non- insulin dependent diabetes mellitus (Muthusamy et al., 2008).

CONCLUSION

The present study was proposed to investigate the secondary metabolites of *Thelypteris meeboldii*, a small to medium sized fern which belongs to the family Pteridaceae. The fronds of *T.meeboldii* were analysed for the phytochemicals. Preliminary phytochemical screening reported the presence of maximum phytochemicals in methanol extract. Due to the presence of maximum phytochemicals in the methanol extract, it was further preferred for quantitative analysis. It showed highest amount of phenols followed by flavonoid and tannin followed with least content of alkaloid and saponin. This study is an output for further research in application of this fern extract for antioxidant and anticancer property because of holding higher phenolic and tannin content. Isolation and identification of the active compound from the selected fern using chromatographic and spectroscopic techniques are essential for bringing promising drug to cure dreadful diseases.

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CONFLICT OF INTEREST

Authors declare no conflict of interests.

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Table: Qualitative phytochemical analysis of fern extracts

Phytoconstituents	<i>T. meeboldii</i>				
	Petroleum ether	Chloroform	Ethyl acetate	Methanol	Water
Alkaloids	-	-	+	+	+
Glycosides	-	+	-	+	+
Phenols	-	-	-	+	+
Tannins	-	+	-	+	+
Flavonoids	-	-	+	+	+
Saponins	-	+	+	+	+
Volatile oils	+	-	-	-	+
Terpenoids	-	+	-	+	-
Resins	-	-	+	-	-
Steroids	-	-	+	+	-

Table 2: Quantitative analysis of phytochemicals of methanolic fern extract

Metabolites	<i>T. meeboldii</i>
Alkaloids (mg/g)	8.41 ± 0.16
Total phenols (mg/g)	15.61 ± 0.18
Total tannin (mg/g)	12.59 ± 0.12
Total flavonoid(mg/g)	15.17 ± 0.04
Total saponin(mg/g)	5.32 ± 0.09
Total terpenoids(mg/g)	11.37 ± 0.08





Evaluation of Potential Role of Aqueous Leaves Extract of *Averrhoa carambola*

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ABSTRACT

Averrhoa carambola is known as tree. *Avera carambola* leaves are commonly used in Ayurvedic and traditional Chinese medicine used for inflammatory skin disorders and fungal skin infection. The leaves of star fruit are rich in vitamin C and bioactive compounds like phenols and flavonoids abundant source of antioxidant. The qualitative phytochemical study of this plant extracts indicates presence of tannins, saponin, flavonoids, alkaloids, proteins, phenol. The herb has been used traditionally from antiquity, in the treatment of neurological healthy and memory issues, breast cancer. It is chiefly possesses the pharmacological study of this plant explains about antibacterial, antioxidant, antifungal, anticatalytic, antiviral activities. The work is an endeavor to explore and to explore and assemble the various pharmacological action and pharmacognostic aspects of the leaves *Averrhoa carambola* reported till date.

Keywords: Ayurvedic, Skin disorders, Fungal skin infection, Phenols, Flavonoids, Antioxidant.

INTRODUCTION

Averrhoa carmbola bioactive compounds are responsible for medicinal properties. *Avera carambola* has proved to be effective in curing multiple diseases. The percentage of antioxidant activity was assessed by DPPH and reducing power of extract was also determined. The bioactive compounds was analyzed in photochemical screening and antibacterial and antifungal activity was also determined. The project will be carried out on *Averrhoa carambola* as chemotherapeutic agent.



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Thus it can be started that this leaves is there suitable drug and can further explored and exploited to meet the global demand for natural, cost-efficient and safer bio active compounds. *Averrhoa carambola* showed that contained tannins, saponins, flavonoids, alkaloids, proteins, phenols. The pharmacological investigations revealed that they possessed antibacterial, antioxidant, anticancer and anti-depressant.

MATERIALS AND METHODS

Leaves of *Averrhoa carambola* leaves treated with cold extraction of phytochemical analysis.

Cold extraction

Ten gram of sample was weighed and soaked in 100 ml of aqueous. The extract was allowed to stand overnight and filtered using sterile filter paper. The filtrate was collected and incubated at room temperature for evaporation. Then measure the weight and find the yield by calculating.

Yield = Initial weight - Final weight

Aqueous extract [2.12 g/10 g leaves powder] and assay antioxidant and used the techniques is thin layer chromatography, analysis for flavonoids and treated with antioxidant activity antimicrobial activity such as antibacterial activity, antifungal activity and MIC assay.

RESULTS & DISCUSSION

The *Averrhoa carambola* leaves were extracted using aqueous. The yield was observed in aqueous extract (2.12 g/10 g leaves powder). Similarly, Shu *et al.* (2014) reported leaves and fruits from *A. carambola* (10 g) were extracted thrice with acetone: water (7:3). The final yield of acetone: water extracts (AWE) of leaves and fruits were 4.30 and 5.79 g, respectively. Phytoconstituents of the *Averrhoa carambola* aqueous extract of leaves were analyzed qualitatively. Our results showed the presence of tannin, saponin, flavanoid, protein, alkaloid and phenol in the aqueous extract. These secondary metabolites could be in source of the therapeutic effects. Ashim Pal *et al.* (2019) revealed that the preliminary phytochemical screening of the *Averrhoa carambola* aqueous extract contains tannins, flavonoids, phenols, terpenoids, sterols, fats, fixed oils *etc.* Our results showed that the analysis of antioxidant property in *Averrhoa carambola* aqueous extract of leaves exhibited IC₅₀ values at 500 µg for DPPH scavenging analysis and reducing power assay showed 165 µg/ml. Similarly, Henrique *et al.* (2012) studied *Averrhoa carambola* crude extract of leaves at 212 µg/g, Hexane extract at 223 µg/g, ethyl acetate extract at 90 µg/g and *n*-butanol extract at 124 µg/ml for DPPH scavenging capacity. Reducing power activity showed in crude extract at 98 mg/g, Hexane extract at 86 mg/g, ethyl acetate extract at 135 mg/g and *n*-butanol extract at 125 mg/ml. Ethyl acetate extract exhibited best DPPH scavenging assay and reducing power capacity when compared with other extracts.

Das *et al.* (2010) performed TLC analysis of *Cyathea gigantea* and *Cyathea brunoniana* with different solvent extracts. The compounds were separated by using various solvent of mobile phase such as PE-EA=9:1, 17:3, 4:1; PE-EA-M=18:1:1 and PE-EA-M=17:2:1 the more phytochemical compounds (spots) were visualised by iodine vapour. Annisa *et al.* (2020) carried out preliminary qualitative phytochemical tests using thin-layer chromatography (TLC). *Averrhoa carambola* leaves extracts (70% ethanol followed by further extraction ethyl acetate, hexane and distilled water) were used for flavonoid identification using the mobile phase chloroform: acetone: formic acid (10:2:1) and 5% AlCl₃ spray reagent, with quercetin as the positive control. TLC analysis for flavonoids showed that the ethyl acetate fraction of *A. carambola* leaves contained flavonoids, as demonstrated by yellowish fluorescent bands in the UV-visible spectrograph at 366 nm. Determining antimicrobial properties of plant extracts can be of great importance in therapeutic cure. Antibacterial susceptibility tests are used in ethnopharmacological research to evaluate the potential antibacterial activity of biological extracts against various pathogenic pathogens. By establishing the Minimum Inhibitory Concentration (MIC), these assays are used to screen plant extracts for antimicrobial properties as well as to determine the effectiveness of antimicrobial medicines in treating illnesses. *Staphylococcus aureus*, *Enterococcus faecalis* and *Klebsiella pneumoniae* was showed more antibacterial activity in *Averrhoa carambola* ethanol extract of leaf





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(Silva *et al.*, 2021). Our results showed more antimicrobial activity in *Escherichia coli* (250 µg) and *Candida albicans* (250 µg) compared with other microbes.

CONCLUSION

The current research has showed that natural sources have therapeutic properties without much toxicity. This potential of plants is due to the presence of secondary metabolites. The results prove that *Avera carambola* leaves extract has antioxidant, antibacterial and antifungal activity.

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Table1. Phytochemical analysis of aqueous extract of *Averrhoa carambola* leaves

S. No.	Contents	Aqueous extract of <i>Averrhoa carambola</i> leaves
1.	Tannins	+
2.	Saponin	+
3.	Flavonoids	+
4.	Alkaloids	+
5.	Proteins	+
6.	Steroid	-
7.	Quinones	-
8.	Terpenoid	-
9.	Cardiac glycosides	-
10.	Phenol	+

Note: (+) Positive ; (-) Negative





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Table 2. Determination of total antioxidant activity

Concentration (µg)	100	200	300	400	500
Ascorbic acid (Std) O.D	0.20	0.40	0.58	0.80	0.97
Aqueous extract O.D	0.12	0.16	0.18	0.21	0.25
Amount total antioxidant (µg)	60	80	90	110	230

Table 3. DPPH scavenging assay

BHT Concentration	100 µg	200 µg	300 µg	400 µg	500 µg
Standard O.D	0.36	0.27	0.17	0.15	0.11
% Inhibition	38.9	54.2	71.1	74.5	81.3

Blank - 0.59

Sample/Concentration (µg)	100 µg	200 µg	300 µg	400 µg	500 µg
Aqueous extract O.D	0.57	0.53	0.48	0.39	0.30
% Inhibition	6.5	13.1	21.3	36.0	50.8

Blank - 0.61

Table 4. The crude aqueous extract sample runs by thin layer chromatography

S. No.	Sample fractions	Distance moved by the solvent (A) (cm)	Distance moved by the solute (b) (cm)	R _f (b/A)
1	a	4.7	2.2	0.46

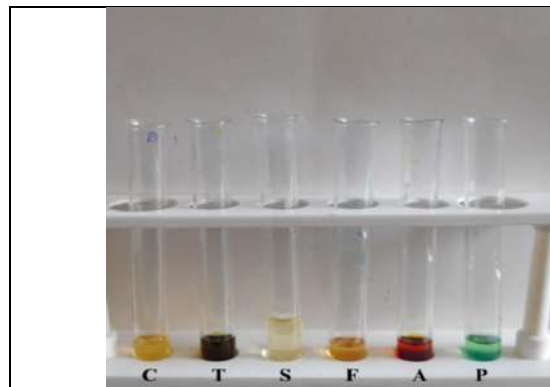


Fig 1: Cold extraction

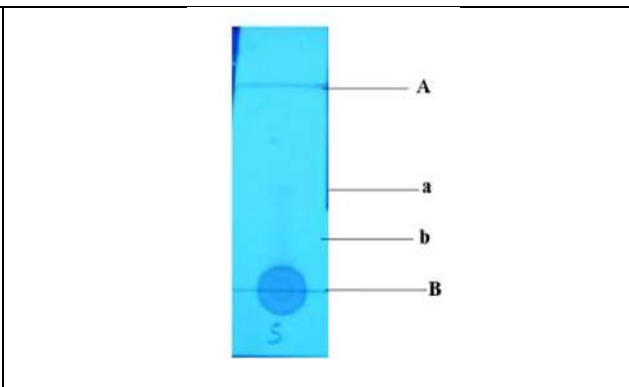


Fig. 2. The crude aqueous extract sample runs by thin layer chromatography





The Ionospheric TEC Responses to Different Solar Flayers

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ABSTRACT

The earth's ionosphere density, temperature, and composition can alter by abrupt increases in solar irradiation during solar flare events. A study of the ionospheric variation with flare irradiance is needed to enhance the accuracy of space weather prediction and better knowledge of the photochemical process. However, a comprehensive picture of the ionospheric plasma's response to a quick solar flare explosion has yet to emerge due to the complexity or variety of flare responses recorded over time and place. In this paper, the effect of several solar flares in the ionospheric Total Electron Content (TEC) during the solar cycle's declining phase of 24 at the "nama" low latitude station of Saudi Arabia (Geog. Lat. 19.21° N, Geog. Long. 42.04° E) is investigated. For this, we have chosen the intense solar flares that come during October 2014. Our findings revealed large increases in TECU of up to 12 TECU due to the solar flare. Our findings suggest a delay in TEC response during the flares peak recovery time in a few cases.

Keywords: Ionosphere, solar flares, Total Electron Content (TEC), low latitude.

INTRODUCTION

The solar flares release magnetic energy that is converted to electromagnetic radiation with a broad spectrum of wavelengths. That can heat the material to temperatures above 10⁷ K. It produces magnetic reconnection in the solar corona. This can lead to severe problems in the form of space weather, as the radiation can reach the Earth within



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minutes and causes extreme weather conditions that are impossible to predict. The solar flare can release energies as high as 10^{25} joules, which is mainly radiation, but some of its energy is converted into accelerated and heated particles, electrons, protons, and radio bursts. The Earth's upper atmosphere temperature, density, and composition can be altered by rapid increases in solar irradiance that comes during solar flare events. That is an essential aspect of space weather research with relevance for space-based communication and navigation systems, as well as astronaut safety. (Woods and Eparvier, 2006) reported that the ratio of flare irradiance to pre flare irradiance is less than a factor of 2 in the EUV region and more than a factor of 50 in the X-ray region during large flare events. Despite the fact that the enhancement in the EUV region is substantially lower than in the X-ray region, the upper atmosphere is governed by EUV irradiance rather than X-ray irradiance. In addition, Ionosphere and thermosphere are primarily affected by solar extreme ultraviolet EUV irradiation, which is absorbed by the upper atmosphere between 90 and 200 kilometers and results in increased ionization and heating. The association between TEC enhancement and increases in EUV flux is stronger than soft X-ray flux during flares (Zhang et al 2011). Different solar transient that affects the earth atmosphere and space weather are (1) solar flares, (2) solar energetic particle (SEP) events (3) coronal mass ejections (CMEs) and their interplanetary counterparts, Interplanetary CMEs (ICMEs), and (4) stream interaction regions (SIRS) including co-rotating interaction regions (CIRs).

A solar flare can significantly increase the overall electron concentration, fadeout of short-wave, and absorption in the D region (Davies 1990; Liu et al., 2004). Zhang and Xiao (2003) used GPS TEC values to analyze the ionospheric response to the solar flare of April 15, 2001 and found a maximum increase of 2.6 TECU for the complete sunlit hemisphere. According to Zhang and Xiao (2005), the morphological properties of SITEC increased by up to 14 TECU on the October 28, 2003, flare, which depends on the solar zenith angle at local midday. The ionosphere is affected by solar EUV radiation, and a sudden surge in EUV emission during SF can generate a severe ionization that lasts for several hours. Thus, not only from the fundamental point of view but also from the perspective of space weather applications, the study of the ionospheric response to SF is important. For many years, the impacts of SF on the ionospheric environment have been investigated (e.g., Liu et al., 2004; Zhang & Xiao, 2005; Tsurutani et al., 2009; Zhang et al., 2011; Sripathi et al., 2013). The previous studies show that the effects of SFs on the ionosphere vary with the flare type, time (day or night), and solar zenith angle. (e.g., Liu et al., 2006; Leonovich et al., 2010; Xiong et al., 2014). (Le et al. 2013) found that SFs from the disc center had a much greater impact on the ionosphere than those from the solar limb areas. (Zhang et al. 2002; Leonovich et al. 2010) Examining the TEC reaction to various SFs (C, M, and X), it was discovered that as the solar zenith angle increases, so does the increment in TEC changes.

In October 2014, a number of solar flares events occurred, including six big X-class solar flares that triggered geophysical disturbances. Wide geographic coverage of GPS stations of the IGS network provides us a very good chance to study the global ionospheric response during solar flares. Although numerous efforts have been made, many aspects of the ionospheric response to SF are not fully understood yet. It will be necessary to conduct more research. The solar cycle 24th starts in December 2008 and maxima in 2014. The 2014 is the high solar activity period, number of solar events occurred in October 2014. In this work, we focus on the six X- class and M-classes of Solar flares during the months of October 2014, and their impact on ionospheric effects. In comparison to solar cycles 22 and 23, solar cycle 24 has an unusually deep minimum and is diminished in terms of activity. Therefore, the study of the impact of the solar flare on the earth's ionosphere during this moderately active solar cycle may reveal novel response features not seen in previous highly active solar cycles. In this work, we use GPS TEC data over "nama" (Geog. Lat. 19.21° N, Geog. Long. 42.04° E) to examine the response of the ionosphere to X-class flares and M-class flares that occurred 19-27 October 2014 of the solar cycle 24. This article is as follows: The introduction of data and methods used in Section 2. The result and discussion are presented in section 3. Finally, the summary and conclusion are in Section 4.

DATA AND METHODS USED

A study of the solar cycle 24 maxima year 2014 is presented in this work. During October 2014, several notable flares occurred. In which six x class flare and several M and C class flares are observed. We study all the six x





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classes, these flares at GPS stations in the low latitudes. We study TEC curves for this date considering the sunlit hemisphere and universal time so. We select “nama” IGS station which is located in Saudi Arabia and compare it with the day before and the day after at the same time zone.

X-ray data

Monitoring of solar X-ray fluxes over Earth's atmosphere has been continuous since 1975. first with the SOLRAD series satellites, and then with the GOES series satellites. For our work, we have used GOES satellite X-ray data observed in the wavelength range of 0.1 to 0.8 nm with a 1-minute resolution, which is freely accessible through the Internet at <<http://www.ngdc.noaa.gov/stp/GOES/>>.

EUV data

From 1996 to the present, daily SEM/SOHO EUV fluxes have been available. The EUV flux data retrieved from the SEM/SOHO, which monitors XUV fluxes 0.1-50 nm and EUV fluxes 26-34 nm wavelength. We used the high temporal resolution data, the 15-s average SEM/SOHO fluxes, which can be downloaded at the Website: <http://www.usc.edu/dept/space_science/semdatafolder/>

GPS derived TEC data

To investigate the TEC variation, we had considered IGS stations “nama” low latitude Station in Saudi Arabia. There have been 06 X-class flares from the same region 12192 (NOAA region) during October 2014. In addition, 4 associated M-class during the X class flayers of the same region is examined.

RESULTS

We have been presented the observations of TEC changes during different SF events during October 2014. In the following section, we provide case-by-case discussions on the observed results. Figures 2, 3, 4, 5, 6, and 7 illustrate the TEC during the selected solar flares with the pink curve representing the TEC variation of solar flayers event day and the blue curve representing the quiet mean of TEC computed using the VTEC of the five quietest days in October month of 2014. The difference in observed TEC value and to the quiet mean TEC (Δ TEC) is in the lower panels of figures 2, 3, 4, 5, 6, and 7. We added fluctuations in the X ray flare index (0.1-0.8 nm) and EUV flux (0.1- 50 nm) in figure 1 to better finer variation of TEC during SF events. Figure 1 depicts the variation of X-ray and EUV fluxes from October 19 to October 27, 2014. The upper panel of figure 1 shows that six intense SFs of classes X1.1, X1.6, X3.1, X1, and two X2 occurred during the period 19–27 October 2014.

Event 01: 19 October 2014

On 19 October X1.1 class SF occurrence at 0417 UT and reached maximum at 0503 UT. The variation in TEC values shown in lower panel of figure 2. During the time of occurrence the solar flare enhancement is 05 TECU at ~0503 UT on 19 October seen from figure 2. In addition, the trend of variation of EUV was the same as SF during X1.1 (Figure 1).

Event 02: 22 October 2014

On 22 October, the flares of intensity X1.6 occurred at 1402 UT. It can be seen in EUV variation that the level of the EUV flux index rapidly increased at 1428 UT, at this time local time at “nama” coincided with post-afternoon hours. The enhancement in TEC values of an order of 07 TECU observed at 1428 UT.

Event 03: 24 October 2014

On October 24, 2014, the active sunspot region AR12192 produced a strong X3.1 SF. The upper section of figure 4 shows that the X3.1 class SF occurred at 2107 UT on October 24 and strengthened at 2141 UT on the same day. By 2213 UT, the SF had decayed. As a result, this SF lasted about 1 hour. At 2141 UT, there is also a significant spike in





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the EUV index (lower section of figure 1). The lower section of figure 4 shows that the level of TEC increased at 2141 UT on October 24, with a magnitude of approximately 5 TECU.

Event 04: 25 October 2014

Figure 5 shows that the SFs of class X1 occurred on October 25, 2014. The TEC variation on October 25th showed a modest reduction in TEC at 1900 UT. As a result, the dayside negative phase prevailed on October 25, 2014. During the negative storm phase, TEC often falls below its normal value (Mendillo 2006).

Event 05: 26 October 2014

The flares occurred at 1004 UT on October 26, 2014, and the timing of occurrence of X-class flares coincided with midday hours. Our results showed a significant increase in TEC throughout the day, with the maximum increase of 11 TECU at 1240 UT. It can also be noticed that the amount of EUV decreased on October 26, 2014. (upper panel of figure 6). Previous investigations only indicated a maximum flare-induced TEC rise of up to 20 TECU (e.g., Zhang and Xiao 2003; Tsurutani *et al.* 2005; Hazarika *et al.* 2016; Yasyukevich *et al.* 2018).

Event 06: 27 October 2014

The SFs of class M7.1, M6.7, and X1 occurred on 27 October shown in figure 1, the TEC variation showed increased during the noon hours due to the M class SF at 0006 UT throughout the day and then a small decrement in TEC at ~1400 UT during the X1 SF as on 27 October was observed in figure 7.

DISCUSSION

During different SF effects, the observed TEC gets disturbed and its behavior can change during the events. Many of our examined SFs like X classes X1.1, X1.6, and X1, respectively on 19, 22, and 26 October and M class M4 and M7.1 respectively on 24 and 27 October have a significant increase in TEC of 5–12 TECU is observed these are during noontime. There is likely to be more absorption of X-ray and EUV radiation from the atmosphere neutral species (Hernandez-Pajares *et al.* 2012). The maximum ionization occurs below 150 km, and because the EUV component associated with SFs has higher energy, they may be able to penetrate to a depth of as little as 100 km. Chemical recombination is also relatively quick at high altitudes. The considerable TEC increase at F2 height can be interpreted as a slowing of the plasma recombination process, in which Plasma produced by photoionization at low altitudes is rapidly driven to higher altitudes where process of recombination is very slow. As a result, at altitudes more than 400 km, the electron density rises (Anthony and Bruce 2018). A minimal or no increment in electron density of the ionosphere is found for SFs that occur during the night hours, such as M8.7, X1, X2, and M4.2. The equator's noon ambient electric field is eastward, which should be noted. The vertical ExB drift of the ionospheric plasma is caused by the interaction of this field with the Earth's magnetic field, which is horizontal at the equator. And during the night, the equator's atmospheric electric field has directed the westward. The observed TEC changes took place with the greatest delay after the SF peak, such as X1.1, X1.6, X1, M4, and M7.1. The time delay in the ionosphere's response during EUV and X ray flayer variations is highly correlated to the SZA at the peak time of X ray SF (Zhang *et al.* 2011).

CONCLUSION

This work used total electron content TEC to investigate the electrodynamics of solar flares and their effects on the low latitude ionosphere. Our study showed enhancements in TEC at low latitude stations of the order up to 12 TECU during the chosen SF events. And the TEC enhances due to SF and the enhancement is observed maximum when SFs coincide during the noon hours. Our results also showed some delay in TEC response during maxima or recovery time of solar flares.





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Table 1 Selected X and M- class solar flare events with their start, peak, and end time.

S. No.	Date of Solar Flares	Solar Flares	Start Time (UT)	Maximum Peak Time (UT)	End Time (UT)
1.	19/10/2014	X1.1	4:17	5:03	5:48
2.	22/10/2014	X1.6	14:02	14:28	14:50
3.	24/10/2014	X3.1	21:07	21:41	22:13
4.	25/10/2014	X1	16:55	17:08	18:11
5.	26/10/2014	X2	10:04	10:56	11:18
6.	27/10/2014	X2	14:12	14:47	15:09
7.	22/10/2014	M8.7	1:16	1:59	2:28
8.	24/10/2014	M4	7:37	7:48	7:53
9.	26/10/2014	M4.2	18:07	18:15	18:20
10.	27/10/2014	M7.1	0:06	0:34	0:44
11.	27/10/2014	M6.7	9:59	10:09	10:26

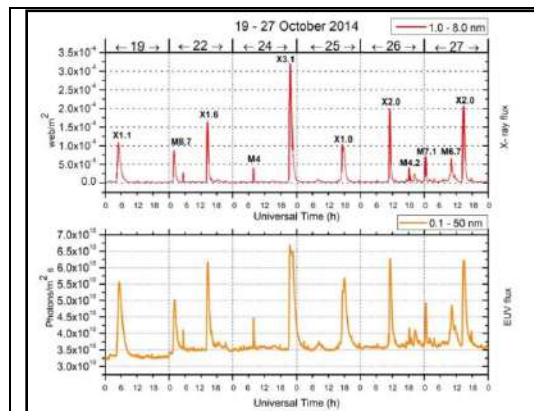


Figure 1 upper panel variation in solar X-ray flux, and lower panel EUV flux on 19–27 October 2014.

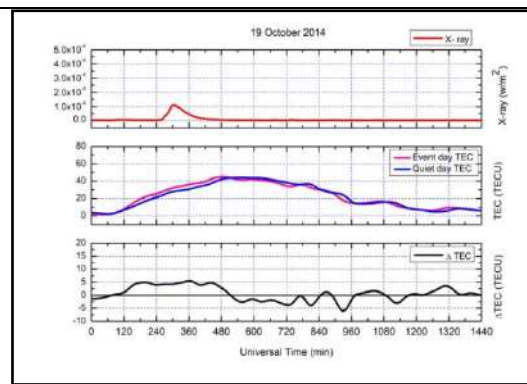


Figure 2 upper panel variation in solar X-ray flux, middle panel TEC, and lower panel difference in TEC value on the day of solar flare event to the quiet mean TEC, ΔTEC on 19 October 2014.

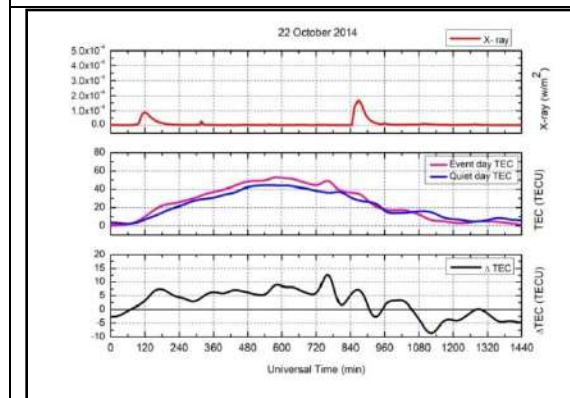


Figure 3 upper panel variation in solar X-ray flux, middle panel TEC, and lower panel difference in TEC value on the day of solar flare event to the quiet mean TEC, ΔTEC on 22 October 2014.

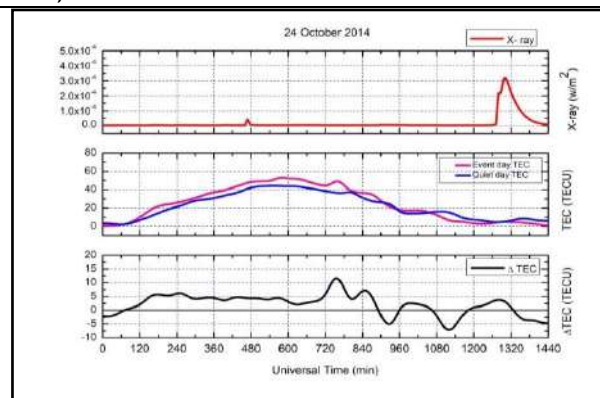


Figure 4 upper panel variation in solar X-ray flux, middle panel TEC, and lower panel difference in TEC value on the day of solar flare event to the quiet mean TEC, ΔTEC on 24 October 2014.





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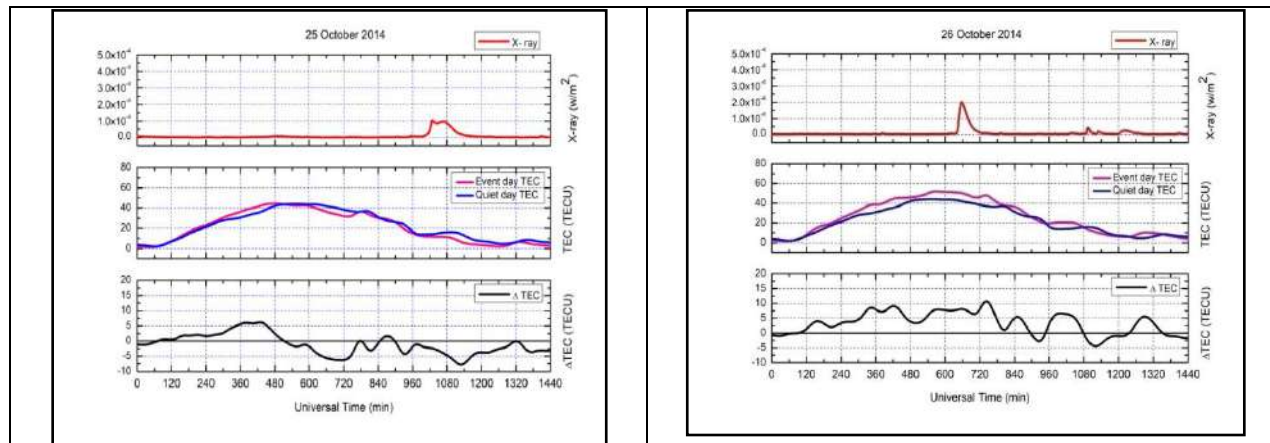


Figure 5 upper panel variation in solar X-ray flux, middle panel TEC, and lower panel difference in TEC value on the day of solar flare event to the quiet mean TEC, ΔTEC on 25 October 2014.

Figure 6 upper panel variation in solar X-ray flux, middle panel TEC, and lower panel difference in TEC value on the day of solar flare event to the quiet mean TEC, ΔTEC on 26 October 2014.

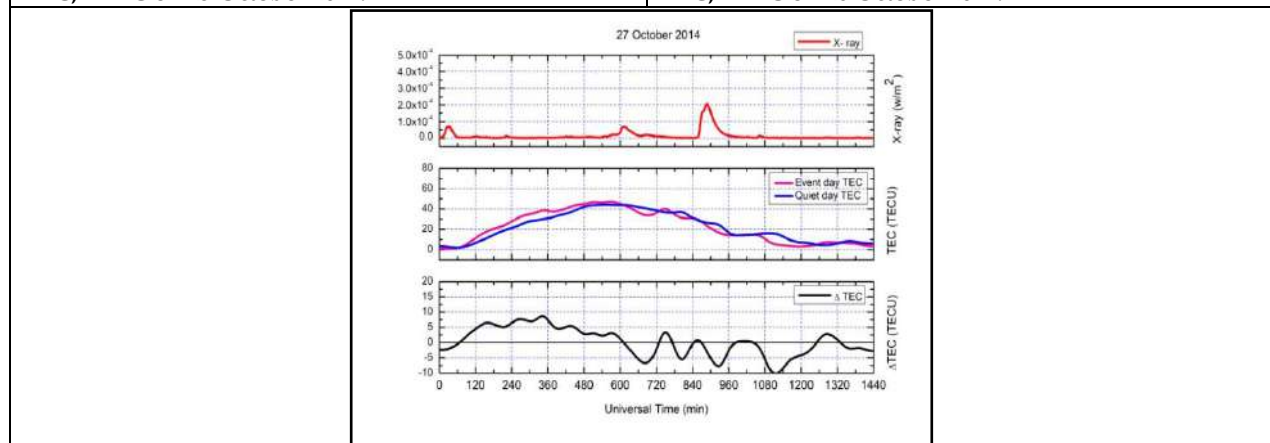


Figure 7, upper panel variation in solar X-ray flux, middle panel TEC, and lower panel difference in TEC value on the day of solar flare event to the quiet mean TEC, ΔTEC on 27 October 2014.





Smart Wildlife Vehicle Collision Detection System

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ABSTRACT

Animals are an important part of the wildlife and forests. But humans are a major cause of the damage caused to the wildlife. Damage caused by vehicles to animals is an important cause for this. Reckless driving of humans and the trespassing of animals on roads are a major cause of human made deaths to animals. The accidents due to Wildlife Vehicle Collision (WVC) contribute a significant proportion to the number of accidents happening around the world. Usually, the death of these animals goes unnoticed and removal of the dead bodies of the animals is not carried out. The individuals responsible for these accidents are also not caught. Hence this system aims at providing a solution to alert the driver about animal crossing and facilitating the removal of the dead bodies of the animals by the forest department if an accident has occurred. At times when the animal is injured, an immediate call for emergency is given to the Forest Department. The Forest department can make the necessary arrangements to save the animal. The detail of the colliding vehicle is captured with the help of cameras and the images are provided to the Police Department. With the help of our technology, we facilitate the ease of transportation and also save the animals, eventually saving money for the Government. The WVC detection system uses PIR and Ultrasonic sensors, web cameras along with the Raspberry Pi kit to facilitate the detection.

Keywords: Raspberry Pi, Sensors, Collision Detection, OpenCV, Information transfer.



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INTRODUCTION

Wildlife-Vehicle Collisions (WVCs) are a global problem that impacts both wildlife and motorists and are a growing concern among Departments of Transportation (DOT), conservation organizations and agencies, and the driving public. It is also a safety concern for drivers and a conservation concern for most animal species. WVC occurs when a vehicle hits an animal as it tries to cross the road [1,2] or when humans interfere in certain animal hotspots. The consequences are profound and include significant socio-economic, traffic safety and environmental costs and concerns. Animal-vehicle collision is a challenging problem for cars, especially in certain rural areas or hill stations where animals are in their natural habitat. It is reported that in the United States, more than 90 percent of animal-vehicle collisions involve large animals such as deer or moose [3], with the total number of two million collisions per year [4,5]. Such animal-vehicle collisions cause about 200 human deaths, 29,000 injuries, and 1.1 billion dollars in property damage every year. WVCs not only result in death and serious injuries, but certain species that belong to an area are becoming endangered and are at risk of disappearing from their natural habitat or even become extinct, which is a threat to biodiversity in our country. The sheer number of animals that are killed in vehicle-collisions [4,6] is alarming. Wildlife-vehicle collisions involving large species can cause substantial vehicle damage and human injuries and are a key public safety concern[7,8]. Reckless driving of humans and the trespassing of animals on roads are the major cause of human made deaths to animals. We cannot blame the animals for these WVCs as it is because of the humans, who build roads in the villages and forests. As these accidents are on the rise, there is a need to try to prevent and detect these accidents [9] so as to reduce the number of accidents and possibly save the lives of both the animal and the human involved in the collision. A complete analysis of the WVC hotspots is needed to reduce the conflict. There have been many measures taken by the government to reduce these accidents but they have not ensured a significant reduction in these collisions. The Smart Wildlife Vehicle Collision Detection System aims to reduce the frequency of wildlife-vehicle collisions.

LITERATURE REVIEW

The governments of various countries have identified Wildlife Vehicle Collisions as a major threat to human and animal life and have hence introduced many methods to try and reduce them. There have been a variety of static and dynamic methods to decrease the number of collisions. The static methods include sign boards, fences [4] and special animal movement corridors. Specific sign boards are installed at animal vehicle collision hotspots to warn the riders about the possibility of an undesirable event. These sign boards don't provide real-time animal information and hence does not reduce the number of accidents significantly[10]. Fences have been installed at various places to restrict the movement of animals and prevent them coming onto the road. Fences are one of the most commonly used methods of preventing WVCs and is also the most cost effective one [11]. The major drawback of this method is that physically stronger animals such as elephants and ungulates could easily break down these fences and roam around on roads. In certain economically forward countries, special corridors [12] have been built across roads to aid the movement of animals from one side of the road to another. Though corridors provide the best way for better movement of animals, they prove to be quite expensive. Hence there is a need for cost effective and scalable systems to detect the animals and possibly try to prevent WVCs. Many technologies have also been developed as a result of this to reduce the number of collisions. The technologies can be mainly classified into two categories: Roadside and Onboard systems. Roadside systems are installed at the sides of the roads to detect possible animal crossings and the driver is notified when there is a crossing. Onboard systems are installed on vehicles such as cars to warn the drivers when the animal is detected. All these methods use a camera to take pictures and the pictures are analysed to find out animal movement. These methods, though able to detect the movement of animals accurately, doesn't provide a mechanism to identify animal collisions and send alerts to the respective department.





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METHODOLOGY

There is a need for the immediate and rapid transfer of information [13] regarding the accident to the necessary authorities to provide first aid to the injured. Thus we have proposed the Smart Wildlife Vehicle Collision Detection System to facilitate information transfer as explained in Figure 1. This system is built as a roadside system where all the components are fixed at the side of the road. The camera monitors the road and a Python program detects the collision. In such a case, the information regarding the accident is sent to the Police department and the Forest Department. The Police department then scrutinizes the available information for further investigation. The Forest department sends an ambulance for the wounded animal(s) and human(s). All the required information is transmitted instantaneously and this is the major advantage of this system.

HARDWARE AND SOFTWARE REQUIREMENTS

The system requires the combination of various sensors, processors and softwares for its working. The major requirements that are essential for the system are listed below.

PIR Sensor

The PIR sensor is a special material which is sensitive to IR and it has two slots. When the sensor is idle, both slots detect the same amount of IR radiated from the walls or outdoors. When a warm body (human or animal) passes by, one half of the PIR sensor is intercepted first which results in a positive differential change between both the slots. Once the warm body leaves the surroundings the reverse happens, that is the sensor results in a negative differential change between the two slots. These changes in pulses are detected by the sensor.

Ultrasonic Sensor

An ultrasonic sensor consists of a transmitter and a receiver. When an obstacle is detected it generates and receives the ultrasonic waves. The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo. To generate the ultrasound, we need to set the Trig on a High State for 10 microseconds which will send out an 8 cycle sonic burst. It will travel at the speed of sound and it will be received in the Echo pin which will output the time in microsecond that the sound waves travelled. When any object comes within the range of the sensor, the ultrasonic sensor will produce an output. Ultrasonic sensor along with the PIR sensor is used to detect animal motion [14,15].

LCD Screen

LCDs are super-thin technology display screens that use a liquid crystal to produce a visible image. Liquid crystal display consists of several layers which include two polarized panel filters and electrodes. The combination of coloured light with the grayscale image of the crystal (formed as electric current flows through the crystal) forms the coloured image. This image is then displayed on the screen.

Raspberry Pi

The Raspberry Pi [16] is a small sized computer which is developed by Raspberry Pi foundation. We use a Raspberry Pi 3 Model B. The Raspberry Pi 3 Model B is the earliest model of the third-generation Raspberry Pi. It includes a Quad Core 1.2GHz Broadcom BCM2837 64bit CPU, 1GB RAM, Bluetooth 4.1, 802.11.b/g/n Wireless LAN, 40-pin extended GPIO, 4 USB 2 ports, full size HDMI among various other features. An upgraded switching micro USB power source upto 2.5A is present in this model. The operating system Noobs boots from the MicroSD card inserted in the Pi. The Raspberry Pi contains the code for analysing the scene.

Web Camera

The web camera [17] is used to capture the images of the road. The web camera has a resolution of 640 x 480 and uses an 8mm lens. The encoding is in MPEG format and the digital signal system is used. The camera has IR capabilities





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to capture images during the night. It has a night vision range from 5 – 30 metres. The camera is easy to plug in through a USB and is supported by Raspberry Pi.

OpenCV

OpenCV is an open source computer vision library that is used with the Python Programming Language. It is mainly aimed at real-time computer vision. The library has more than 2500 optimized codes that can be used for various activities such as recognizing faces, identifying objects, track camera movements, find similar images and so on. We will be using the OpenCV library to extract the number plate from the accident scene and also to detect the animal vehicle collision [16]. The existing Open CV algorithms are used for this purpose.

Keras

tf.keras is Tensor Flow's high-level API for building and training deep learning models. It's used for fast prototyping, state-of-the-art research, and production, with three key advantages: User-friendly, Modular and composable, Easy to extend. Keras has a simple, consistent interface optimized for common use cases. It provides clear and actionable feedback for user errors. Keras models are made by connecting configurable building blocks together, with few restrictions. It is possible to write custom building blocks to express new ideas for research. We can create new layers, metrics, loss functions, and develop state-of-the-art models.

EXPERIMENTAL SETUP

The experimental setup of the components is explained in this chapter. Two types of sensors: Ultrasonic Sensor and the PIR Sensor are installed on the sides of the road to detect for possible animal movement. If any such movement is sensed by the sensors, a warning message is shown on the LCD Screen by the Raspberry Pi to which the camera is connected. The connection between the various components of the setup is shown in Figure 2. The camera is turned on to detect possible animal vehicle collisions [18, 19]. The Raspberry Pi is used as the storehouse and the processor. After obtaining the signal from the sensors, the Raspberry Pi turns on the camera and takes pictures of the road for possible accidents. The images are stored in an SD card located in the camera. The accidents are detected using a python program which uses machine learning techniques to detect if there is an accident in the image that is given as the input [20]. Once the accident is detected [21], the photo of the number plate of the vehicle is captured, the place and time of the accident is sent to the Police and Forest departments via an email.

METHODOLOGY

The basic structure of this system consists of PIR and Echo sensors which are attached to the Raspberry Pi. The PIR and Ultrasonic sensors detect the motion of the animals near the road sides. When movement is received, the Raspberry Pi alerts the drivers within a particular radius of possible animal crossings by displaying a message on the LCD.

Sensing the Movement

The following Algorithm does the sensing part in the Raspberry Pi.

1. Compute the distance between the object and sensor for every one second using Echo sensor.
2. $Distance = Speed \times Time$
3. $Real\ Distance = Distance/2$
4. Set the Dout pin of the PIR sensor as input pin(p) and measure the value as $val = digital\ Read(p)$
5. Get val and Real Distance.
6. If ($val == HIGH$ and $Real\ Distance \leq required\ distance$), Display “Animal Crossing” in LCD and go to the next step.
7. Else Display “Safe Journey” in LCD and go to the previous step.



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If motion is detected, the Raspberry Pi initiates the webcam. The webcam starts capturing images. These images are used for accident detection purposes. The accidents are detected using a Deep learning model which runs in the Raspberry Pi.

Detecting the Accident

The camera is started whenever a motion is detected. The dataset consists of two classes, namely "Accident" and "No Accident". It consists of images collected from Google Images. The image data generator function in keras preprocessing library is used to link the dataset to the model. The build function of the model is used to build the model with reference to the dataset. The model is compiled for errors and is trained for 10 Epochs. Once an accuracy threshold of 0.9 is obtained, the model is saved for deployment. The predict function of TensorFlow is used to give an image to the model as the input and check if the image has an accident scene or not. The image is classified into one among the two classes. If the image has an accident scene, it is sent to the number plate detection algorithm to extract the number plate.

Extracting the Number Plate

The recordings are stored as images. When an accident is detected [22], the images are processed to detect the Number plate of the vehicle and the processed images are sent to the Police Department. The Number plate of the vehicle involved in the accident is detected by the Number plate tracking algorithm [23]:

1. The original image is converted into a Grayscale image for easier extraction.
2. All the possible characters in the scene are found out using the K-Nearest Neighbours algorithm and a vector of all the possible characters is generated.
3. Using the vector of possible characters, a vector of all the possible plates is generated.
4. Each and every plate in the vector is converted to grayscale and all the possible characters in the plate is generated. This set of characters in a plate is analysed.
5. Within each possible plate, the longest list of characters is considered to be the actual number plate.
6. The number plate is finally bounded and an image is generated.

Sending the mail

This number plate image, along with the accident image is then transferred to the Police Department. The location of the accident and the accident image is sent to the Forest Department. This information is sent with the help of an automated Email [12]. The email can be made to send once all the required information is gathered. This mail is sent to the departments with the help of SMTP [24] Gmail Server. After the information transmission, the whole process starts from the beginning, waiting for an animal's movement to extraction of the number plate from the scene. The overall flow of the system is shown in Figure 3.

PERFORMANCE ANALYSIS

There isn't any mechanism to detect Wildlife vehicle collisions spontaneously. In this paper, a Raspberry Pi based system to detect collisions and send the information instantaneously is devised. The detection here is done with the help of a camera connected to the Raspberry Pi. It is assumed that the surroundings are captured by placing the camera at a tree/pole so that it is able to get a 180° view. The sensors are placed at the tree/pole facing each other with the assumption that the animal would reach the road by crossing the pole. In the proposed work, the deep learning model is run to detect for possible accidents. The model used is a Sequential model. Sequential model is a linear stack of layers. The model consists of three Convolutional layers and two Dense layers of 128 and 1 parameters each. One of the dense layers is used for binary classification at the end of the Neural Network. A Flatten Layer is used between the convolutional and dense layer to flatten the inputs. A Dropout of 0.5 is used. It helps in reducing over fitting by randomly turning off 50% of neurons while training. ReLU and softmax activations are used. Soft max is used for the





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last dense layer while all the other layers use ReLU activation. The model is compiled using ‘adam’ optimizer. An accuracy threshold of 0.9 is accepted as the limit for the model. The Summary of the model is given in Figure 4. The number plate detection algorithm attempts to capture the number plate of the vehicle from the accident scene. This number plate detection system is able to detect if there is any number plate from the image provided. This algorithm takes an average of 600ms to produce the output number plate for an input accident scene image. An already existing number plate detection system is used in our system. After the number plate is extracted, it is sent to the respective departments with the help of an email using the Gmail SMTP server. The program to send a mail to the departments takes a few seconds to reach the inbox of the departments if the Raspberry Pi is connected to the internet. Faster internet connectivity could reduce the time taken in sending the mail after the program gets executed. Though there may be some delay in the arrival of necessary help, the proposed system is still faster and more efficient than others of its kind. Various images of varying quality, file size, file resolution, zoomage have been taken and given as an input for the number plate detection algorithm.

The time taken for the execution of the program is noted and various observations were made. Three important parameters, time taken to process the image in milliseconds, size of the file and the quality of the image, are compared and a scatter plot as shown in Figure 5 is created to analyse the difference in the running times between different kinds of images. The quality of the images could be categorised into High, Medium and Low quality based on their level of pixelation. It could not be clearly interpreted that low size equals faster time execution. Images that are pixelated take longer to execute than normal images whereas as usual, images with larger image size and high quality take longer to execute. This distribution is random and the fastest runtime is achieved by taking a clear image with a considerable image size of 20KB-50KB. The accuracy of the number plate detection algorithm varies with file quality and zoomage. A graph with respect to the quality of the image as shown in Figure 6 is presented. It could be perceived that images with higher qualities lead to more accurate detection whereas images with low qualities lead to poor detection of the number plate. Thus the camera that is set up with the Raspberry Pi should yield images of comparatively high clarity for the algorithm to detect the number plate successfully. The number plate detection algorithm is not based on any dataset and hence repeated training of the algorithm will not improve the accuracy rate. Machine learning models could be used to detect number plates from the image in the future. The accuracy varies with respect to the zoomage of the number plate in the image. For different qualities of the image, the accuracy rate vs the zoomage is compared and visualised in the form of a chart.

RESULTS

Whenever a movement is sensed by the PIR and Ultrasonic sensors, the message “Animals” is displayed on the LCD Display and Accident Detection algorithm is started. The message “Safe Journey” is displayed until any movement is sensed with the sensors constantly sensing for any possible movements as seen in Figure 8. When an accident occurs, it is detected and the Number plate detection algorithm is started, the output of which is shown in Figure 9. If there is no accident, the accident detection algorithm constantly runs for a particular amount of time. After that, the process starts from the beginning. If a number plate is detected by the number plate detection algorithm, the number plate image is mailed to the Police Department. Else, if no number plate is detected, no mail is sent. These are the possible results that can occur and can be observed in the number plate detection algorithm. After the number plate is extracted, it is sent as a mail to the Respective Departments as shown in Figure 10. cases when noise is present, we may be able to get away with noise removal techniques used in the implementation, though the accuracy will depend on there maining data that we have after the noisy part is removed.

SCOPE FOR FUTURE WORK

This implementation of the Wildlife Vehicle Collisions(WVC) detection system is just a prototype of its kind. There is room for improvement in the way it is implemented. The data here is stored and processed locally in the Raspberry Pi, which is not backed up and is prone to data loss. Cloud concepts can be used to perform storage and processing





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of the necessary images. The images taken from the various webcams can be stored in an Amazon S3 storage bucket [25] and these images can be processed by storing the necessary codes in an Amazon EC2 instance. The processed images can then be sent to the respective departments from the EC2 instance. The power to be given to the Arduino and Raspberry Pi should be either via a battery or an AC source. It is difficult to find an AC source in the remote areas and the frequent replacement of batteries is a major issue if we use them. Hence, a solar powered power source could be used to supply power to the boards in the remote areas. Alternatively, a step-down transformer can be used to extract power from the supply lines that pass through the area. The system uses images to detect the accidents and there may be cases where there has been a minor collision and the animal isn't hurt. The accuracy of the system could be improved by using Audio Analysis [26] programs to detect if the animal is in pain or not by analysing its cry. This will avoid the need for help at times when it isn't needed.

CONCLUSION

Wildlife Vehicle Collisions are on the rise and pose a major threat to the vehicles and the animals. There are many ways to prevent and detect such accidents but none of them were able to rapidly transfer information to the concerned organisation. There were only static methods for preventing accidents but not any dynamic ones. Fitting cameras in cars to detect accidents does not leave the riders with time to react. Even if a system is successful in detecting an accident, it doesn't provide any means of helping the injured. Hence a WVC detection system is introduced in this paper which aims at detecting the accidents and immediately notifying the Forest department about the accident so that first aid could be provided for the injured. Such a system will be helpful in saving the lives of the injured. By fitting cameras at trees, we could alert the drivers of animal crossings beforehand. This system could be used in remote areas where there is very little human settlement. Thus the system provides a cost-effective, technology based approach of detecting accidents on the road.

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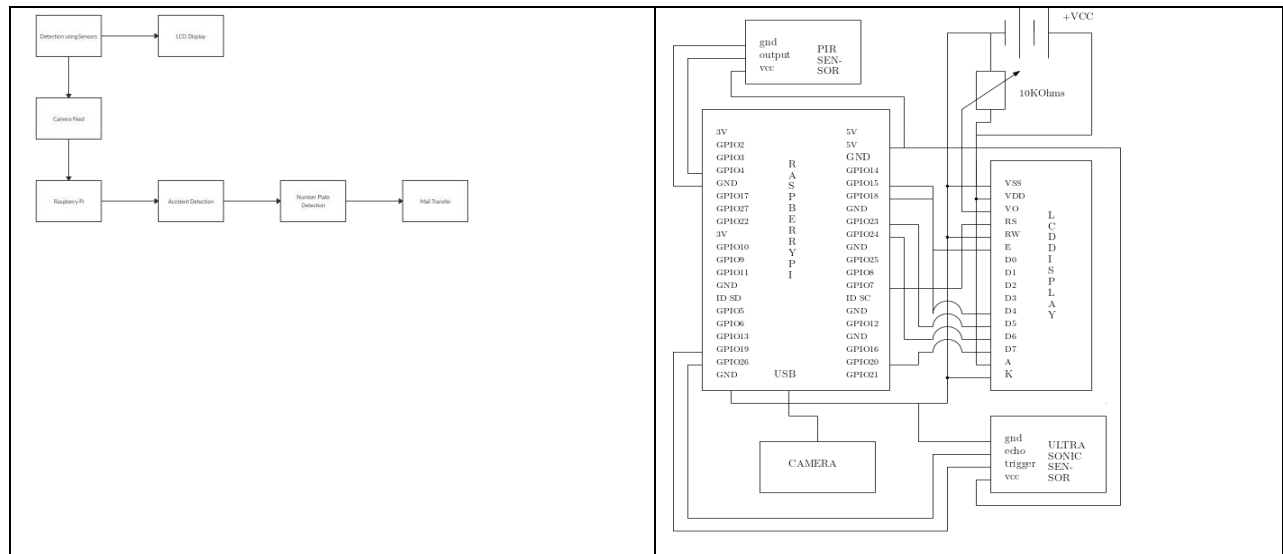


Fig. 1. Workflow of the Wildlife Vehicle Collision Detection System.

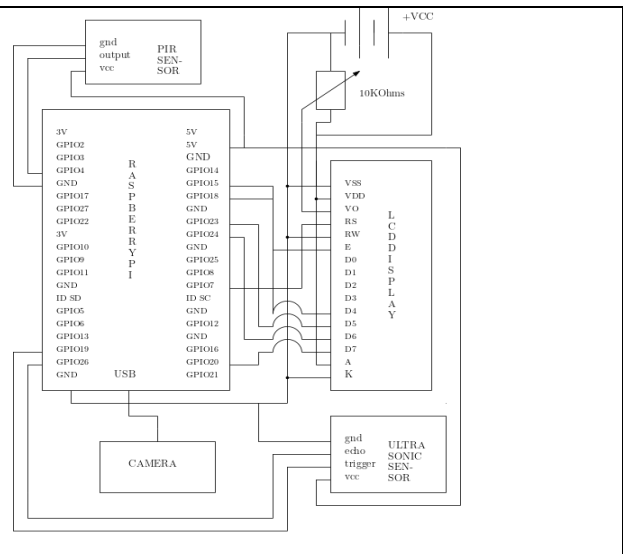


Fig. 2: Hardware connection between components.

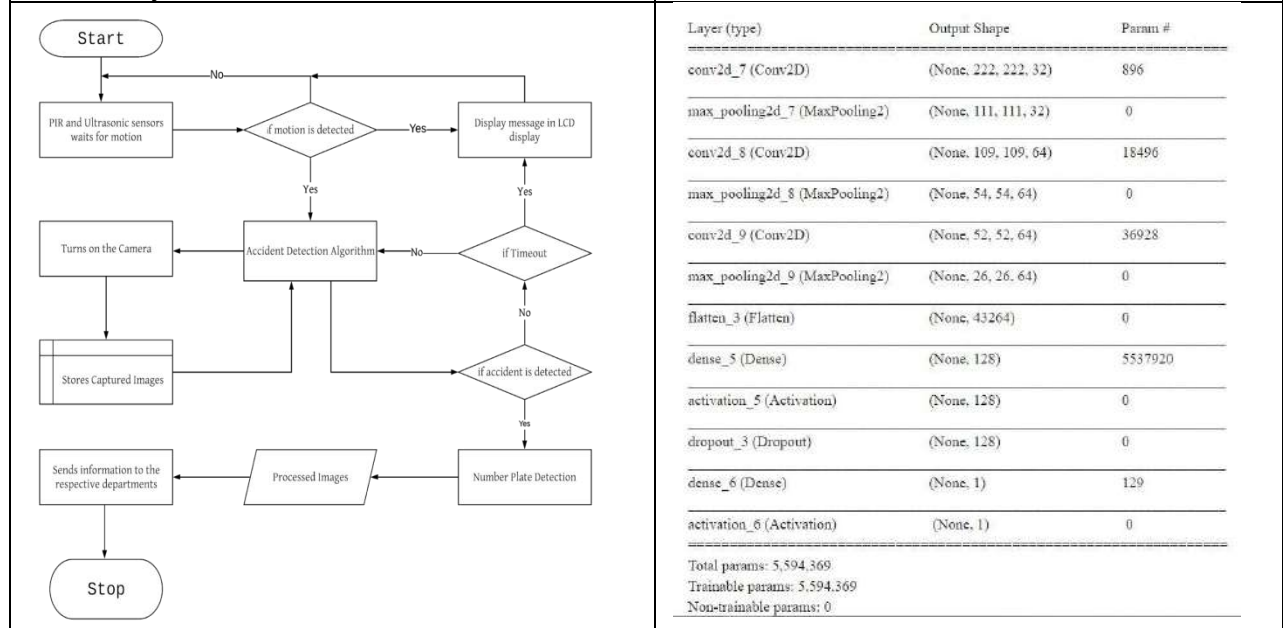


Fig. 3: Overall flow of the proposed system.

Layer (type)	Output Shape	Param #
conv2d_7 (Conv2D)	(None, 222, 222, 32)	896
max_pooling2d_7 (MaxPooling2)	(None, 111, 111, 32)	0
conv2d_8 (Conv2D)	(None, 109, 109, 64)	18496
max_pooling2d_8 (MaxPooling2)	(None, 54, 54, 64)	0
conv2d_9 (Conv2D)	(None, 52, 52, 64)	36928
max_pooling2d_9 (MaxPooling2)	(None, 26, 26, 64)	0
flatten_3 (Flatten)	(None, 43264)	0
dense_5 (Dense)	(None, 128)	5537920
activation_5 (Activation)	(None, 128)	0
dropout_3 (Dropout)	(None, 128)	0
dense_6 (Dense)	(None, 1)	129
activation_6 (Activation)	(None, 1)	0
Total params: 5,594,369		
Trainable params: 5,594,369		
Non-trainable params: 0		

Fig. 4: Summary of the Accident Detection Module.



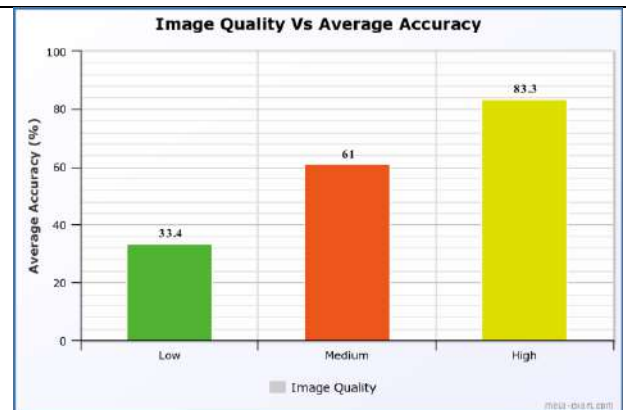
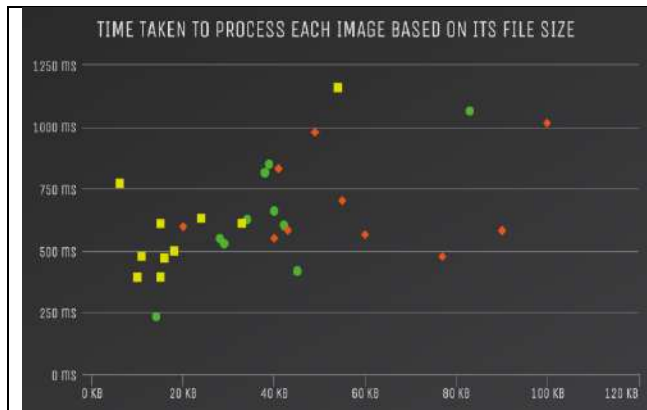


Fig. 5: The scatter plot showing the relation between the size of the file, quality of the image and the time taken to process the image.

Fig. 6: A bar graph showing the relation between the image quality and accuracy.

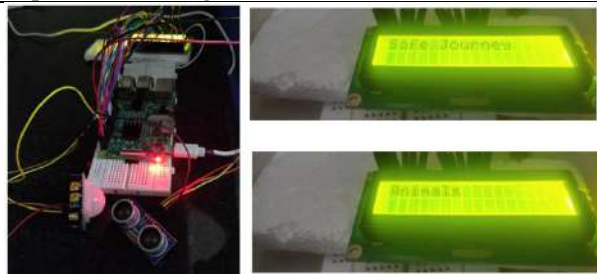


Fig. 7: Output of the sensing module.



Fig. 8: The number plates from the scene extracted using the number plate detection algorithm with its output.

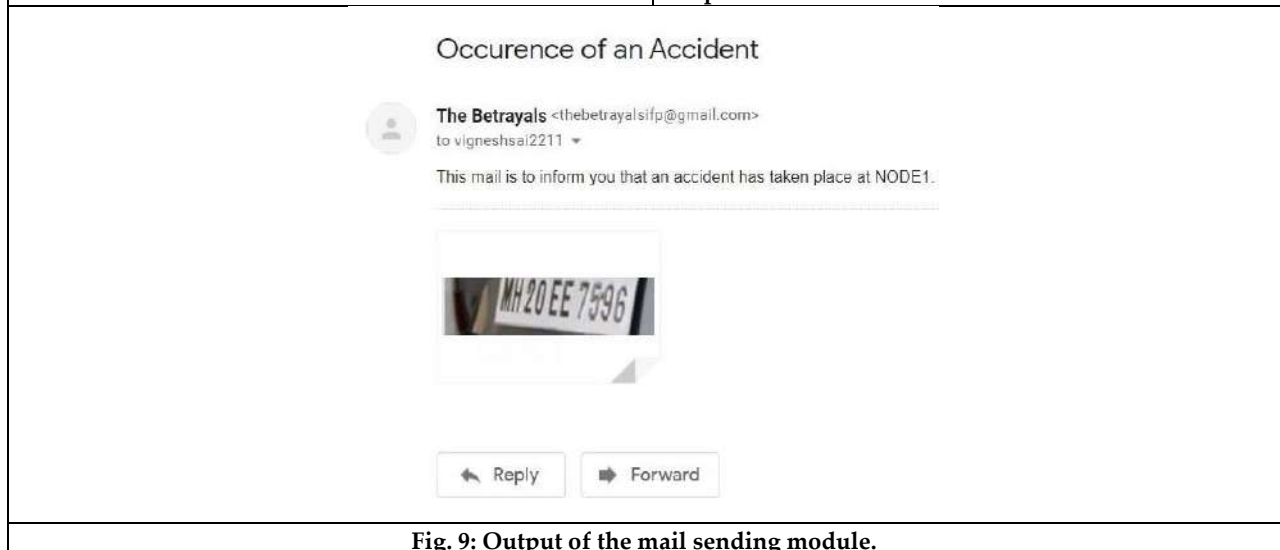


Fig. 9: Output of the mail sending module.





Qualitative and Quantitative Analysis of *Thurunji Manapaagu* – A Siddha Herbal Formulation

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ABSTRACT

Citrus aurantium belongs to the family Rutaceae and possesses multiple therapeutic potential. It is known for its antimicrobial, anti-cholinesterase, antispasmodic, anticoagulant, radical scavenging, and anti-cancer activities. In this paper, an attempt was made to evaluate the Siddha herbal medicine *Thurunji Manapaagu* by analytical methods and chromatographic studies. It is a compound with fruit juice *Thurunji (Citrus aurantium)* and sugar (*Saccharum officinarum*). It is indicated for reducing the vitiated *pithathodam* and other *pitham-related* disorders. *Manapaagu* (syrup) is one of the easily palatable dosage forms with a shelf life of 6 months. *Thurunji Manapaagu* is a mild yellowish, free-flowing, non-greasy, non-viscous liquid with an acidic pH of 5.1 and a specific gravity of 1.088. It is soluble in water, ethanol, and DMSO and insoluble in chloroform, ethyl acetate, and hexane. It is a clear solution with no visible foreign particles. The preliminary phytochemical analysis revealed the presence of carbohydrates, saponins, flavonoids, diterpenes, gum, and mucilage which supports the literature study of the individual ingredients of the drug. TLC profiling of the sample confirms the presence of phytochemicals. HPTLC fingerprinting analysis reveals the presence of six prominent peaks corresponding to the presence of six versatile phytocomponents present with the R_f ranging from 0.02 to 0.90.

Keywords: *Citrus aurantium*, chromatographic studies, phytochemical analysis.

INTRODUCTION

Siddha is one of the ancient medical systems in India considered the mother medicine of ancient Tamils/ Dravidians in south India. The word Siddha means established truth. The Siddha system of medicine was classified based on five properties *suvai*(taste), *gunam*(character), *veeriyam*(potency), *pirivu*(class), and *mahimai*(action) [1]. It is based on the concept of “*Annada thilullathaepindam, pindat hilullathaeandam*” which means the composition and life of the human body are like the composition of the universe e.g. ,Extrinsic, and Intrinsic factors in health and disease[2].



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The World Health Organization (WHO) defines herbal medicine as a practice that includes herbs, herbal materials, herbal preparations, and finished products that contain active ingredients parts of plants or other plant materials. The active ingredients protect plants from damage and diseases and contribute to the plant's aroma, flavor, and color. Scientifically, they are known as phytochemicals [3].

Chromatographic methods are an excellent tool in the analysis of bioactive compounds present in pharmaceutical preparations and extracted from the plant medicinal substance. The versatility and resolving power of chromatographic systems have made chromatography an excellent analytical technique intensively used for scientific, industrial, and medical purposes [4]. Thin-layer chromatography is the preliminary step to identify the phytochemical constituents in a sample. High-performance thin-layer chromatography HPTLC can provide an electronic image of the chromatographic fingerprint and a densitogram to detect the presence of a marker compound in a plant sample. It is the most efficient, faster, reliable, and reproducible [5]. In this paper, an attempt was made to evaluate a Siddha formulation, *Thurunji Manapaagu* by analytical methods and chromatographic studies. *Thurunji Manapaagu* is used to treat *Pithathodam* and diseases preceding the *Pithathodam*. *Manapaagu* (syrup) is one of the easily palatable dosage forms with a shelf life of 6 months.

MATERIALS AND METHODS**Preparation of trial drug *Thurunji Manapaagu***

Thurunji Manapaagu was prepared as per the Siddha classical literature, *Siddha Vaidhiya Thirattu*. Ref. K.N. Kuppusamy Mudhaliyaar, 1st edition, published by the Directorate of Indian Medicine and Homeopathy (1933).

Ingredients

Thurunji fruit juice - *Citrus aurantium*

Sugar - *Saccharum officinarum*

Procurement and authentication of the drug

The fresh fruit was procured from Accharapakam farmlands, and it was authenticated by the botanist of the National Institute of Siddha.

Preparation of the Drug

The fruit juice was taken in an earthen pot. Sugar crystals are added and boiled until moisture content evaporates and an aromatic odor appears. The *Manapaagu* formed was stored in an airtight container. Represented in Figure – 1.

Analytical Methods [6]

The analytical methodology includes the determination of organoleptic characters, solubility, physicochemical parameters, preliminary Phytochemical analysis, TLC photo documentation, and HPTLC fingerprint studies.

Organoleptic Characters

The Organoleptic characteristics such as color, odor, taste, flow property, nature, and consistency were noted.

Solubility

The solubility of *Thurunji Manapaagu* was noted in different solvents.

Physicochemical Parameters

The physio-chemical examination includes specific gravity, pH, and clarity of the *Thurunji Manapaagu* was determined by standard methods.

Preliminary Phytochemical Analysis

Preliminary Phytochemical analysis for phenols, terpenoids, steroids, flavonoids, quinines, coumarins, alkaloids, tannins, acids, and glycosides were conducted by standard procedures.

Thin Layer Chromatography

The sample was subjected to a thin layer chromatography method using silica gel 60F254 cm (Merck). The mobile phase which was used Chloroform: n-Butanol: Methanol: Water: Acetic acid (4:1:1:0.5:0.5). Micropipettes were used to



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spot the sample for TLC and applied sample volume of 10- microliter by using pipettes at 1 cm at 5 tracks. In the twin chamber with the specified solvent system. After the run plates were dried and were observed using visible light short-wave UV light 254nm and light long-wave UV 365nm [7].

HPTLC Finger Print**Chromatogram Development**

It was conducted in CAMAG Twin Trough chambers. Sample elution was carried out according to the adsorption capability of the component to be analyzed. After elution, plates were taken out of the chamber and dried. Plates were scanned under UV at 366nm. The data obtained from scanning were brought into integration through CAMAG software. The chromatographic fingerprint was developed for the detection of phytoconstituents present in each sample and their respective R_f values were tabulated [8].

RESULTS:**Organoleptic characteristics:**

The organoleptic characteristics of *Thurunji Manapaagu* are shown in Table 1, *Thurunji Manapaagu* was a mild yellowish, non-viscous, non-greasy, free flowing with a characteristic odor.

Solubility

The solubility of *Thurunji Manapaagu* is shown in Table 2. *Thurunji Manapaagu* was soluble in water, ethanol, and DMSO.

Physiochemical analysis

Physiochemical analyses of *Thurunji Manapaagu* are shown in Table 3. It is a clear solution with a specific gravity of 1.088 and pH 5.1.

Phytochemical analysis

The preliminary phytochemical analysis of *Thurunji Manapaagu* is shown in Table 4. *Thurunji Manapaagu* contains carbohydrates, saponins, flavonoids, diterpenes, reducing sugars, gum, and mucilage.

TLC and HPTLC fingerprint

The TLC photo documentation and HPTLC fingerprinting are shown in Figures 2 and 3. The fingerprint documentation reveals the presence of six volatile phytoconstituents.

DISCUSSION

Thurunji Manapaagu is a Siddha herbal preparation consisting of the fruit juice *Thurunji*(*Citrus aurantium*) and *Sarkari* (*Saccharum officinarum*) which is used to treat the *pitham* and the disease related to vitiated *pitham*. As per Siddha literature, “*pithamathikaripinpesumparikaramsuthaththuvorodussoliniupusathaagum*” by *Kannusamiyam* states that the increased *pitham* is pacified by the taste of bitter, sweet, and astringent. The plant *Thurunji* is known as *kittchilipalam*, *kolunjipalam*, possesses the taste of bitter and sweet. The *Citrus aurantium* fruit possesses proton radical, oxyradical, and hydroxyl radical scavenging abilities. Regression analysis showed a positive association between total phenolics and different antioxidant assays [9]. *Sarkari* (*Saccharum officinarum*) has the taste of sweet and coolant properties. “*Senkarumbupathana saarutheerthidumpithamellam*” The quote states that the juice indicated for the reduction of *pitham*. It has been used as an adjuvant for various Siddha medicines [10].

Thurunji Manapaagu is a mild yellowish, free-flowing, non-greasy, non-viscous liquid with an acidic pH of 5.1 and a specific gravity of 1.088. It is soluble in water, ethanol, and DMSO and insoluble in chloroform, ethyl acetate, and hexane. It is a clear solution with no visible foreign particles. The preliminary phytochemical analysis revealed the presence of carbohydrates, saponins, flavonoids, diterpenes, gum, and mucilage which supports the literature study of the individual ingredients of the drug. Saponin has been reported to have a wide range of pharmacological and medicinal activities. It has been revealed that saponin has both hypertensive and cardiac depressant properties. They are potentially useful for the treatment of hypercholesterolemia which suggests that saponin might be acting by interfering with intestinal absorption of cholesterol, thus having antidiabetic effects [11]. The flavonoids of citrus fruits include Quercetin, myricetin, rutin, tangerine, naringin, and hesperid in which possess antioxidant activity



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[12]. HPTLC fingerprinting analysis of *Thurunji Manapaagu* reveals the presence of six prominent peaks corresponding to the presence of six versatile Phytocomponents presenting R_f values 0.02, 0.09, 0.12, 0.18, 0.21, and 0.90. The HPTLC results are interpreted based on the area coverage of the peak, the height of the peak, the number of peaks, and the R_f value of the peaks. It was noted that the six components occupied the R_f value ranging from 0.02 to 0.90. Among them, peaks 0.02 and 0.90 have higher percentage areas of about 43.44% and 20.35% which denotes the abundant existence of this compound. The prior studies of HPTLC fingerprint of *Citrus aurantium* rind scanned at wavelength 254nm for ethanol extract revealed eight polyvalent phytoconstituents with R_f values ranging from 0.03 to 0.80 in which the highest concentration was found to be 48.61% and its corresponding R_f value was found to be 0.03 [13]. Herbal medicines are composed of many phytoconstituents. It is important to obtain reliable chromatographic fingerprints that represent pharmacologically active and chemically characteristic components. HPTLC fingerprinting profile helps for the herbal drug standardization with proper identification of medicinal plants. These methods were also employed to analyze commercial samples to illustrate their application in qualitative and quantitative determinations, demonstrating their feasibility in the quality control of Phytoconstituents from herbal drugs and formulations [14].

CONCLUSION

Analysis of *Thurunji Manapaagu* has been carried out to put forward the standards for evaluating its quality and purity. The present study has revealed the physiochemical, preliminary phytoconstituents, TLC, and HPTLC fingerprinting of the drug. However, in addition to the present study, further clinical and preclinical studies are mandatory to confirm the efficacy of *Thurunji Manapaagu* for *pitham-related* diseases. This study can be a beneficial root of data for future research.

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Table 1 : Organoleptic characters of *Thurunji Manapaagu*

State	Liquid
Nature	Non – viscous
Odor	Characteristic
Touch/Consistency	Non- Greasy
Flow property	Free Flowing
Appearance	Mild Yellowish

Table 2 : Solubility Profile of *Thurunji Manapaagu*

S. No	Solvent used	Solubility/Dispersibility
1	Chloroform	Insoluble
2	Ethanol	Soluble
3	Water	Soluble
4	Ethyl acetate	Insoluble
5	Hexane	Insoluble
6	DMSO	Soluble

Table 3 : Physiochemical analysis of *Thurunjimanapaagu*

S.no	Parameters	Results
1	pH	5.1
2	Specific gravity	1.088
3	Clarity	Clear solution with no visible particles

Table 4 : Phytochemical analysis of plant *Thurunji* and *Thurunji Manapaagu*

S.no	Phytochemicals	<i>Thurunji Manapaagu</i>
1	Alkaloids	-ve
2	Carbohydrates	+ve
3	Saponin	+ve
4	Phenols	-ve
5	Tannins	-ve
6	Flavonoids	+ve
7	Diterpenes	+ve
8	Quinines	-ve
9	Gum and Mucilage	+ve
10	Reducing sugars	+ve





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Figure1: Preparation of the drug

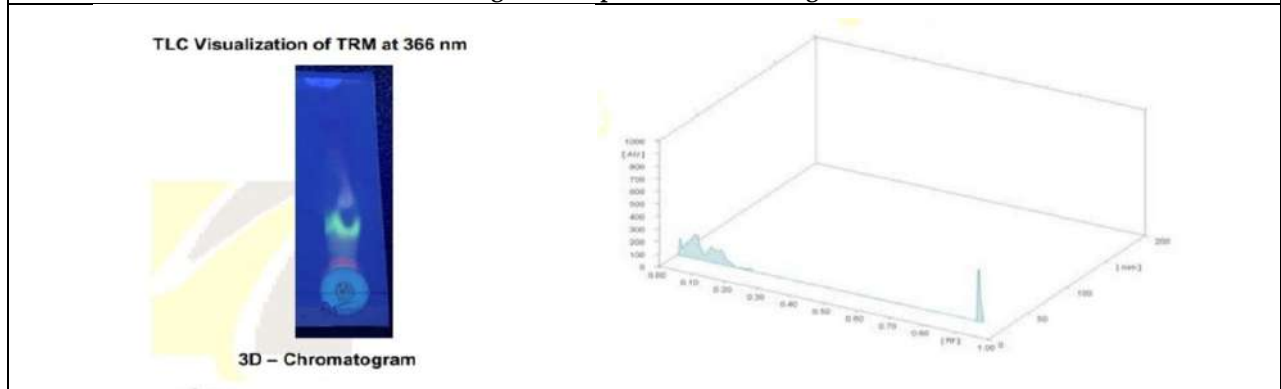


Figure 2 : TLC photo documentation profiles of *Thurunji Manapagu*

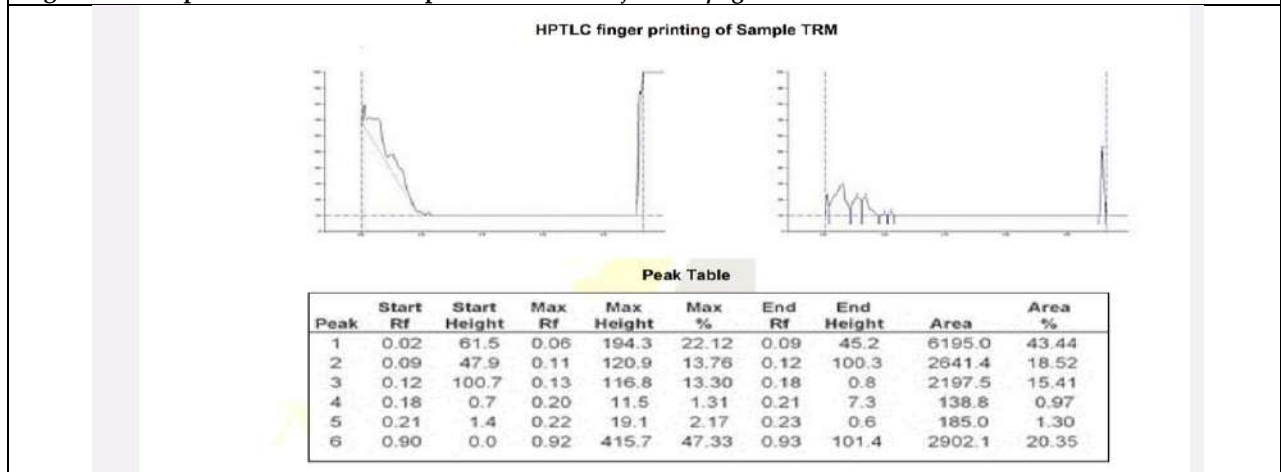


Figure 3 : HPTLC fingerprint profile of *Thurunji Manapagu*





Comparison of Mirror Box Therapy, Action Observation Technique and Motor Imaginary Technique in Stroke Patients - A Narrative Review

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ABSTRACT

In stroke there is a sudden interruption of the blood flow to the brain which leads to severe motor and sensory dysfunction. In this 80% have motor impairment among them 20% recovered in a few months while the remaining 50-60% are left with the chronic motor disorder and approximately 50% of stroke patient's show somatosensory deficits. The aim of the study is to review the literature on effectiveness of various cognitive Therapy i.e, Mirror box therapy, Action observation technique, and Motor imaginary technique in stroke patients. Electronic databases used for relevant trials: were Google scholar, PubMed, Cochrane and NCBI. All the articles, irrespective year of publication, on Mirror box therapy, Action observation technique, and Motor imagery technique in stroke patients were kept as Inclusion Criteria. Total 192 articles were search which includes Mirror box therapy, Action observation technique, and Motor imaginary technique in stroke patients. After screening 41 studies were finally included in the review. A total of 41 studies were finally included in the review. 14 studies of the Action observation Technique, 12 studies of Mirror box therapy, and 14 studies of Motor Imagery technique. All three methods significantly improved motor & sensory dysfunction in stroke patients. The effectiveness of each technique varied depending on the stage of the stroke; MBT improved hand function in chronic stroke, AOT improved gait and balance in subacute stroke, and MI was more successful in acute stroke.

Keywords: Stroke, Mirror box therapy, Action observation technique, Motor imagery technique, Rehabilitation.

INTRODUCTION

A stroke is characterized by an abrupt loss of neurological function caused by a disruption in blood flow to the brain.[1] The second most substantial cause of mortality worldwide is stroke.[2][3] There are two distinct forms of stroke. Ischemic stroke extremely prevalent form of stroke is one that endures for an extended period of time and can



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be triggered by a lack of blood flow to the brain[4][5]. Hemorrhagic stroke is an acute space-occupying lesion that compresses and disrupts the surrounding tissue and causes an increase in intracranial pressure due to that blood flow and metabolism are disturbed [5] Motor and sensory challenges are exceptionally common after stroke; 80% of stroke patients wore motor impairment, 20% of those for whom recovered within a few months, while the remainder of 50–60% have a pervasive motor dysfunction, while approximately 50% of stroke patients have sensory anomalies[6]. As a consequence, there are numerous alternative physiotherapy modes accessible one of which employs cognitive treatment to emphasize the mirror neuron system, such as Mirror Box treatment, Action Observation, and Motor Imaginary Training.[7][8] For instance, of mirror neurons to be indulged by visual inputs, a biological effector (such as the hand or mouth) has to interface with a specific object.[9] The relationship between the visual and motor features of mirror neurons is a crucial component of their functionality.[10] Mirror neurons are categorized into "strictly congruent" and "broadly congruent" neurons based on the type of parallelism they exhibit. Mirror neurons were identified and described as "strictly congruent" when the effects seen and executed actions match in terms of the aim (such as grasping) and method of achieving the goal (such as a precise grip). Broadly congruent mirror neurons have been defined as those that do not require the same action to be observed to activate as that which they code motorically.[9][10] These cognitive therapy methods are more practical, inexpensive, and the patient can perform independently and which helps to change the thoughts, emotions, and behavior of the patient.[11] Motor imagery (MI) is the process of portraying an item or a person moving.[12] Despite the presence of external stimuli, humans actively replicate actions thru a process known as motor imagery. MI technique is the ability to imagine movement visually and somasthetically to improve motor skills without performing the actual movement.[13] It is a dynamic process that incorporates kinesthetic and visual data about the movement that has been mentally practiced.[14] MI is immediately implementable and doesn't need any specific facilities or equipment. Greater functional independence could result from MI by facilitating the motor relearning process.[15] Acute, subacute, and chronic hemi paresis are all effectively treated with MI, and it additionally performs well for Parkinson's, spinal cord injury, intractable pain, and multiple sclerosis patients[16,17]. Action Observation Technique (AOT) is the simulate of attempting to imitate an action that has been seen in a video clip or is being carried out by a Person.[18] Activities can be mentally practiced or simply observed, and these acts can also cause the recruitment of motor regions.[19] In a somatotopic way, observing someone else perform an activity activates the same motor representations that are used to perform that action itself.[17] The subjects' recorded muscular response patterns and the pattern observed when they performed the motion physically were identical.[20] It seems to be beneficial for restoring function after a stroke and enhances motor function,[21] improving language deficit, Parkinson's, improving function of post orthopedic surgery[22], and cerebral palsy [23]. Mirror Box therapy (MBT) is used to improve motor recovery by giving visual stimuli. [24][25] The contra-lateral hemisphere activated when the paretic limb is moved. A paretic limb's visual representation is said to resemble a person's moving limb.[24] There are many different mechanisms underpinning rehabilitation, such as active training techniques and passive damage adaptability methods.[19] The goal of this study is to evaluate the existing research on the efficacy of many different cognitive therapies in stroke patients, such as motor imagery, action observation method, and mirror box treatment. So it will provide in-depth insight into the efficacy of different tactics, through which a physiotherapists can choose an appropriate technique for stroke patients.

With the Objectives

To assess the efficacy of Mirror box therapy, Action observation method, and Motor imaginary technique in improving stroke patients' motor and sensory function.

Non-invasive treatments such as mirror box therapy, action observation technique, and motor imaging have shown encouraging results in improving motor function in stroke patients.

A comparative study will provide physiotherapists with an in-depth insight of the efficacy of different tactics, assisting them in picking the appropriate technique for each patient





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METHODOLOGY

A thorough review of the literature was carried out utilizing internet resources such as PubMed, Google Scholar, NCBI, and Cochrane Library. "Mirror Box Therapy, Action Observation, Motor Imagery, Stroke, Rehabilitation, Therapy, and Treatment" were utilized as search phrases. The search was constrained to Articles published in English between 2005 and 2022. The initial search yielded total of 192 articles, of which 62 study were included in the review. After reading all abstract and methodology duplicate are remove remaining 94 reviews were screening whole methodology and result. And after full text screening 32 articles were exclude. A total of 62 studies were finally included in the review (Figure 1). Fourteen studies of the Action observation Technique, Twelve studies of Mirror box therapy, and fourteen studies of Motor Imagery technique. Inclusion criteria are: Studies that have been published in English; Stroke sufferers have been the subject of studies; Research on the use of motor imagery, action observation, and mirror box treatment as therapies; conducted between 2005 and 2022; and Randomized controlled trial is a part of the study. Exclusion criteria are: Studies that have not been published in English; Studies without participants with stroke; Research not use motor imagery, action observation, or mirror box therapy as methods; Research with a small sample size (e.g., less than 10 participants); and Review articles.

DISCUSSION

Mirror box therapy, Action observation, and motor imagery are all promising techniques used in stroke rehabilitation. These techniques aim to improve motor and sensory function. These all techniques work on the mirror neuron system. Mirror neurons are a distinct group of neurons that provide a "observation-execution matching Mechanism" capable of unifying action sensing and execution.[26] The purpose of this study is to review the effectiveness of these approaches in stroke rehabilitation. In accordance with Lee *et al.* (2012), after a period of four weeks of Mirror Therapy Program (MTP), there is a substantial rise in motor abilities of the upper limb in acute stroke patients.[27]. Yeldan *et al.* (2015) revealed that in acute stroke, MBT has no additional impact upon upper extremity functional recovery.[28] According to the study of Mathieson *et al.*(2018), suggest that the combination of mirror box therapy and functional electrical stimulation (FES) do not have the desired stacking effect on improving motor recovery. But in acute stroke FES alone shows significant improvement compared to mirror box therapy,[29] but it is only maintained when a patient takes regular physiotherapy and adjunct therapies.[30] Then in 2018, Yim and Kim *et al.* reported that Repetitive trans-cranial magnetic stimulation (rTMS) along with task-oriented mirror therapy (TOMT) shows exceptional results in terms of motor function recovery through mirror neuron system in stroke patients and shows significant improvement in grip strength, pinch grip, and box and block outcome.[31] In a study of Karamat *et al.* (2022) compared the Mirror therapy with repetitive facilitation exercise (RFE) and was found mirror therapy more effective. As in MT large number of muscles work together and it stimulate damaged muscles which improves patient upper arm function following hemiplegic stroke.[32] Study of kang *et al.*, stated that the use of PC application based mirror therapy can improve face movement along with orofacial Exercise.[33]According to Kuys *et al.*, patients with chronic hemiparesis may gain from MBT in terms of sensation as well as motor impairments, activity limitations and participation restrictions if it is used as an active sensory-motor training program in the chronic stage.[34] Similar to a research by Lin *et al.*, using the MBT with Mesh Glove (MG) approach, which is a type of sensory-motor stimulation, significantly improved Chronic stroke patients' hand dexterity, gripping, and transfer performance.[35] Further study conducted by Lee *et al.* (2015) they combine two therapy together i.e MT alone, MT + MG, MT + sham, and they found that MT + MG and MT + Sham group showed significant improvement then MT alone in manual dexterity and ADL's.[36] Task-based mirror therapy (TBMT) was used in a research by Arya *et al.* (2015) on post-stroke patients to address the upper arm (UA), wrist-hand (WH) components. The mirror box design restricted upper-arm movements, such as shoulder rotation and overhead movement, which caused FMA-UA scores to improve less substantially than FMA-WH scores.[37] He did another research in 2018 that demonstrates the benefits of mirror therapy treatment in the healing of sensory impairment.[38] According to Lee *et al.* (2015), there is a research where they combine mirror treatment with functional electrical stimulation (FES), which is based on biofeedback, to produce integrated muscular contraction for the afflicted and



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less affected sides. Due to the fact that BF-FES provides motor input, mirror therapy provides visual biofeedback to the patient, and both treatments serve as task-oriented training for the bilateral upper extremities, patients who have had strokes have significantly improved thanks to this combination.[39] Patients were requested to visualise 18 distinct ADLs in order to improve upper extremity performance in a study by Seong-sik Kim *et al.* on the use of the motor imaginary technique as a therapeutic approach for stroke patients. After using the MIT, patients' FMA-UE scores dramatically increased from 27.92 to 36.08.[40] A study of Frolov *et al.*, "Study on sensory- motor function suggests that MI could be a promising treatment for improving cutaneous sensibility in patients with stroke. The mirror illusion prompted by MI can be utilized to make up the difference for sensory and motor deficits, as well as to differentiate between more and less affected hands".[41] Hemmen and seelen *et al.* conducting a study on movement motor imagery along with electromyography-triggered feedback for wrist Extensors but it does not show any significant improvement in arm-hand performance.[42] A motor imagery technique is to enhance functional task performance, according to Eerdt *et al.* (2010), "found that both the patient and the therapist had limited compliance with employing motor imagery. Future research must go more deeply into how this tactic is applied in clinical settings.[43] Similar concerning the way Kim and Lee *et al.* (2015) propose that motor imagery approach can enhance gait speed and balance in stroke patients.[44] When stroke patients employ the motor imagery technique to sit to stand, according to Sherin *et al.* (2022), their capacity to do so is greatly increased. It aids in transfer activity and ADLs as well.[45] According to the kim *et al.* a "study demonstrates a substantial increase in gait time and distance variables". According to the study's findings, people with post-hemiparesis may be able to walk more easily if certain acts from their motor repertoire are observed and related to gait performance.[46] Oostra *et al.* (2015) noted that motor imagery training may help subacute stroke patients with their gait function, but they also noted that more research was necessary.[47] Kumar *et al.* (2016) shows similar effect to improve muscle strength of lower extremity and gait through motor imagery.[48] Another study on mental practice using motor imagery found no evidence of help in stroke patients. There was not any sign of better performance as a result of mental practice with motor imagery on any of the outcome measures.[49] Park and lee *et al.* (2015) mentioned that function of upper extremity and ADL's may improve through motor imagery and mental training.[50] A study on little mental practice to improve motor task performance revealed performance gains after mental practice in any of the four groups. In this study, there was little mental practice, which might not have improved motor skills. Yet, increasing mental practice and concentration levels might enhance motor performance rather than simply making the subject's mental imagery more vivid. [51] There is a study by Page *et al.* (2005) where they used mental practise (MP) in chronic stroke patients with their most affected side. As we know, stroke patients do not use their affected arm much, so for the same reason, they use mental practise as an intervention. They found that after the 6 week of protocol (two sessions per week), changes were observed in the affected side and the individual started to use that limb more often.[52] He conducted further in 2007 study which also showed the effectiveness of programs incorporating mental practice for treating individuals with chronic stroke who have impaired a motor function.[53] "Studies on game-based virtual reality plus mental practice outcomes indicate that game-based VR movement therapy may be effective for functional recovery of the UE in chronic stroke patients, and that the effects are enhanced when the therapy is combined with MP," Park *et al.* (2016) write.[54] A study by Kuk and Eun-ju *et al.* on the use of the action observation approach to treat hand dexterity in stroke patients showed a notable improvement in cortical reorganization and the activation that fosters motor memory. This result was discovered using an EEG-based brain mapping.[55] In the words of Franceschini *et al.*, AOT has the ability to carry out traditional rehabilitation by highlighting the positive effects of the action observation technique in the patients functional dexterity and primary goal to restore lost function within the damaged motor network via use-dependent plasticity, the important component of action observation is replication of the observed movement.[56] According to sale *et al.*, study shows someone move with the intent of imitating them can make some brain regions more excitable and encourage the regaining of motor function. Right hemisphere strokes improve more quickly than left hemispheric strokes when action observation and action execution are combined.[57] and in left hemisphere dominance, patients with left hemisphere lesions showed higher overall activation levels than those with right hemisphere lesions.[58] which suggest that Action observation with conventional rehabilitation can improve function in the upper extremity and daily living activities in stroke patients.[59,60] A film is shown in three phases at various speeds in the Bang *et al.* (2013) Study; to improve walking ability in chronic stroke patients, allowing participants to precisely observe walking behavior while the therapist also gives vocal instructions. The results of this





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study showed that action observation and treadmill exercise greatly enhance patients' ability to walk after chronic stroke.[61] Another study by Oh and Lee *et al* examines if Functional Action-Observation (FAO) can help individuals with post-stroke hemiparesis by using a gait analysis system to measure spatio-temporal characteristics. Findings indicate that functional action observation training is more successful at improving the gait of chronic stroke patients [62]. Limitation, some studies have a relatively small sample size, which leads to inaccurate results, while others have limited age restrictions, so the results are not applicable to the entire population. One of the virtual studies is tele-rehabilitation, which cannot be adequately evaluated. Some studies were completed in a short period of time, while others required an inordinate amount of time to complete. Some studies just look at hand functions, while others look at gait and balance as a whole.

CONCLUSION

We came to the conclusion from this study that all three stroke treatment methods are efficient. Both MBT and MI significantly improve at the acute stage, but MI does so more dramatically than MBT. All three treatment modalities—MBT, AOT, and MI—show considerable improvement in subacute stroke patients, although AOT produces the best outcomes. All three techniques are helpful in the chronic period; although MBT demonstrates the most improvement in hand function. AOT is superior to MI for enhancing gait function and balance.

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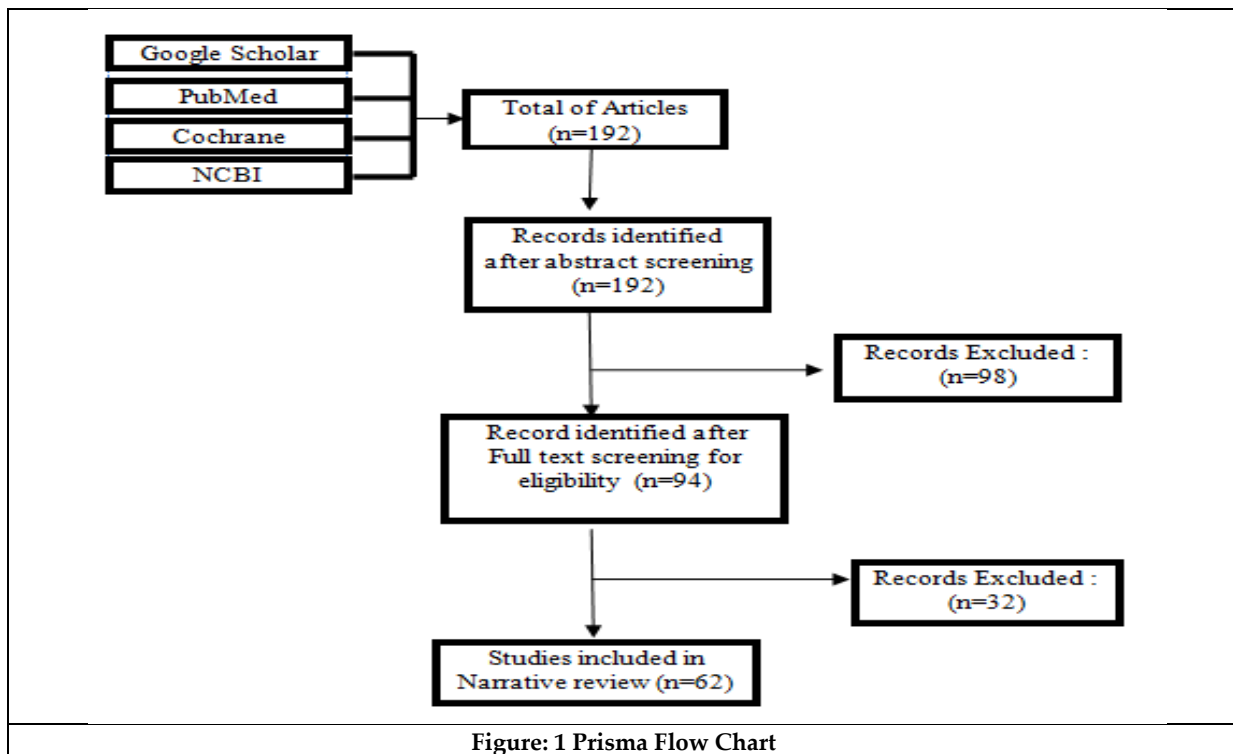
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Phytochemical Screening and Evaluation of Anthelmintic Activity of *Thespesia populnae* by *In-Vitro* Methods

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ABSTRACT

The whole plant extract of *Thespesia populnea* was subject to anthelmintic activity. The ethanol extract showed a good anthelmintic property when compared to other extracts. Also, the phytoconstituents were also investigated and analysed. Albendazole was used as a standard drug for anthelmintic activity. The ethanolic extract showed a moderate time of paralysis and death in the worms. These results indicate that the phytoconstituents may possess an anthelmintic activity. The anthelmintic effect of the extract *in-vitro* may either be the effect of the individual phytoconstituents or synergistic effect of the phytoconstituents.

Keywords: *Thespesia populnea*, *in-vitro*, anthelmintic, Albendazole,

INTRODUCTION

Thespesia populnea, commonly known as the **Portia tree**, **Pacific rosewood**, **Indian tulip tree**, or **milo**, among other names, is a species of flowering plant belonging to the mallow family, *Malvaceae*. It is a tree found commonly on coasts around the world. Although it is confirmed to be native only to the Old World tropics, other authorities consider it to have a wider, possibly pantropical native distribution. It is thought to be an invasive species in Florida and Brazil.





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Leaf Description

Simple leaf, heart shaped with long stalk. stipules 4-10 mm long, free, lateral, linear to lanceolate, cauducous; petiole 5-10 cm, slender, swollen tipped, scaly; lamina 5-12.7 x 5.5-15 cm, orbicular or ovate, base cordate or truncate, apex acute or acuminate, margin entire or dentate, coriaceous, with peltate scales above, glabrescent or stellate-tomentose beneath; 5-7 nerved from the base, palmate, prominent, lateral nerves 4-5 pairs, pinnate, prominent, intercostaesubscalariform, prominent, often a glandular pore in one or more of the intercostal spaces beneath.

Treatment

Albendazole was highly effective against *Ascaris lumbricoides*, *Ancylostoma duodenale* and *Enterobius vermicularis*. Significant improvement was also observed in patients having infections due to *Trichuris trichiuria*. The primary drugs used for cestode infections are albendazole and praziquantel. It is a broad-spectrum anthelmintic affecting both flukes and tapeworms. Diethylcarbamazine and ivermectin, used for treating filarial worm infections, are absorbed from the intestinal tract. Benzimidazoles, macrocyclic lactones, levamisole, piperazine and amino-acetonitrile derivatives may be used to treat almost all these parasites and lower infection levels below clinical relevance. However helminth resistance to these medications have been documented in certain publications, which is typical in the field of veterinary medicine. Plants produce a broad spectrum of secondary metabolites or phytochemicals which aid in several biological activities including the defence of the plant against pests and diseases. The major classes of phytochemicals include phenolic, alkaloids, flavonoids and terpenoids compounds. These phytochemicals make some plants a good source of remedy for ailments.

Plant secondary metabolites have been successfully used in ethnomedicine and are generally used for insecticide, pesticidal, molluscicidal, antimicrobial, antiparasitic and other ailments. Drug resistance in helminths threatens human and animal health across the world. Understanding the genetics and mechanisms of helminth medication resistance is critical for preventing resistance to newly discovered anthelmintic treatments, reducing the dissemination of resistant parasites, and effectively managing parasite management at all phases of their lifecycle. Resistance to gastrointestinal nematodes, as well as other parasitic worms such as liver fluke, has been shown to be high in ruminants. As a result, parasitological research into the causes of anthelmintic resistance is required in order to create new treatment techniques and medications for helminth control. The major approach for discovering novel anthelmintic medications were centred mostly on screening new compounds using *in vitro* and *in vivo* test system.

Helminthiasis

Helminthiasis, commonly known as **worm infection**, is a macro parasitic disease in which a part of the body is infected with parasitic worms or helminths. There are several species of parasites and they often reside in the digestive tract of the host body. Helminths either live as parasites, or free of a host, in aquatic and terrestrial environments. The most common worldwide are intestinal nematodes or soil-transmitted helminths (STH), schistosomes (parasites of schistosomiasis) and filarial worms, which cause lymphatic filariasis (LF) and onchocerciasis. Soil-transmitted helminthiasis and schistosomiasis are the most important helminthiasis and are among the neglected tropical diseases. A parasitic worm's lifecycle may be quite complicated, with several hosts for different stages; also, a significant adaptation to parasitism of a worm is a complex lifecycle incorporating tropic transmission. Some helminths (soil-borne nematodes) such as *Strongyloides* and Hookworms have a free-living stage (Rhabditiform larvae) and a parasitic stage (Filariform larvae) that may need a different host or environment.

EXPERIMENTAL METHODS

The plant sample was washed with distilled water for several times and subjected to air dried under the shade. After drying they were ground by an electrical mixer until it become powder. About 160 g of dried sample powder was weighed and extraction process is carried out in Soxhlet extractor by using 200 ml of ethanol in rotary shaker at 150 rpm at 25 °C temperature for 72 h. The extracts were filtered using Whatman No.1 filter paper, the filtrate was



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concentrated by a rotary evaporator, and the residual extracts were dried under vacuum desiccator, and stored for further use of phytochemical studies.

Preliminary Phytochemical Screening

The preliminary phytochemical analysis was carried out for the presence of terpenoids, flavonoids, steroids, anthraquinones, glycosides, carbohydrates, alkaloids, quinones, phenols, tannins, saponins, proteins and amino acids.

Test for alkaloids: Mayer's Test: To the extract, 2 ml of Mayer's reagent was added; formation of reddish-brown precipitate indicates the presence of alkaloids.

Test for saponins: To 1 ml of the extract, 5 ml of water was added and the tube was shaken vigorously. Copious lather formation indicates the presence of saponins.

Test for tannins: To the extract, ferric chloride was added, formation of a dark blue or greenish black color showed the presence of tannins.

Test for cardiac glycosides: Keller-Killani test: To 1ml of the extracts, 2 ml of glacial acetic acid containing a drop of FeCl₃. Equal volume of conc. H₂SO₄ was added from the sides of the tube. A brown color ring indicates the presence of cardiac glycosides.

Test for flavonoids: Alkaline reagent test: Extract was treated with 10% NaOH solution; formation of intense yellow colour indicates presence of flavonoid.

Test for phenols: Lead acetate test: The extract was taken; 3 ml of 10% lead acetate solution was added. A bulky white precipitate indicated the presence of phenolic compounds.

Test for steroids: 1 ml extract was dissolved in 10 ml of chloroform & equal volume of concentrated H₂SO₄ was added from the side of test tube. The upper layer turns red and H₂SO₄ layer showed yellow with green fluorescence This indicates the presence of steroid.

Test for terpenoids: Salkowski test: 5 ml of extract was mixed in 2 ml of chloroform, and concentrated sulphuric acid was carefully added to form a layer. A reddish-brown coloration of the interface indicates the presence of terpenoids.

Test for Quinones: The extracts were treated separately with Alc. KOH solution. Appearance of colors ranging from red to blue indicates the presence of quinones.

Test for Proteins: Ninhydrin test: The extract was taken and few drops of freshly prepared Ninhydrin reagent was added and heated. The appearance of pink or purple colour indicates that the presence of proteins, peptides or amino acids.

In-Vitro Anthelmintic Activity

The anthelmintic activity was tested on the Indian adult earthworm *Eiseniella fetida* using technique described by Ghosh et al. The standard medicine, Albendazole was diluted with normal saline to produce concentration of 2.5, 5 and 10 mg/ml and placed onto Petri plates. Ethanolic extracts were diluted with normal saline to reach concentrations of 2.5, 5 and 10mg/ml. The negative control was plain saline (0.9 percent NaCl). All of these dilutions were carefully put onto the petri dishes. The study used six earthworms (n = 6). At room temperature, earthworms roughly identical size (approximately 8cm) was inserted in each Petri dish. The time for paralysis was recorded when no movement of any kind could be detected, save when the worms were severely agitated. After determining that the worms did not move when shook forcefully or dunked in warm water, the time of death was recorded (50 °C). The paralysis and fatal times were measured in minutes .

RESULTS AND DISCUSSION**In-Vitro Anthelmintic Activity**

In-vitro anthelmintic activity was measured, as well as the paralysis and fatal times. The data was statistically evaluated using one-way ANOVA. The findings were reported as mean SD. The table shows the paralysis and death



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times of both standard and ethanolic extracts, as well as the norm. The study found that both standard and ethanolic extract of *Thespesia populnea* exhibited substantial efficacy at higher concentrations (10mg/ml). Each value in the table is represented as mean \pm SEM *P < 0.05 compared with standard drug Albendazole. The extracts were subjected to anthelmintic activity with albendazole as standard drug. Albendazole at 2.5mg/ml paralyzed the worm at 53.80 \pm 3.45 minutes and caused death at 110.38 \pm 3.45 minutes. The ethanol extract showed a close range of paralysis and death similar to albendazole at 10mg/ml. At this concentration the worms paralyzed at 52.64 \pm 3.46 minutes and death at 118.42 \pm 2.61 minutes.

CONCLUSION

The whole plant extract of *Thespesia populnea* was subject to antioxidant and anthelmintic activity. The ethanol extract showed a good antioxidant property and anthelmintic property when compared to other extracts. Also, the phytoconstituents were also investigated and analysed. Albendazole was used a standard drug for anthelmintic activity. The ethanolic extract showed a moderate time of paralysis and death in the worms. The antioxidant activity of the ethanolic extract were studied. The absorbance of the mixture was measured at 517 nm. Ascorbic acid was used as the reference standard. These results indicate that the phytoconstituents may possess an anthelmintic activity. The anthelmintic effect of the extract *in-vitro* may either be the effect of the individual phytoconstituents or synergistic effect of the phytoconstituents.

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Table: 1 Preliminary phytochemical screening

SAMPLE	TPSJ
Alkaloids	–
Flavonoids	–
Saponins	–
Tannins	+
Phenols	+
Cardiac glycosides	+
Steroids	+
Terpenoids	+
Quinones	+
Proteins	+

+ Present

- Absent

The ethanolic extract were prepared and subjected to phytochemical screening. The investigation revealed the presence of steroids, glycosides, tannins, terpenoids, proteins, quinones, phenols, saponins, flavonoids and alkaloids.

Table :2 Analysis of paralysis and death of worms

S. No.	Treatment	Time taken for paralysis	Time taken for Death
1.	Control (Saline water)	0.00	0.00
2.	Albendazole (2.5mg/ml)	53.80 ± 3.45	110.38 ± 3.45
	(5mg/ml)	46.62±5.31	100.61± 1.34
	(10 mg/ml)	35.92 ± 2.34*	84.32 ± 4.76*
3.	Ethanolic extract (2.5 mg/ml)	80.15 ± 2.64	145.62 ± 2.55
	(5mg/ml)	70.61± 1.90	138.73±4.73
	(10mg/ml)	52.64± 3.46	118.42± 2.61





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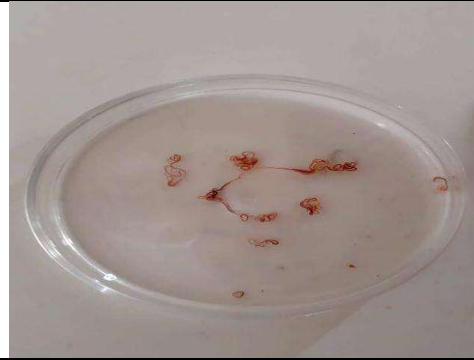


Figure 1: Control saline



Figure 2: Albendazole 2.5mg/ml



Figure 3: Albendazole 5mg/ml



Figure 4: Albendazole 10mg/ml



Figure 5: Ethanolic extract 2.5mg/ml



Figure 6: Ethanolic extract 5mg/ml



Figure 7: Ethanolic extract 10mg/ml





Branching Out to Safeguard India's Tomato Crop: A Novel Decision Tree Approach for Late Blight Disease Prediction

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ABSTRACT

Agriculture is a cornerstone of India's economy, constituting 20.19% of its GDP. Tomatoes, as the country's leading agricultural export, face challenges due to climatic factors and diseases, with leaf disease significantly impacting crop yield and quality. This paper presents an innovative machine learning approach, leveraging the Decision Tree algorithm, to predict Late Blight Disease in tomato leaves. A comprehensive dataset encompassing various leaf attributes was collected and used for model training. The Decision Tree, chosen for its interpretability and capacity to capture intricate data relationships, underwent rigorous evaluation via cross-validation. This research advances precision agriculture by offering a dependable tool for early disease detection, enabling timely interventions and minimizing crop losses. The simplicity and effectiveness of the Decision Tree algorithm enhance its value in sustainable farming practices. Experimental results showcase the superior performance of our method, surpassing existing literature-based approaches. This work heralds a promising path towards safeguarding India's vital tomato crop and bolstering agricultural sustainability.

Keywords: Agriculture, Tomato, Late Blight Disease, Machine Learning, Decision Tree Algorithm, Precision Agriculture

INTRODUCTION

Agriculture stands as the cornerstone of India's economy, playing a pivotal role in both GDP contribution and providing livelihoods to a vast population. Amidst the plethora of agricultural products cultivated across the country, tomatoes hold a special significance. They are not only a staple in Indian cuisine but also a prominent





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agricultural export, contributing significantly to the nation's economic prosperity. However, the tomato crop in India faces formidable challenges, primarily arising from climatic factors and various diseases. Among these challenges, Late Blight Disease emerges as a significant threat, imposing severe impacts on both crop yield and quality [1]. Late Blight Disease, caused by the pathogen *Phytophthora infestans*, is notorious for its rapid spread and devastating effects on tomato plants. The disease manifests as dark, irregularly shaped lesions on the leaves, ultimately leading to the withering and death of the plant. In a country where agriculture is the lifeline, the consequences of Late Blight Disease can be dire. A detail picture of these shown in Fig 2. Farmers often struggle to detect and manage the disease in its early stages, resulting in substantial crop losses and economic hardship [2]. In recent years, the fusion of technology and agriculture, known as precision agriculture, has emerged as a promising solution to address such challenges. Within this realm, machine learning, a subset of artificial intelligence, has gained momentum, offering innovative approaches to combat crop-related issues. The evolution of machine learning, as depicted in Figure 1, showcases various stages of its development, ushering in numerous advancements and fresh ideas across diverse fields.

This paper centers on one such innovative approach—a Decision Tree-based predictive model for the early detection and management of Late Blight Disease in tomato plants. The driving force behind this research lies in the urgent necessity to safeguard India's tomato crop, which serves as a vital component of the country's food security and contributes significantly to export revenue [3]. To achieve this goal, an exhaustive dataset comprising various leaf attributes was painstakingly collected and employed for model training. The Decision Tree algorithm was selected as the primary tool for disease prediction owing to its interpretability and its capacity to capture intricate relationships within the data. The significance of early disease detection cannot be overstated. Timely interventions, such as targeted pesticide application or altered irrigation practices, can significantly mitigate the impact of Late Blight Disease. The simplicity and effectiveness of the Decision Tree algorithm enhance its value in sustainable farming practices, empowering farmers with a practical tool for disease prediction [4]. This research contributes to the ongoing discourse on precision agriculture and disease management by offering a reliable and easily interpretable tool for the early detection of Late Blight Disease. The paper underscores its significance by demonstrating the superior performance of the proposed Decision Tree-based model compared to existing literature-based approaches. In doing so, it lays the groundwork for a promising future in safeguarding India's vital tomato crop and bolstering agricultural sustainability [5]. As we delve deeper into this research, we will explore the methodology, dataset, model development, evaluation, and the implications of this innovative approach in the context of India's agricultural landscape. Through this, we aim to shed light on the immense potential of machine learning in addressing critical challenges in agriculture and propelling sustainable farming practices forward, thereby securing the future of India's agricultural sector. The key contributions of the work titled "Branching Out to Safeguard India's Tomato Crop: A Novel Decision Tree Approach for Late Blight Disease Prediction" are as follows:

Innovative Machine Learning Approach: The paper introduces an innovative machine learning approach for the early detection and management of Late Blight Disease in tomato plants, which is a significant threat to India's tomato crop.

Decision Tree Algorithm: The study employs the Decision Tree algorithm as the primary tool for disease prediction due to its interpretability and its ability to capture complex data relationships. This algorithm enhances the simplicity and effectiveness of disease prediction, making it a valuable tool for sustainable farming practices.

Comprehensive Dataset: An exhaustive dataset containing various leaf attributes relevant to Late Blight Disease in tomato plants was collected and utilized for model training. This dataset forms the basis for the predictive model's development and evaluation.

Contribution to Precision Agriculture: The research aligns with the concept of precision agriculture, offering a reliable and easily interpretable tool for early disease detection. Timely interventions based on this tool, such as





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targeted pesticide application or adjusted irrigation practices, can significantly reduce the impact of the disease.

Superior Performance: The experimental results demonstrate the superior performance of the proposed Decision Tree-based model compared to existing literature-based approaches for Late Blight Disease prediction. This showcases the effectiveness of the novel approach in addressing a critical agricultural challenge.

Significance for India's Tomato Crop: Given the vital role of tomatoes in India's economy and food security, this work has direct implications for safeguarding the tomato crop, minimizing crop losses, and bolstering agricultural sustainability.

Contribution to Future Agriculture: The paper contributes to the ongoing discourse on precision agriculture and disease management, emphasizing the potential of machine learning in addressing critical challenges in agriculture. It lays the groundwork for future research and applications in securing the future of India's agricultural sector.

Related Works

In the realm of plant disease detection, particularly in the context of Late Blight Disease in tomato plants, several noteworthy studies have delved into the application of machine learning and image processing techniques. Mehmood *et al.* (2019) utilized Convolutional Neural Networks (CNNs) for accurate disease recognition but noted the black-box nature of CNNs [6]. Meena and Chandrasekar (2019) conducted a review on various image processing methods, highlighting the computational resources they may demand [7]. Singh *et al.* (2020) offered a comprehensive exploration of machine learning approaches, including decision trees and neural networks, in plant disease prediction [8,9]. Senthilnath *et al.* (2020) surveyed the use of deep learning techniques, emphasizing CNNs, in image segmentation for precision agriculture [10,11]. Naveen Kumar *et al.* (2021) employed various machine learning algorithms for tomato disease detection [12], while Patil *et al.* (2021) focused on deep learning methods like CNNs and recurrent neural networks [13]. However, this current research distinguishes itself by adopting the Decision Tree algorithm, prioritizing interpretability, and potentially facilitating widespread adoption in precision agriculture. With its comprehensive dataset and superior performance, this study contributes significantly to safeguarding India's tomato crop and promoting agricultural sustainability [14,15].

Proposed Work

The proposed work aims to address the challenges associated with the identification and detection of tomato leaf diseases through traditional naked eye observations, which are often less accurate and limited in scope. Additionally, accessing agricultural experts for crop inspections can be costly and time-consuming for farmers and agriculturalists. To overcome these issues, we leverage recent advancements in computing technology, specifically AI and machine learning, to develop a computerized system for the automatic detection of tomato leaf diseases, facilitating the monitoring of large tomato crops.

Our approach employs a decision tree classifier, a supervised machine learning algorithm, to predict the presence of late blight diseases in tomato leaves based on certain key features. These features include:

- Contrast
- Homogeneity
- Energy
- Correlation
- Dissimilarity

The prediction of disease is based on the symptoms identified in the dataset, and our algorithm makes use of these features to make accurate predictions. Through rigorous training and fine-tuning of the models, incorporating various hyperparameter modifications, we have achieved an impressive accuracy rate of 99%. These promising results demonstrate the effectiveness of our approach in disease detection.

The advantages of employing these machine learning techniques in agricultural disease detection are manifold. They are not overly resource-intensive, reducing the need for extensive labor and minimizing the likelihood of errors in





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disease diagnosis. By harnessing the power of AI and machine learning, we aim to provide an efficient and cost-effective solution for farmers and agriculturalists to monitor and protect their tomato crops from diseases, ultimately contributing to improved crop yields and food security [16].

Proposed Algorithm

Here is the proposed algorithm for the automatic detection of tomato leaf diseases using a Decision Tree classifier:
Algorithm for Tomato Leaf Disease Detection using Decision Trees

Step 1: Data Collection

- Gather a comprehensive dataset containing features related to tomato plants.
- Include information such as leaf color, texture, size, shape, and environmental factors like temperature, humidity, and rainfall during the growing season.
- Ensure the dataset includes labels indicating whether tomato plants are infected with Red Blast Disease (late blight) or not.

Step 2: Data Preprocessing

- Handle missing values, outliers, and inconsistencies in the dataset.
- Normalize or standardize numerical features to ensure similar scales.
- Encode categorical variables if necessary.
- Split the dataset into training and testing sets for model evaluation.

Step 3: Feature Selection

- Utilize feature selection techniques to identify the most important features for predicting Red Blast Disease.
- Decision Tree algorithms naturally rank features by importance during the tree-building process.
- Evaluate feature importance using techniques like Information Gain, Gini Impurity, or other criteria specific to Decision Trees.

Step 4: Building the Decision Tree Model

Initialize the tree with the root node, say S , which contains the complete dataset.

- Find the best attribute in the dataset using Attribute Selection Measure (ASM).
- Divide S into subsets that contain possible values for the best attribute.
- Generate a decision tree node containing the best attribute.
- Recursively create new decision trees using the subsets of the dataset created in Step 3.
- Continue this process until a stage is reached where you cannot further classify the nodes, and label this final node as a leaf node.

Step 5: Prediction

- To make predictions, traverse the decision tree starting from the root node.
- For each internal node, follow the branch that corresponds to the value of the selected attribute.
- Repeat this process until a leaf node is reached.
- The label associated with the leaf node represents the predicted class (infected or not infected with Red Blast Disease).

Step 6: Model Evaluation

- Evaluate the Decision Tree model's performance using the testing dataset.
- Calculate metrics such as accuracy, precision, recall, and F1-score to assess the model's effectiveness in disease detection.

Step 7: Model Deployment

- Once the model achieves satisfactory performance, deploy it as a computerized system for automatic detection of tomato leaf diseases in real-world applications.
- This algorithm outlines the process of collecting data, preprocessing it, selecting relevant features, building a Decision Tree model, making predictions, evaluating the model, and deploying it for practical use in monitoring and protecting tomato crops from Red Blast Disease.

Pseudo code

Here's a pseudo-code presentation of the proposed algorithm for predicting Red Blast Disease in tomato leaves using





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a Decision Tree algorithm:

```
# Step 1: Data Collection
# Gather a comprehensive dataset
dataset = gather_tomato_dataset()
# Step 2: Data Preprocessing
# Clean and format the raw data
cleaned_data = preprocess_data(dataset)
# Step 3: Feature Selection
# Identify and select important features
selected_features = feature_selection(cleaned_data)
# Step 4: Building the Decision Tree Model
# Train the Decision Tree model
model = train_decision_tree_model(selected_features)
# Step 5: Cross-validation Technique
# Evaluate model performance using k-fold cross-validation
evaluation_metrics = cross_validation(model, selected_features)
# Step 6: Model Evaluation and Deployment
# Analyse cross-validation results
analyze_results(evaluation_metrics)
# Fine-tune hyperparameters if necessary
tune_hyperparameters(model, selected_features)
# Deploy the model for practical use
deploy_model(model)
```

This pseudo-code outlines the main steps of the algorithm, from data collection and preprocessing to model training, evaluation, and deployment. You would need to implement each function or step in a programming language of your choice to create a working predictive model for Red Blast Disease in tomato leaves using a Decision Tree algorithm.

Visualization

- Data visualization assists in exploring business insights to achieve business goals in the right direction. It helps to correlate the data from the visual representations or graphical representations. It allows for fast analysis and instantly digests critical metrics.
- It enables enterprises to stay on top of their game by discovering the latest trends through data visualization tools.

Without data visualization, businesses would have to spend tons of their time customizing reports and modifying dashboards, replying to ad hoc requests, etc. The benefits of Data visualization tools optimize and instantly retrieve data via tailor-made reports, which significantly cuts down on employee time shown in figure3.

Model Evaluation and Deployment

- Analyze the results of cross-validation to determine the model's performance.
- Fine-tune hyperparameters if necessary to optimize model performance
- Once satisfied with the model's performance, it can be deployed in a practical setting for early detection of Red Blast Disease in tomato plants

Comparison Study

Comparative Analysis of the Algorithms

Based on the performance metrics, the Decision Tree algorithm shows the highest accuracy, precision, recall, and F1-score among the algorithms considered. Hence, Decision Tree is identified as the most effective algorithm for



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detecting Late blight disease on tomato leaves.

RESULT ANALYSIS

In the Result Analysis section of our research, we conducted an extensive comparative study of various machine learning algorithms aimed at detecting Late Blight Disease on tomato leaves. Our evaluation encompassed essential performance metrics, including accuracy, precision, recall, and F1-score. Among the algorithms we assessed, the Decision Tree algorithm emerged as the standout performer, achieving an outstanding accuracy rate of 99%. Furthermore, it demonstrated perfect precision and a substantial recall rate of 99%, resulting in an impressive F1-score of 0.99. This exceptional performance underscores the Decision Tree algorithm's effectiveness in accurately identifying and detecting Late Blight Disease, positioning it as the preferred choice for practical applications in tomato crop disease monitoring shown in figure 4. Our study underscores the potential of AI and machine learning in revolutionizing agricultural disease detection. It offers a dependable and efficient solution that can significantly enhance crop yields and food security while simultaneously reducing the resource-intensive demands associated with traditional methods. It's important to note that interpreting Decision Tree results should always be done within the context of the specific problem and dataset under consideration. Decision Trees are powerful tools for both classification and regression tasks, and a thorough understanding of their results is essential for extracting meaningful insights.

CONCLUSION AND FUTURE WORK

In conclusion, our research has demonstrated the remarkable effectiveness of the Decision Tree algorithm in detecting Late Blight Disease on tomato leaves, showcasing its superiority over other machine learning algorithms in terms of accuracy, precision, recall, and F1-score. This underscores the immense potential of AI and machine learning in revolutionizing agricultural disease detection, offering a reliable and efficient solution that can substantially improve crop yields and food security while reducing resource-intensive demands associated with traditional methods. However, for future work, we acknowledge the need for continued research in several areas. Firstly, further refinement of the Decision Tree model through hyperparameter tuning and the exploration of ensemble methods could potentially enhance its performance even further. Additionally, expanding the dataset to include a broader range of environmental factors and incorporating real-time monitoring systems would contribute to more robust disease detection in practical agricultural settings. Lastly, exploring the scalability and integration of this technology into precision agriculture systems and IoT devices represents a promising avenue for future research, allowing for early disease detection and proactive disease management in large-scale farming operations.

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Table 1. Comparison of Machine Learning Algorithms for Late Blight Disease Detection on Tomato Leaves

Index	Algorithm Name	Accuracy	Precision	Recall	F1-score
1	Support Vector Machine (SVM)	0.90	0.93	0.94	0.91
2	Random Forest	0.97	0.97	0.97	0.97
3	Logistic Regression	0.46	0.75	0.63	0.67
4	Decision Tree	0.99	1.00	0.99	0.99

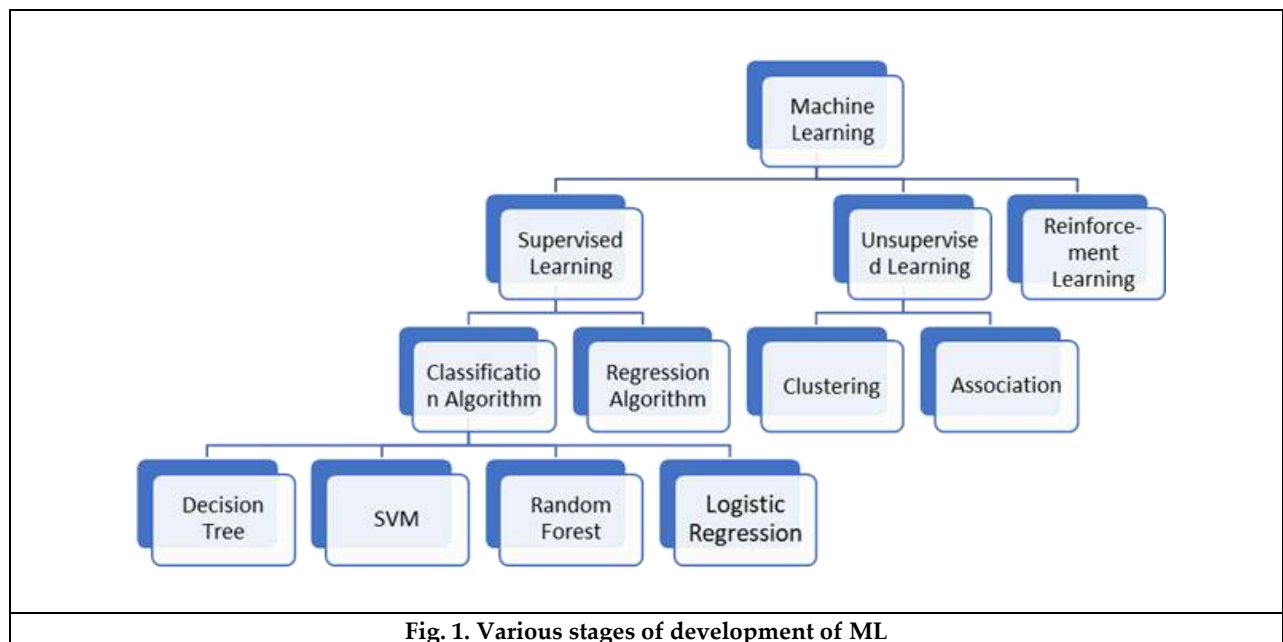


Fig. 1. Various stages of development of ML





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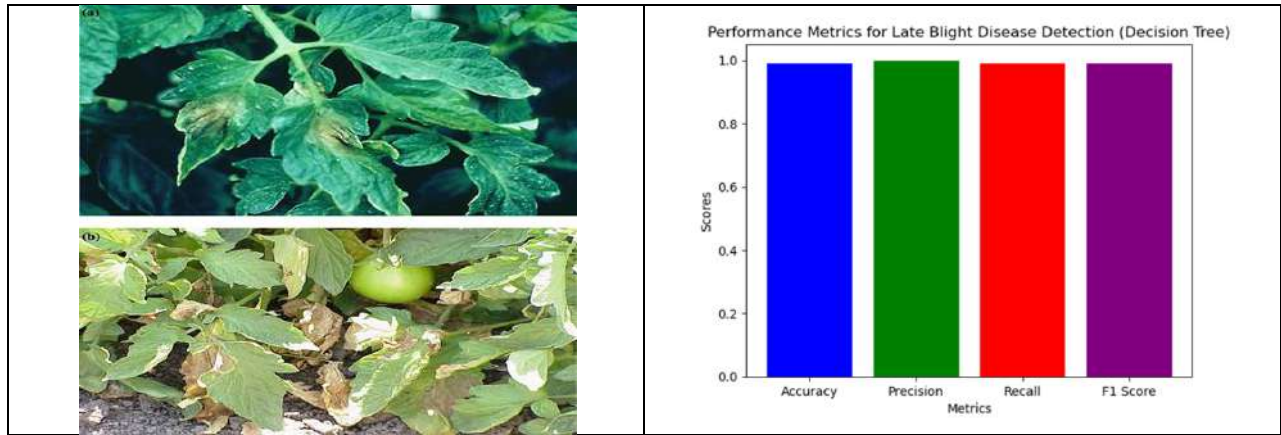


Fig. 2. Representative image of the late blight disease affecting tomato leaves

Fig. 3.: Performance Metrics

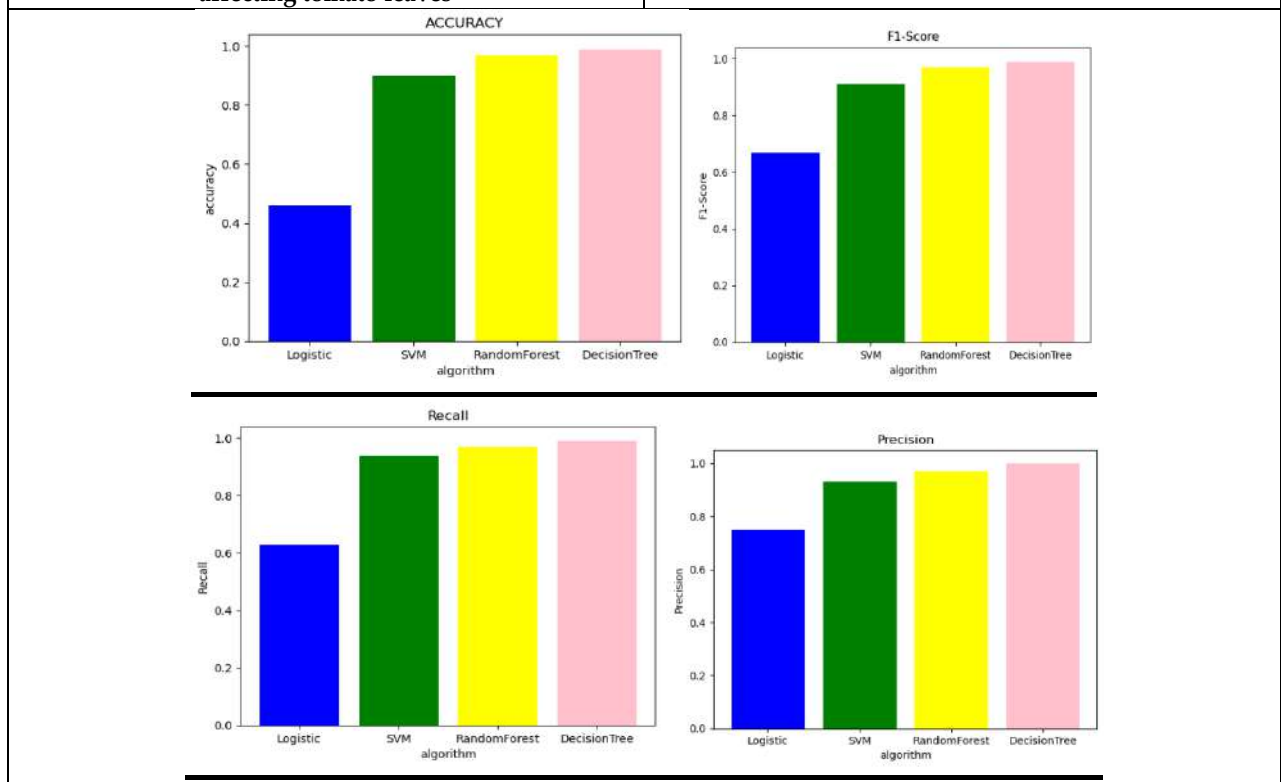


Fig. 4.: Accuracy graph





Antioxidant and Antibacterial Activity of Grape Seed Extract

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ABSTRACT

One of the fruits that is most often consumed worldwide is the grape. In addition, it is a rich source of fiber and vitamins. Grape skin and seeds contain a lot of polyphenol developed in lipid oxidative was measured by thiobarbituric acid reactive substance (TBARS) and antioxidant activity minimum growth inhibitory concentration MIC grape seed extract done by dilution method the contact hemolysis of the grape seed extract they carried out by this method then, the percentage of hemolysis was found to be reduced in the presence of seed extract resveratrol. When compared to the control tube containing RBC and bacterial stain.

Keywords: grape seed extract, resveratrol, shigella flexneri, antioxidant, antibacterial

INTRODUCTION

The largest fruit crop in the world is grapes (*Vitis vinifera*), which produce around 58 million metric tonnes annually (FAO year book, 1997). Monomeric phenolic compounds found in grape seeds, such as dimeric, trimeric, and tetrameric procyanidins, as well as (+) catechins, (-) epicatechins, and (-) epicatechin-3-O-gallate have anti-mutagenic and antiviral properties (Saito *et al.*, 1998). The red grape is a berry that ripens found on woody, evergreen vines belonging to the genus *Vitis vinifera*. In addition to being consumed fresh, grapes can be used to make wine, jam, grape seed oil, vinegar, raisins, juice, and jelly (Patrice *et al.*, 2016). Many studies have been conducted on the *Vitis Vinifera* composition as well as characteristics of grape seeds, and they have revealed a number of benefits for human health, including a reduction in low density lipoprotein. (Vigna *et al.*, 2003, Teissedre *et*



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al., 1996, Frankel *et al.*, 1995. Many organizations have investigated the antibacterial, anticancer, antihypertensive, antihyperglycemic, cardiovascular, and hypercolostrolemic grape seed extract's (GSE) effects (Hong and Yimin, *et al.*, 2006; Broker *et al.*, 2006 ;). *Vitis vinifera* seed extracts contain antibacterial and characteristics that scavenge free radicals (Jayaprakasha *et al.*, 2001), lowering the risk of chronic disease by preventing damage caused by free radicals (Caillet *et al.*, 2006; Gorinstein *et al.*, 1994) due to its lipid peroxidation inhibition and radical scavenging activity, and lessen the possibility of stroke. (Uchida *et al.*, 1995). A study was conducted to evaluate the antibacterial activity of *Vitis vinifera* seed extracts against both Gram positive and Gram negative bacteria, including *Escherichia coli* and *Pseudomonas aeruginosa*. The study's targets were *Staphylococcus aureus* and *Bacillus subtilis*. (E.Q. Xia *et al.*, 2016).

Oxidative Stress and Antioxidants

Comparing grape seed polyphenol. Its antioxidant activity is higher when compared to additional well-known antioxidants (beta-carotene, vitamin C, and vitamin E). It also has several enzymes that cause allergies and inflammation by catalyzing the production of histamine in addition to their antioxidant properties (Amitava and Kimberly 2014). It is obvious that an imbalance between oxidative and anti-oxidative processes causes oxidative damage. Species of reactive nitrogen (RNS), reactive oxygen species (ROS), and chlorinated compounds are some examples of the harmful oxidants that are produced in excess and lead to oxidative processes. Enzymatic and non-enzymatic compounds might be regarded as protective agents. Tocopherol, another name for vitamin E, and vitamin C, sometimes referred to as ascorbic acid, are two of the most crucial non-enzymatic antioxidants for preventing ROS and lipid peroxidation. (Rice-Evan *et al.*, 1995, Dip locket *et al.*, 1993) which act synergistically.

Glutathione

Antioxidant enzyme activity and glutathione concentrations in grape seed and peel extract or powder feeding groups. The normal group's glutathione content was substantially less than what the cholesterol group experienced (P 0.05). Also, it was shown that cholesterol levels were significantly reduced in the grape seed and grape seed extract and peel powder collectives (P 0.05). However, there was no appreciable difference in the glutathione content of GSE and cholesterol (M.H. Kang *et al.*, 2010). In addition to its reduced and oxidized forms, glutathione can also be covalently linked to proteins through a process known as glutathionylation. (Thomas *et al.*, 1995, Hung *et al.*, 2002). The total redox status of the cell affects the ratio of GSH to GSSG. The two enzymes are glutathione synthetase and glutamyl cysteine synthetase (GCS). Involved in the enzymatic synthesis of glutathione, with GCS serving as the rate-limiting enzyme. (Lu Schematic *et al.*, 1998).

Glutathione and Disease

A broad phrase used to describe the generation of reactive oxygen, nitrogen, or iron species, oxidative stress, and the cell's overall redox condition. GSH and GSSG measurements can be used to determine the level of oxidative stress, which is typically reported as their ratio. It's interesting to note that GSH oxidises to GSSG with age, presumably indicating the buildup of oxidative stress (Jones *et al.*, 2002). The development of malignancies is likewise correlated with a reduced GSH to GSSG ratio (Lusini, *et al.*, 2001) and individuals with chronic illnesses, such as those affecting the genitourinary, digestive, cardiovascular, and musculoskeletal systems, had lower levels of total glutathione (Lang *et al.*, 2000). Studies on the polyphenols present in green tea and grape seed extract were carried out in the middle of the 1990s. Green tea contains a significant amount of epigallocatechin-3-gallate as a polyphenol (EGCG). It is said to have an antioxidant capacity that is 15–20 several times more than the amounts of vitamins C25 and E. (vschedea, 2010). Phenolics, anthocyanins, and other flavonoid molecules are mostly responsible for the plant tissues' compounds with antioxidant potential (Cao *et al.*, 1997). Certain flavonoids, including quercetin, are thought of as dietary antioxidants because of their capacity as free radical scavengers. Epidemiological studies have



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demonstrated an unfavorable link between dietary flavonoid intake and coronary heart disease mortality because they prevent low-density lipoprotein oxidation and decrease platelet aggregability. (Cook, *et al.* 1996). Many grape juice flavonoids, including catechin, epicatechin, quercetin, and anthocyanins, are known to have antioxidant, anti-inflammatory, and platelet-inhibitory properties. They can also decrease LDL oxidation and oxidative DNA damage in both in vitro and animal experiments. (Singleton *et al.*, 2003).

Resveratrol

Antioxidant resveratrol has a phytoalexin structure. It is mostly present in the skins of red grapes and exhibits hydroxyl-radical scavenging activity, quenching the superoxide anion and preventing the generation of hydrogen peroxide. (Nikita Wilson 2009). A diphytoalexin produced biologically is resveratrol. Since red wine contains the grape peel, which is where resveratrol is concentrated, red wine has significantly higher levels of resveratrol than white wine. Resveratrol among other plants, grapes have a naturally occurring phytoalexin called (3,5,4'-trihydroxy-trans-stilbene). Its presence in red wine has been suggested to provide health benefits at concentrations ranging from 0.1 to 15 mg/L. (L. Fremont, *et al.*, 2000) is linked to the "French paradox," which claims that regular wine drinking, which is popular in various regions of France, lowers the death rate from coronary heart disease despite eating a lot of fat. (G.J. Soleas *et al.*, 1997).

General Introduction of shigella:

Shigellosis, bacterial dysentery that affects 165 million people annually and kills 1.1 million people, predominantly young children under the age of five, occurs in the poor countries. (Kottloff *et al.*, 1999) *Shigella flexnerii* is the most common agent of endemic shigellosis and the main cause of epidemic dysentery, making it the causative agent for acute diarrheal illness. Shigellosis vaccine development is ranked first on the World Health Organization's list of priorities for the diarrheal disease vaccine. *Shigella flexneri* vaccines are being developed, but there are still many unanswered concerns regarding the disease loads. The genus *Shigella* contains four species of bacteria that cause shigelloses, encompassing 12 serotypes of *S. dysenteriae*, 6 serotypes of *S. flexneri*, 18 serotypes of *S. boydii*, and 1 serotype of *S. sonnei*.

Anti – Microbial Studies of Isolate Flavonoids

By using a disc diffusion test, the study evaluated the grape seed extract against the prevalent peri-implantitis microflora present in craniofacial implants, encompassing clinical strains of *Candida parapsilosis*, *Klebsiella pneumoniae*, and *Staphylococcus aureus* in addition to reference strains of these bacteria. (Prashith *et al.*, 2014). There is no end to the battle between man and the microorganism that causes sickness. Man uses weapons, including naturally occurring chemicals, to destroy microorganisms. Plants are the store-house of chemicals which save man from diseases by the destruction of microbes. Many plants and their constituents have been investigated for their microbial activity. (Lwu *et al.*, 1984, Rao and Rao *et al.*, 1985). The popular methods of testing the anti-microbial activity of a compound are (i) Disc Diffusion Technique (Verma and Nobles *et al.*, 1975), (ii) Serial Dilution Technique (Gould, *et al.*, 1960) and (iii) Ditch plate Technique (Colins and Lyne, *et al.*, 1970).

MATERIALS AND METHODS**Preparation of Grape Seed Extract**

Grape peel and pulp were removed from the grape seeds. The seeds were dried for 72 hours at 50°C in a drying oven. Then, a kitchen mixer was used to grind the dried seeds into a fine powder. Each powder was extracted using 10 ml of ethanol and about 1 gm. Give it three days to rest at room temperature in a beaker covered tightly. The ethanol to be evaporated. The ethanol extracts of grape seed were then filtered by using Whatman No.1 filter paper, the



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supernatant discarded (dust) then the filtrate (ethanol) allow to ethanol evaporate through holes in covered paper. After complete evaporation of ethanol the Resveratol deposited at the bottom of the beaker. The powder collect and used for further experiment of research work. (HuseyinEnginare *et al.*, 2007)

Shigella Flexneri

The strains of shigella flexneri were obtained from Dept. of Microbiology, Sri Ramachandra Medical College and Hospital, Chennai.

Media Growth Conditions

All the *shigella* species were routinely in Nutrient Agar (NA), Nutrient broth and *Shigella* agar (SA) at 37°C. The composition of NA, NB, and SA are as follows (Himedia, Mumbai, India). The medium was adjusted to PH =7.4 using 0.1N sodium hydroxide and sterilized by autoclaving at 15psi maintained constantly for 15 – 20 min. SA medium should not be autoclaved and hence was heated to dissolve the medium completely. When the temperature of the medium reached 50°C medium was then poured into culture plates (Scott, Duran, Germany)

Isolation of Erythrocytes

The Rizvi and Zaid method was used to isolate the erythrocytes (2005). After an overnight fast, healthy people's venous blood was drawn using EDTA as an anticoagulant.

Determination of Minimum Growth Inhibitory (MIC) Concentration

Grape seed extract's minimal inhibitory concentration (MIC) Mckance and Mandal, *et al.* claim that the microdilution method was used to perform the mic (1986). I) Nutrient Broth medium; II) Grape seed extract; and *Shigella flexneri* bacterial strain.

Antibacterial Activity of Grape Seed Extract

Grape seed extract's antibacterial activity was assessed using the agar well diffusion method, in accordance with (Hugo and Russel, *et al.*, (1977). Nutrient agar plates, Grape seed extract.

Contact Hemolysis

Contact hemolysis assay was done by the method of Blocker *et al.*, (1999). Reagents Nutrient broth, Grape seed extract, Human blood, Tris – saline.

Hydrogen Peroxide Induced Peroxidation of Erythrocytes

Reagents: 40M Hydrogen peroxide in a pH 7.4 phosphate buffer, 0.06M. Procedure In a total volume of 1 ml, the reaction mixture contained 0.2 ml of erythrocytes, 0.2 ml of 40 M hydrogen peroxide, and 25 g of grape seed extract. Hydrogen peroxide was added to start the reaction, which was then maintained at 37 °C for 30 minutes with periodic shaking every 10 minutes. The TBARS, conjugated dienes, and glutathione assays were conducted using the incubated mixtures.

Segregation of Experimental Groups

Group I- Only an erythrocyte

Group II -Containing erythrocytes incubated 750µg/ml of Grape seed extract.

Group III -Erythrocyte incubated with 0.5M hydrogen peroxide.

Group IV- Erythrocyte incubated with 750µg Grapeseed extract and 0.5 MH₂O₂.



**Subhashini and Fernandus Durai****Estimation of Lipid Peroxides**

A modified version of the procedure described by was used to determine the level of TBARS in the lens homogenate Oh kawaet *al.*, (1979).

Estimation of Reduced Glutathione

An estimation of the amounts of reduced glutathione in erythrocytes was made using Ellmanet *al.*, (1959).

Assay of Superoxide Dismutase (SOD)

The method of Misra and colleagues was used to quantify the activity of total superoxide dismutase (SOD)Fridovichet *al.*, (1972).

Assay of Catalase

Spectrophotometric analysis was used to assess catalase using the Beer and Sizeret *al.*, (1952). **Reagent:**30 mm of hydrogen peroxide and 50 mm of phosphate buffer (7 pH)

RESULTS AND DISCUSSION

In addition to being used in alcohol-based tonics, Vitisviniferais recommended for spleen, subacute cases of enlarged liver, cough, and respiratory tract catarrh.(Wang, L, *et. al.*, 2014).European folk healers tried to treat skin and eye conditions with grapevine sap. (Monagas M *et.al.*, 2003).The leaves have also been used historically to treat hemorrhoids' pain, inflammation, and bleeding(R. Carpenter, M. N, *et. al.*, 2007).The antibacterial and antioxidantcharacteristics of grape seed extract have been studied. Shigellaflexneri, a pathogen that causes diarrhea, was used as a test subject for antibacterial activity, while human RBC was used as a test subject for antioxidant activity.Fig(1)depicts how Grape Seed Extract works to fight microorganisms using agar well diffusion method carried out by the method of Hugo and Bussel (1997). In this method inhibition by grape seed extract was observed for *ShigellaFlexneri*. The inhibition was found to be concentration dependent for both the extract and for the strain.The present studyFig(2). Shows the inhibitory effect of various antibiotics on *Shigellaflexneri* by agar well diffusion method.Antibiotic sensitivity of *Shigellaflexneri* wild type clinical isolate is given in the (Table -1) Clinical isolates of *Shigellaflexneri* is found to be resistant to Ampicillin, and sulfosomidine. Fig (3) depicts (MIC) the technique's minimum inhibitory concentration test of Mekance and Kandal (1986) for the seed extract of VitisVinifera on *Shigellaflexneri*. The MIC for *shigellaflexneri* was found to be 1000 µg / ml.

Using the modified agar dilution millipore method, minimum inhibitory concentrations (MIC) and also minimum cidal concentrations (MCC) were calculated. The extract's ability to inhibit the growth of microorganisms was further examined after being mixed with propylene and polyethylene glycol.Fig (4) depicts the contact hemolysis and was carried out by the method of Block (1999) for the seed extract of VitisVinifera on *Shigellaflexneri*. The percentage of hemolysis was found to be reduced in the presence of seed extract for *Shigellaflexneri*, when compared to the control tube containing RBC and bacterial stain.Polyphenols have a strong affinity for proteins, and the inhibitory effect of polyphenols against microbes is due to their interaction with proteins present on the microbial surface (Rauhaet *al.*, 2000). Polyphenols suppresses the release of verotoxin in to the culture medium of EHEC cells (Sugita – Konishi *et al.*, 1999). Fig (5) A similar mechanism may be responsible for the observed result of lowering of contact hemolysis on treatment with grape seed extract.

Anti Oxidant Activity

Because of their effective defense systems, RBCs are resistant to oxidative damage under normal physiological circumstances. Antioxidant enzymes include glutathione reductases, catalase, superoxide dismutase, and glutathione peroxidase are abundant in RBCs. Yet, in the presence of heme-iron, polyunsaturated fatty acids, and oxygen, which



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may trigger the events that result in oxidative damage in red blood cells, RBCs are vulnerable to oxidative damage under situations of oxidative stress (Rajasekaran *et al.* 2004). It is known that the erythrocyte membrane makes up 1% of the entire cell weight. It comprises several membrane-bound enzymes that are essential for antioxidants, membrane-receptor complexes, ion transport, glycolysis, and the pentose phosphate cycle. It also has a great potential for plasticity and flexibility. The majority of certain areas of the membrane's inner (cytoplasmic) side are home to erythrocyte proteins, where they join together to form an actin and intermediate filament network that covers the entire cell volume. To keep the erythrocyte in its typical shape, this network creates a cytoskeleton (V. V. Moroz *et al.*, 2019).

Lipid Peroxides

Lipid peroxidation, glutathione SOD, and catalase in the organizations conducting experiments. In contrast to the group under control, erythrocytes treated with 0.5 M H₂O₂ had considerably higher levels of lipid peroxides. Erythrocytes exposed to 0.5 M H₂O₂ and grape seed extract showed reduced levels of peroxidation. The initial stage of oxidative damage in polyunsaturated fatty acids is conjugated diene creation, which may be evaluated by the rise in the absorbance ratio A₂₃₃/A₂₁₅. Conjugated diene formation can be used to monitor lipid peroxidation in erythrocyte membrane. TBARS is a measure of lipid peroxidation, and a rise in TBARS is a sign that there are more oxygen free radicals present. (Gabbianelli *et al.*, 2002). The current study's finding that TBARS and conjugated diene levels have increased suggests that H₂O₂ causes erythrocytes to experience oxidative stress. Resveratrol was discovered to block UVB-mediated enhanced lipid peroxidation, indicating that its antioxidant qualities may be responsible for resveratrol's ability to protect against the negative effects of UVB radiation. (AfaQ F, *et al.*, 1998). Several investigations have shown that resveratrol has antioxidant properties. (Martinez and Moreno, *et al.*, 2000; Olaset *et al.*, 1999). With its antioxidant capacity, resveratrol has been discovered to guard the kidney, heart, and brain against ischemic-reperfusion harm. (Bastia-netto *et al.*, 2000). According to the current study, the grape seed extract's components' claimed ability to scavenge free radicals is what caused the lipid peroxide in group IV to decrease. (Morales *et al.*, 2002).

GSH

When compared to control, the amount of glutathione in erythrocytes treated with H₂O₂ fell considerably. Erythrocytes treated with grape seed extract and H₂O₂ displayed elevated GSH levels. Group III had a significantly lower amount of GSH in comparison to group I. The most common intracellular thiol, glutathione, protects cells from hydroxyl radicals and singlet oxygen by scavenging them and acting as an antioxidant. The main component of the defense against free radicals is erythrocyte glutathione. Directly or by a method involving glutathione peroxidase, GSH detoxifies reactive oxygen species. (Fang *et al.*, 2002). In the current investigation, it was discovered that erythrocytes treated with H₂O₂ had lower GSH levels than controls. Addition of H₂O₂ causes an increase in oxidative stress in erythrocyte as seen by significantly decrease in GSH level and increase in lipid peroxides level. Addition of H₂O₂ activates glutathione peroxidase, an enzyme that uses glutathione as its substrate to remove H₂O₂ from the system (Fang *et al.*, 2002). Thus, increased utilization of glutathione due to addition of oxidant system cause a decrease in its level. By taking part as part of the cellular defense system against oxidative damage, GSH offers significant protection against oxidative injury. (Jo *et al.*, 2001). A crucial defense against the harmful effects of free radicals produced as a result of radiation on the blood, the lungs, and the brain. (Erden, *et al.*, 1992). A crucial defense against the harmful effects of free radicals produced as a result of radiation on the blood, the lungs, and the brain (Bhattathiriet *et al.*, 1994). This protective action of the development by glutamyl cysteine synthetase, the rate-limiting enzyme for GSH synthesis in flavonoids, may account for GSH's defense against oxidative harm. GSH and vitamin E therapy reduced lipid peroxidation and restored GSH levels in pulmonary tissues (Myhrstadet *et al.*, 2002). Obtainable from grape seed extract. In blood samples from rats exposed to X-rays, a study found that GSE and vitamin E improved the antioxidant status and reduced the incidence of free radical-induced lipid peroxidation. These investigations show that GSE had a stronger antioxidant impact on animals when compared to vitamin E when rats were exposed to radiation (Myhrstadet *et al.*, 2002; Krishnamurthy, *et al.*, 1986). Jang and Pezzuto (1999). TPA therapy



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was also found to increase the expression of transforming growth factor- β 1 (TGF- β 1), COX-2, cyclooxygenase-1 (COX-1), and tumor necrosis factor. Resveratrol pre-treatment of mouse skin inhibited several of these TPA-induced effects in a dose-dependent manner. Myeloperoxidase, oxidized glutathione reductase as well as glutathione and H₂O₂ concentrations, were brought back to baseline levels, as was superoxide dismutase activity (Jang M, *et al.*, 1999). The observed effect in the present study may be due to the maintenance of the antioxidant (GSH) by resveratrol present in the grape seed extract and which otherwise could be space in scavenging these radicals.

Superoxide Dismutase

RBCs treated with H₂O₂ (Group III) were found to have considerably less SOD and Catalase activity than controls. The SOD and catalase activity of RBC treated with grape seed extract and H₂O₂ (Group IV) increased significantly. The increasing use of SOD in the adaptive response to oxidative stress for converting the superoxide anion to molecular oxygen and H₂O₂ is likely the cause of the lowered SOD activity (Kishimoto W, *et al.*, 1995). Treatment with grape seed extract negated the impact of oxidative stress caused by H₂O₂, as documented in numerous studies (Jany and pezzuto *et al.*, 1999).

SUMMARY

Clinical isolates of *shigella flexneri* was found to be resistant to many antibiotics showing the virulent nature of the microorganism. Growth is inhibited by ethanolic seed extract of *Vitis Vinifera* (Grape) and the minimum inhibition concentration for *shigella flexneri* was found to be 1000 μ g / ml. Treatment with ethanolic seed extract of *Vitis Vinifera* (Grape) reduces the ability of *shigella flexneri* to causes hemolysis, that is reduced the virulence of bacterial stain. Hence it may be used in the treatment of diarrhea caused by *shigella flexneri*. The lipid peroxidation was induced in human erythrocytes *in vitro* by hydrogen peroxide. In H₂O₂ induced peroxidation, there is an increase in TBARS and conjugated dienes level in erythrocytes with a decrease in glutathione, SOD and Catalase levels. Grape seed extract supplement reduced TBARS and conjugated dienes level and increased the level of GSH, SOD and Catalase. A good chemo preventative agent should have the following qualities: (a), minimal to no adverse effects on healthy, normal cells; (b), strong anti-tumor effectiveness; (c), oral bioavailability; (d), well-established mode of action; (e), affordable; and (f), approval by the general populace. One of the substances with numerous biological effects related to human disorders is grape seed extract. These findings indicate that ethanolic grape seed extract can stop diarrheal pathogen development. *Shigella flexneri*. Due to its antioxidant property it may have good future in preventing or mitigating various oxidative stresses associated diseases.

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Table -1 Clinical isolates of *Shigella flexneri*

No	ANTIBIOTIC	QUANTITY (MICRO GRAM)	RESISTANT/ SENSITIVE	ZERO DIAMETER (mm)
1	Gentamicin	G 10	sensitive	25
2	Chloramphenicol	C10	sensitive	23
3	Keramycin	Nr100	sensitive	23
4	Sulfosomidine	So300	Resistant	-
5	Ampicillin	A10	Resistant	-
6	Norflaxacin	Nr100	Sensitive	21





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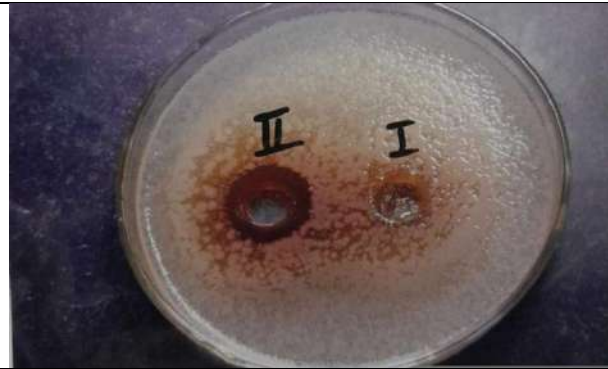


Fig 1: Antibacterial effect of Grape Seed Extract

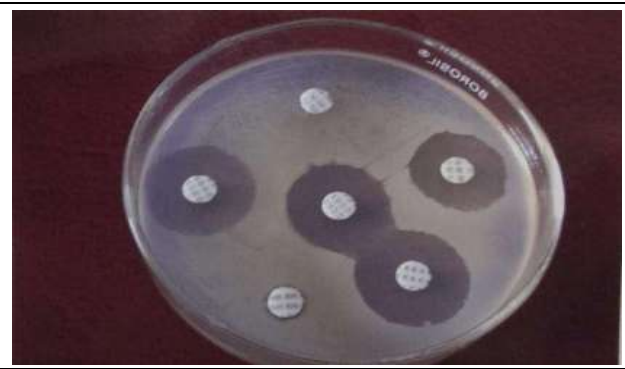


Fig (2). Inhibitory effect antibiotics Resistant to Ampicillin, and sulfosomidine on *Shigella flexneri* by agar well Diffusion method

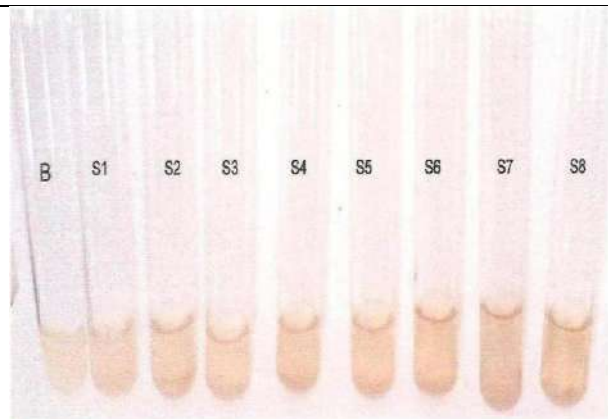


Fig 3. Minimum Inhibitory Concentration test of *Vitis Vinifera* on *Shigella flexneri*.

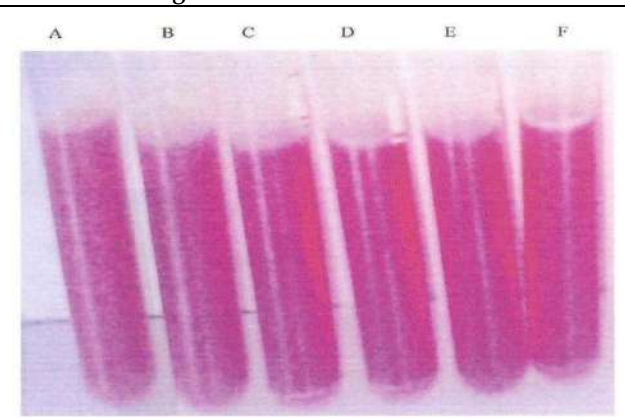
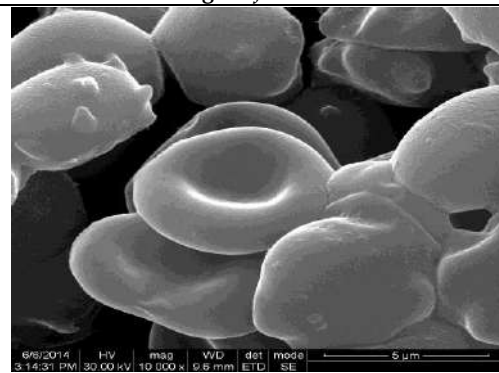


Fig 4. Contact hemolysis of *Vitis Vinifera* on *Shigella flexneri*.



Group-I Erythrocyte alone

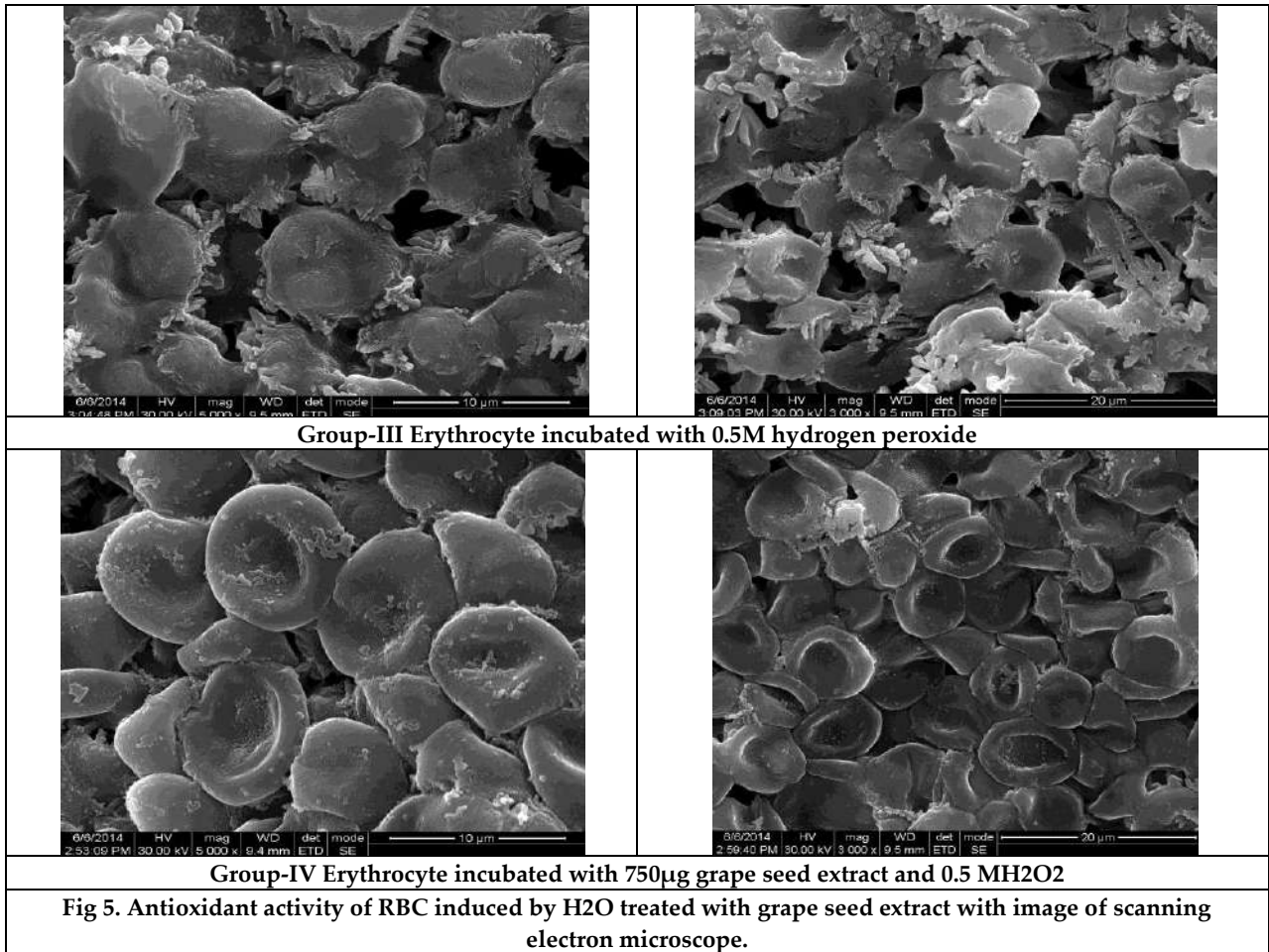


Group-II Erythrocyte incubated 750µg/ml of grape seed extract





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Regulation of Cryptocurrencies: Integrating Accountability and Innovation

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ABSTRACT

This study primarily focuses on the advantages and complexity of using block chain technology for cryptocurrencies and discusses the extensive regulatory challenges brought on by their development and expansion. Governments and regulatory agencies struggle with issues like investor protection and money laundering prevention as the Cryptocurrency ecosystem grows and changes. The diversity of cryptocurrencies and applications and the diverse regulatory standards employed by different Indian and other countries worldwide. In addition, this article explores significant regulatory challenges and offers viable solutions. The study's findings will be extensively used to comprehend the many kinds of available cryptocurrencies. Importance of Cryptocurrency regulation in striking a balance between innovation and accountability. Beyond cryptocurrencies, fostering a legislative climate that supports the growth of this new technology would enable the distribution of crypto-assets, which are a crucial economic stake for nations hoping to maintain their financially pleasant appearance.

Keywords: Cryptocurrency, Block chain, Regulatory, Technology in Finance, Challenges

INTRODUCTION

Advantages of using Blockchain Technologies for Cryptocurrencies

A sophisticated database system called blockchain technology enables transparent information sharing inside a company network. Data is kept in blocks that are chained together in a blockchain database. Due to the inability to delete or amend the chain without network consensus, the data remains chronologically consistent. In order to manage orders, payments, accounts, and other transactions, you can utilize blockchain technology to establish an



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unchangeable or immutable ledger. A common picture of these transactions is made consistent by the system's built-in features, which also stop unauthorized transaction submissions. A digital money known as a cryptocurrency was developed utilizing encryption methods. Cryptocurrencies can be used as both a medium of exchange and a virtual accounting system thanks to encryption technologies. It would help if you had a cryptocurrency wallet in order to use cryptocurrencies. These wallets might be PC or mobile device apps, or they could be cloud-based services. Wallets are the devices that you use to keep your encryption keys, which link your cryptocurrency to your identity and validate it.

Importance of Block Chain Technology

There are various obstacles when it comes to capturing financial transactions with traditional database technologies. Take the sale of a property, for example. Ownership of the property passes to the buyer once payment is exchanged. Both the seller and the buyer can independently record the financial transactions, but neither source can be relied upon. Both the buyer and the seller might easily argue that they have paid the money even though they have not received it or that they have not received it at all. To steer clear of any possible legal problems, transactions must be supervised and verified by a reliable third party. In addition to making the transaction more difficult, the existence of this central authority adds one more point of risk. If there was a breach in the central database, both sides might be affected.

Blockchain reduces these problems by establishing a decentralized, impenetrable transaction record system. Within the real estate transaction context, blockchain generates a single ledger for both the vendor and the buyer. Every transaction that is automatically updated in real-time in both ledgers requires approval from both parties. Any manipulation of past transactions will taint the entire ledger. These characteristics of blockchain technology have made it useful across a range of industries, including the production of virtual currencies like Bitcoin. Blockchain is a particularly groundbreaking and promising technology because it provides scalable transparency, eliminates fraud, and lowers security threats. Blockchain technology, made popular by its connection to cryptocurrencies and NFTs, is now a management tool used by all international sectors. Blockchain technology is currently revolutionizing gaming, safeguarding healthcare data, bringing transparency to the food supply chain, and generally altering the way we handle ownership and data on a big scale.

Use of blockchain in cryptocurrency

Currently, the most popular application of this technology is blockchain for money. Blockchain facilitates the safe processing and recording of transactions for popular cryptocurrency coins like Ethereum and Bitcoin. Transparency, identity protection, and financial data security for cryptocurrency buyers and sellers are all made feasible by this technology. However, no public or private organization is supporting cryptocurrencies. It has been challenging to argue their legal standing in various financial jurisdictions across the globe as a result. It does not help that the majority of cryptocurrencies have operated outside of the current banking system.

Advantages and Disadvantages of Cryptocurrency

The goal of the introduction of cryptocurrencies was to transform the financial system. However, as with any revolution, there are costs and benefits. The theoretical ideal of a decentralized system with cryptocurrencies and its actual execution differ greatly at this point in the development of cryptocurrencies.

- Eliminates isolated points of failure
- It is simpler to move money between parties,
- Eliminates intermediaries,
- Generates returns, and
- Streamlines remittances.

Cryptocurrencies represent a new financial paradigm. They pledge to speed up and reduce the cost of the current financial architecture. Furthermore, their architecture and technology decentralize the current monetary systems and enable value and money exchange between transacting parties without the need for intermediaries like banks. Asset



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tracking and transaction recording in a corporate network are made easier by blockchain, an immutable shared ledger.

Issues pertaining to the utilization of Bitcoin and blockchain technologies

To hide their true identities, thieves use a variety of tools and services that route money through multiple addresses or companies. The assets are subsequently transferred to a destination location or an exchange for liquidation from a source that appears to be authentic. It is challenging to link money laundered through this procedure to illegal activity. On the blockchain, popular techniques are employed for money laundering.

1. Services that function inside one or more exchanges fall under the large category of nested services. In order to take advantage of trading opportunities, these services use addresses hosted by the exchanges to access the exchanges' liquidity. Certain exchanges have lax compliance requirements for nested services, which makes it possible for dishonest people to use them as a means of money laundering.

2. Among bitcoin money launderers, gambling platforms are well-liked. Money is deposited into accounts that are either recognizable or anonymous on the platform. They are frequently used in conjunction with affiliates to either cash out or place bets. The gambling account may be granted legal status once the funds have been disbursed. The "Virtual Assets Red Flag of Money Laundering and Terrorist Financing" report published in September 2020 by the Financial Action Task Force (FATF) includes information about gambling services.

3. To improve anonymity, mixers combine digital assets from many addresses before releasing them sporadically to new wallets or destination addresses. Before money is moved to reputable companies or significant exchanges, they are frequently employed to hide the trail of money.

4. Fiat exchanges, which convert cryptocurrencies into fiat money, can be mainstream, peer-to-peer (P2P), or non-compliant (exchanges that do not follow the rules or are exempt from restrictions). Conventional financial investigative techniques need to be used after monetary exchanges have occurred.

5. Service providers with their headquarters located in high-risk jurisdictions are those whose AML or CFT regulations have been found to have strategic shortcomings. The "block list" and "grey list," as they are colloquially known, are lists of nations maintained by the Financial Action Task Force (FATF) that have inadequate mechanisms in place to prevent money laundering and terrorism financing (AML/CFT). Some other difficulties that the cryptocurrency faces are as follows:

- Due to their extraordinary volatility, the quick expansion and growing popularity of cryptocurrency assets potentially present risks to financial stability.
- Compared to currency rates, stocks, or commodities, these are significantly more erratic. Instability is being introduced into the environment by this volatility.
- The cryptocurrency ecosystem presents various challenges, such as operational and financial integrity concerns from cryptocurrency asset providers,
- investor protection risks for cryptocurrency assets and
- Inadequate reserves and disclosure for certain stablecoins.

Regulatory Obstacles to the Development and Growth of Cryptocurrencies

Regulators and legislators are hastily drafting, approving, and changing crypto-asset laws all around the world. Many significant modifications to the regulatory environment are being considered by over three-quarters of the nations assessed in the Atlantic Council's Cryptocurrency Regulation Tracker. Globally, one of India's main priorities during its G20 presidency is the regulation of crypto assets. In addition, the legal impact of FTX's collapse is still very much ongoing here in the United States. Binance and Coinbase, two significant cryptocurrency exchanges and competitors of FTX were sued earlier this week by the US Securities and Exchange Commission (SEC). Recently, decision-makers convened in Washington, DC, for the IMF and World Bank Spring Meetings, underscoring the necessity of international advancement in the regulation of cryptocurrency assets. Global regulatory development was on the agenda for the G20 finance ministers and central bank governors, as well as the International Monetary and Financial Committee. The future of crypto-assets was the subject of one session wherein crypto rules were deliberated. The meetings clarified two points. Firstly, there is an obvious need for strong, internationally synchronized crypto rules. Furthermore, second, reaching that objective will provide significant obstacles for





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policymakers. Regulations pertaining to consumer protection are less developed than others. Investors who engage in cryptocurrency markets run a significant risk. Theft is becoming more frequent. Volatility is a key characteristic of cryptocurrency markets, frequently driven by speculation. Make intelligent investing harder with misinformation and misleading advertising. We discovered that, despite the risks to consumers, barely one-third of the countries under study had laws protecting them. While laws are frequently unproven or unclear, participants in the cryptocurrency market may be covered by legal protections in other nations.

Cryptocurrency assets' challenges

- Owing to their extraordinary volatility, the fast expansion and growing popularity of cryptocurrency assets potentially present threats to financial stability.
- Exchange rates, commodities, and stocks are less volatile than these. This volatility is introducing an ecosystem of instability.
- The threats to investor protection for crypto-assets,
- Operational and financial integrity from crypto asset providers and inadequate reserves
- Disclosure for certain stablecoins is among the challenges presented by the crypto ecosystem.

Regulation of cryptocurrencies is crucial for achieving a balance between responsibility and innovation because:

- Investor Protection: Regulations help safeguard the interests of investors by ensuring transparency, disclosure of information, and preventing fraudulent activities.
- Mitigating Risks: Regulations address risks associated with cryptocurrencies, such as money laundering, terrorist financing, and fraud, by implementing measures like KYC and AML requirements.
- Market Integrity: Regulations promote fair and orderly markets by preventing market manipulation, insider trading, and other unethical practices.
- Consumer Confidence: Clear regulations enhance consumer confidence in cryptocurrencies, encouraging wider adoption and participation in the market.
- Innovation with Responsibility: Regulations provide a framework for responsible innovation, encouraging the development of new technologies and business models while ensuring compliance with legal and ethical standards.
- Financial Stability: By monitoring and regulating cryptocurrency activities, regulators can help maintain the financial system's stability and protect against systemic risks.
- Global Standards: Regulations help establish consistent global standards for cryptocurrency operations, facilitating cross-border transactions and fostering international cooperation.
- Compliance and Accountability: Regulatory frameworks hold cryptocurrency businesses accountable for their actions, ensuring they operate within legal boundaries and meet certain standards of conduct.
- Preventing Illicit Activities: Regulations help deter the use of cryptocurrencies for illicit purposes, such as money laundering, tax evasion, and funding illegal activities.
- Evolving Landscape: Regulations must adapt to the evolving nature of cryptocurrencies and technological advancements to balance innovation and accountability.

Cryptocurrencies have come a long way from being an ordinary means of exchange to disrupting the traditional finance industry. Crypto users can now participate in old and new financial activities, such as trading and lending services, decentralized finance (DeFi), and NFTs. The new cryptocurrency, Big Eyes (BIG), intends to tap into this disruptive nature of cryptocurrencies. Thus, it could join crypto giants like Binance Coin (BNB) and Compound (COMP) to offer users versatile features in the crypto space.

Big Eyes: The Upcoming Versatile Meme Coin: Big Eyes (BIG) is the latest entrant in the meme coin family. However, it intends to impress the market by offering wealth-generating opportunities to users through its diverse ecosystem.

The Multifunctional Binance Coin: Binance Coin (BNB) drives the BNB Chain ecosystem. It was created as a utility token for discounted trading. However, it has expanded to include numerous applications, including smart contracts, transaction fee payment, travel, entertainment, and general digital finance services.





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Compound: The Secured Lending Cryptocurrency: Compound (COMP) is a DeFi protocol strictly for crypto lending. It allows users to earn interest on their cryptocurrencies by depositing them into one of several lending pools supported by the platform.

Applications of Cryptocurrency: Currently, private investors can access cryptocurrency assets the simplest. Investors can buy, sell, and trade cryptocurrencies through a number of brokerage firms in addition to stocks, mutual funds, and other investment options.

The majority of people view cryptocurrency trading as a way to generate passive income, but some people view it as an alternative investment to more traditional forms of investing. Every day, the market for cryptocurrencies is growing in size and attracting an increasing number of investors. Cryptocurrency platforms have created apps as a result.

Pionex: One of the greatest choices for Bitcoin applications for investors seeking automated trading is Pionex. Auto trading is feasible with this cross-platform program's 16 free built-in trading bots.

Webull: If you are looking to risk only a small amount of money or are on a limited budget, Webull can be one of the best cryptocurrency applications for this purpose. Regarding fees, Webull charges merely a spread for all of its marketplaces. We found that there was not much competition in the minimum spread for cryptocurrency transactions, which is 1%.

Coin base: This is possibly one of the best cryptocurrency programs for beginners. It is the next alternative. When utilizing the app to purchase Bitcoin with a debit or credit card, Coin Base's basic trading fees will be heavily taxed at 3.99 percent. The user-friendly user interface comes after the program.

Binance: One of the greatest applications for cryptocurrencies is Binance, which provides the essential features of investing, staking, sending, and receiving money. Trading pairings between more than 500 coins and tokens are possible. For the same transaction, users from other nations may have to pay up to 4%. The Binance app is available for free download on both iOS and Android handsets.

Gemini: Gemini might be the best Bitcoin app for an experienced trader who makes significant trading investments on a regular basis. This highly regarded exchange is heavily regulated in the United States and is one of the few cryptocurrency platforms licensed by the New York State Department of Financial Services.

Aqru: Aqru differs from other cryptocurrency programs in that it is not centered on trading services. Conversely, Aqru is one of the best sites for generating interest in cryptocurrencies. A very generous APY of 7% will be awarded to investors who deposit their Ethereum or Bitcoin tokens into the Aqru app.

Due to its popularity among those wishing to use cryptocurrency as an alternative form of capital, it has grown significantly in the last several years. Cryptocurrency assets are viewed as high-risk investments by millennials despite their widespread use. However, those who have realized its potential are aware of its ability to change the course of history.

Act to Prevent Money Laundering as it Relates to the Cryptocurrency Ecosystem.

A notification was released on March 7, 2003, and went into effect on July 1, 2005, in accordance with the terms of the PMLA Act 2002. including other regulated companies, including banks, virtual digital asset (VDA) service providers are subject to reporting requirements and KYC guidelines, and the Union Minister of Finance to payment system operators. The PMLA Act covers the following: trading virtual digital assets (VDAs) for fiat money; transferring VDAs; exchanging VDAs in different formats; keeping and managing VDAs; and offering financial services associated with the offers and sales of VDAs.

Before using Bitcoin, people or organizations must purchase a digital wallet to hold their public and private keys. These keys are needed to transfer and receive cryptocurrency as well as to validate blockchain transactions. Thanks to the notification, cryptocurrency exchanges are now considered "reporting entities" for PMLA Section 2(a).

The following operations pertaining to cryptocurrencies have been included under the purview of PMLA:

- VD/FIAT currency exchange
- The interchange of one or more virtual digital asset types
- The exchange of virtual digital assets.
- The management or preservation of virtual digital assets or tools that allow for their control.



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Taking part in the offer and sale of a virtual digital asset by an issuer and offering financial services in connection with it. Stated differently, transactions involving the exchange of cryptocurrency for fiat money, the transfer of VDAs between two individuals or legal entities, and the trading of cryptocurrency for cryptocurrency are all subject to the restrictions of the Money Laundering Act. Crypto exchanges are now considered "reporting entities" under Section 2(a) of the PMLA as a result of the notification. According to the definition of a reporting entity in this Section, it is "a banking company, financial institution, intermediary or a person carrying on a designated business or profession," which suggests that all entities that deal with cryptocurrency, NFTs, and other VDAs get included. A prevalent motif throughout most cybercrimes is money laundering. Malevolent actors take advantage of anonymity through the use of blockchain technology to conceal the origins of illegal monies, turn them into cash, and then transfer those funds into the established banking system.

The legal standing of cryptocurrencies in India

- Despite including a cryptocurrency tax in the Union Budget of the previous year, the government chose not to move further with drafting legislation.
- India imposed an income tax of thirty percent on Bitcoin earnings in April of 2022.
- July 2022 saw the implementation of regulations pertaining to the deduction of 1 percent tax at source on cryptocurrencies.
- The Supreme Court had earlier struck aside a prohibition that the RBI had recommended.
- Noting the RBI's worries, the Finance Minister informed Parliament in July 2022 that international cooperation would be required for any law regulating cryptocurrencies or prohibiting them.

Prospects for the expansion of the cryptocurrency system:

- Technological progress is bringing in a new era that makes financial services and payments more affordable, quicker, and available.
- It also enables these services to move quickly across borders.
- Stablecoins derived from bank deposits can provide quick access to a range of financial goods and facilitate instant currency conversion.
- Decentralized finance has the potential to serve as a foundation for financial services that are more inventive, inclusive, and transparent.

CONCLUSION

Leaders of the G20 will now consider how nations might work together to manage digital assets more effectively. "an official said. "India has brought the regulation of these assets on the agenda of G20, whose role gained greater importance amid global financial sector woes in 1999 and 2008," the official added. 'Crypto challenge' "A single country cannot regulate cryptocurrencies effectively. We have discussed the building blocks for such regulation. A road map arrived at in consultation with the International Monetary Fund, whom we roped in to advise on macroeconomic implications of these assets, and the Financial Stability Board," The representative continued by pointing out that India has drawn attention to the unique hazards that these virtual assets pose to developing and emerging regions. A comprehensive approach should be taken when regulating cryptocurrencies. Finding the right mix between responsibility and creativity is crucial. Effective regulation may promote a safe and secure environment for businesses and cryptocurrency consumers while advancing blockchain technology. Policymakers must remain flexible and forward-thinking as the cryptocurrency environment changes to ensure their regulatory frameworks keep up with this fast-moving and revolutionary sector. Finding this balance is difficult, but it must be accomplished if cryptocurrencies are to reach their full potential in the contemporary financial ecosystem.

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Impediments to Environmental Education in the Context of Indian Education System

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ABSTRACT

In today's global context, addressing environmental concerns has transcended national boundaries, making it a paramount issue not just in India but across the world. Our awareness of pressing environmental challenges such as pollution, soil erosion, and ozone layer depletion is extensive, yet there exists a critical gap in understanding the hurdles within the realm of education itself, hindering the awakening of citizens to the imperative of planetary care. While we acknowledge the pivotal role education plays in mitigating environmental issues, we often overlook the barriers that impede its effectiveness. The prevailing approach focuses on sensitizing citizens to environmental protection through education, yet lacks comprehensive efforts in refining educational strategies and frameworks to tackle these challenges head-on. The pressing need for transformative Environmental Education and active engagement in environmental issues is undeniable. Education's purpose extends beyond imparting mathematical skills or historical facts; it is fundamentally about equipping learners, educators, and stakeholders to safeguard our planet, fostering a conducive environment for all living and non-living entities. This paper delves into the intricate challenges within the field of environmental education in India, aiming to identify these obstacles as a precursor to devising effective strategies. By understanding these challenges, we pave the way for informed and strategic interventions that can sensitize generations to the existing and potential environmental threats, thereby nurturing a collective responsibility towards our planet's well-being.

Keywords: Environmental Education, Protection, Planning, Provisions, Stakeholders, Challenges, Sensitize, etc.



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INTRODUCTION

In the intricate tapestry of life, we are sustained by the benevolence of Mother Nature. Yet, in our relentless pursuit of sustenance, we have grown heedless, neglecting the very abode we inhabit and the nurturing embrace of our motherly provider. Enthralled by the allure of progress, globalization, and modernity, we have unwittingly become blind to the gradual erosion of our natural surroundings. The degradation of our environment has reached such alarming proportions that it demands urgent and unwavering attention, imploring us to step forward as stewards of our planet's well-being. To unravel the complexities of this degradation, we must delve into its roots, confronting challenges spawned by industrialization, burgeoning populations, pollution, poverty, and an insatiable appetite for opulence. Among these challenges lies the failure of education to instill a deep-seated environmental consciousness within our society, imperilling the delicate equilibrium between humanity and the ecosystems we inhabit. Recognizing these critical issues and the imperative to address them, the paradigm of Environmental Education for sustainable development has emerged as a beacon of hope. This transformative approach seeks to empower learners and stakeholders, urging them to safeguard, preserve, and cherish our natural heritage across all echelons of society. This noble initiative not only endeavours to salvage our environment from imminent peril but also endeavours to awaken our society, rousing it from its eco-indifferent slumber. At the academic forefront, Environmental Education has been woven into the fabric of learning, mandated as a compulsory subject at the undergraduate level by the esteemed University Grants Commission. This mandate extends its benevolent reach to students of Arts, Science, and Commerce, while at the school level, the National Council of Educational Research and Training and State Education Councils of almost all states in India have embraced this essential subject. Curriculum designers, too, have meticulously integrated environmental concerns at every educational tier. Despite these commendable strides, the collective endeavour to nurture an environment-conscious populace encounters numerous stumbling blocks. These obstacles, akin to unseen threads, weave a tapestry of hindrances that thwart our nation's ability to embrace environmental stewardship with the diligence it deserves. Thus, it becomes our collective imperative to diagnose, dissect, and dismantle these barriers, liberating education from the constraints that shackle its potential to address environmental challenges comprehensively and effectively.

Content

Presently, the educational content within Indian Environmental Education falls short of being truly comprehensive and enlightening for students. Those entrusted with framing the curriculum must not confine their focus solely to the theoretical facets of the environment; instead, they should craft content that offers abundant opportunities for students to immerse themselves in exploring the environment firsthand. This immersive approach aims to awaken an awareness of the intricate interconnections between humans and their environment, shedding light on the detrimental actions of humans that degrade it, and elucidating the responsibilities we bear in its preservation. Siddqui & Khan (2015) have astutely advocated for content that bridges the gap between classroom knowledge and the tangible world, emphasizing relevance to learners' lives. Such content should grapple with issues that hold paramount significance for society while equipping learners with vital skills that foster lifelong learning. Crucially, this educational approach advocates for firsthand experiences, recognizing their pivotal role in cultivating a genuine understanding. By directly encountering environmental challenges, students can develop an innate sense of empathy and concern. These experiences serve as catalysts, compelling students to contemplate innovative solutions for the betterment of the environment and the lives reliant upon it. Therefore, the content of environmental education must not only be practical but also imbued with an encouraging spirit. It should inspire future generations to embark on earnest initiatives, instilling in them the zeal to improve the degraded state of our environment, thereby ensuring a sustainable legacy for all.

Allocation of Time

The time allocated by educators and learners to familiarize themselves with environmental issues remains woefully insufficient to grasp the depth of environmental challenges and their potential solutions. Environmental education,



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often relegated to the status of an additional, substitutive, or less prioritized subject, fails to receive the attention it truly merits. It is perceived merely as an adornment, incapable of fulfilling the essential objectives of other disciplines. Attempting to beautify a dishevelled or charred home seems futile when the core issues are overlooked. A prevailing pattern observed in educational institutions is the scant attention dedicated to environmental education, typically confined to once a week or biweekly sessions. The institution's timetable, a reflection of its priorities, further underscores the lack of seriousness attached to environmental education. These sessions are often scheduled after lunch or slotted once or twice a week, underscoring the prevailing apathy towards recognizing the urgency of environmental education.

Absence of Environmental Initiatives Organization

In light of the previously discussed inadequacies regarding time allocation for environmental initiatives and the burden of existing curricular demands, it becomes evident that educational institutions seldom prioritize the organization of eco-friendly activities. Infrequent glimpses of environmental engagement occur, such as sporadic tree plantation or cleanliness drives carried out annually, often coinciding with occasions like World Environment Day or as part of NSS (National Service Scheme) initiatives. Sadly, these events serve as rare opportunities for learners to genuinely perceive environmental issues and actively engage with them. Environmental awareness initiatives, limited to activities like tree planting and community cleanups, overlook a plethora of meaningful endeavors. A wealth of untapped potential lies in activities such as educational field trips, invigorating debates on environmental concerns and the human actions underlying them, stimulating slogan-writing competitions, compelling awareness rallies, and insightful symposiums addressing multifaceted environmental issues. The vast spectrum of possibilities remains largely unexplored, leaving a significant void in learners' understanding and active participation in the realm of environmental conservation.

Diminished Scholastic Significance

A prevailing trend underscores the perception of Environmental Education as a subject or discipline possessing diminished academic merit. This devaluation extends to environmental professions, often regarded as inconsequential or lacking in significance. Remarkably scarce are instances where schools incorporate Environmental Education into their daily curriculum, relegating it to the periphery in comparison to subjects like mathematics, English, or Science. Furthermore, colleges and universities seldom elevate Environmental Education to the status of an honors subject or a viable career choice. The scarcity of educational institutions embracing Environmental Education as a fundamental discipline illustrates a glaring gap in awareness, not only among learners but also within the intellectual circles and the nation at large, concerning the paramount importance of environmental knowledge. Siddiqui & Khan (2015) emphasized this very issue, shedding light on students' indifference towards Environmental Education, rooted in the misconception of its negligible academic worth. Bridging this gap necessitates a transformative shift in societal perspectives, acknowledging the profound significance of environmental education in shaping informed and responsible future generations.

Educational Overload

Learners find themselves inundated with a deluge of subjects, homework assignments, and an array of practical tasks, projects, and dissertations, leaving them with scant time to delve into the realm of environmental knowledge and its complexities. Without a solid understanding of environmental issues, the prospects of formulating innovative solutions dim, and the possibility of adopting corrective lifestyles to prevent environmental degradation remains elusive. The onus falls heavily on curriculum developers to alleviate the weight of other subjects that often receive disproportionate emphasis. The Central Board of Secondary Education advocates for a minimum of two periods per week dedicated to Environmental Education, with student performance meticulously recorded. However, the stark reality is that students preparing for their board examinations perceive Environmental Education and its associated outdoor activities as an unwelcome burden, an unnecessary encumbrance. This burden doesn't merely weigh on the shoulders of students but also burdens teachers and parents, causing undue stress. Striking a balance in the educational curriculum is imperative; overemphasis on certain subjects should be mitigated, allowing essential



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subjects like Environmental Education to receive the attention they deserve, thereby fostering a harmonious educational experience.

Educators' Limited Environmental Insight

Upon scrutinizing the syllabi of B.Ed., D.El.Ed., and comparable teacher training programs, a conspicuous absence emerges regarding the incorporation of environmental awareness. These programs notably lack discussions on environmental issues and fail to equip trainees with the essential knowledge and skills needed to imbue their future learners with environmental sensitivity. Crucial subjects such as biological diversity, pollution control, waste management, and the conservation of forests and wildlife remain conspicuously absent from the training curriculum. Integrating practical tools for field learning becomes pivotal, enabling teachers to comprehend the intricate facets of nature and subsequently share this knowledge with their students. In-service teachers, too, require ongoing exposure to environmental issues, tailored to their specific needs. Recognizing that only educators awakened to environmental concerns can effectively nurture a sense of environmental responsibility among their students, it becomes imperative to bridge this knowledge gap and empower teachers as effective catalysts for environmental awareness.

Deficient Entry Requirements for Environmental Education Instructors

Acareful examination of the prerequisites for teachers instructing Environmental Education reveals a glaring oversight. Individuals possessing postgraduate degrees in Science are often appointed to teach Environmental Education in schools. However, the genuine criterion mandates a specialized degree in Environmental Science – a postgraduate qualification complemented by B.Ed. and STET certifications – for teaching students in grades 6-10, and D.El.Ed. qualifications for other levels. Despite the explicit eligibility criteria outlined for Environmental Science teachers, the educational system inexplicably opts for candidates with mere B.Sc. degrees, even if they struggle to articulate a basic understanding of the term "Environment." This laxity in recruitment standards underscores the urgent need for the education system to meticulously select qualified educators, assistant professors, and teaching professionals capable of imparting environmental knowledge effectively.

Absence of Career Guidance

Little do we realize the myriad career prospects within the realm of Environmental Education. Individuals can emerge as environmental advisors for esteemed corporations specializing in Environmental Impact Assessment. Moreover, avenues within international organizations like UNDP, UNEP, WWF, CEE, IUCN, BNHS, WTI, etc., become accessible with a pursuit in Environmental Education as a profession. The spectrum of career choices extends to environmental activism, agricultural technology, air quality inspection, animal services, and beyond. It is imperative to shed light on these diverse professional opportunities available to those venturing into Environmental Science as a subject or career path.

Scarcity of Support from Organizations

The responsibility of education transcends the realms of the government, teachers, and parents; every societal stakeholder must contribute equally. To educate future generations about environmental preservation, conservation, and sustainability, society at large must actively engage. Environmentalists and organizations devoted to environmental causes can dedicate their time to share experiences and insights, fostering a collective understanding. Financial support from these entities can facilitate educational institutions in organizing workshops focused on environmental awareness for both teachers and students. Collaborative initiatives, such as cleanliness drives, involving community workers and volunteers can be orchestrated in schools and colleges. Furthermore, national bodies like the National Council of Science, Technology and Communication and the National Institute of Science Communication and Information Resources can orchestrate campaigns and programs addressing environmental awareness in educational institutions. By encouraging learners, teachers, and the entire nation to work collaboratively, these initiatives can significantly contribute to the enhancement of our environment. In addition, programs like GLOBE, which stands for Global Learning and Observations to Benefit the Environment, present invaluable opportunities for learners to engage in data collection and scientific processes. This active involvement



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allows them to meaningfully contribute to our comprehension of Earth systems and the global environment. Recognizing that the environment is the shared abode of not only teachers and students but all living beings, it becomes a collective responsibility to support educational institutions in nurturing environmentally conscious learners. Every individual must actively bolster these educational endeavours, enabling learners in all their environmental initiatives.

CONCLUSION

Given our collective awareness that existence is inseparable from our abode and the environment that sustains us, urgent measures are imperative to rejuvenate our environment, teetering on the precipice of severe degradation. The imperative to rectify our eco-unfriendly practices, the root cause of pollution, global warming, and soil erosion, cannot be overstated. While education undeniably assumes a pivotal role in sensitizing humanity toward eco-friendly behaviours, overcoming the challenges outlined above demands concerted efforts from every individual and stakeholder in society. Immediate action, particularly within the realm of Environmental Education, is indispensable. This necessitates refining educational content, dedicating substantial time to environmental concerns, elevating Environmental Education to the status of a disciplined career path, and infusing environmental awareness and training into teacher education programs. Additionally, robust organizational backing is essential to achieve the objectives of Environmental Education. Rigorous criteria for the eligibility of teaching professionals involved in environmental education are equally vital. By upholding these standards, we can pave the way for a sustainable future, where both humans and the environment coexist harmoniously

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Fish Collagen for Wound Management: Extraction, Sources and Applications

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ABSTRACT

This review provides an overview of fish collagen production for pharmaceutical and medical applications, focusing on extraction and characterization techniques. Mammalian collagen derived from sources such as cattle and pigs is widely used but faces limitations due to religious and ethical concerns and the risk of infectious diseases. Fish collagen, sourced from by-products such as the head, fins, skin, and viscera, offers a potential solution. Its ease of extraction, low molecular weight, and lack of animal-related risks make it an attractive alternative. Additionally, fish collagen exhibits biodegradability, biocompatibility, and antigenicity. The review aims to shed light on fish collagen's composition, characteristics, and structure, as well as its potential for wound healing in biomedical settings.

Keywords: Fish collagen, collagen Extraction, Wound Healing, Collagen Structure.





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INTRODUCTION

In the extracellular matrix of the several connective tissues in the body, including the skin, bones, ligaments, tendons, and cartilage collagen is the most prevalent structural protein [1,2]. Collagen's main biomedical uses include biomaterials, particularly as carriers for drugs and genes, tissue engineering, absorbable surgical sutures, osteogenic and bone filling materials, hemostatic agents, immobilisation of therapeutic enzymes, and burn/wound cover dressings [3–8]. For tissue growth and structural support, collagen is crucial. It guarantees the tensile strength, hardness, and elasticity of tissues for motility, regeneration, and maintenance as structural support through mechanochemical transduction processes [2, 5]. Additionally, it encourages the development of fibroblasts, a fibrous network of cells that serves as a scaffold for the expansion of new cells into tissues with different physiological functions, such as cartilages, bones, tendons, and skin [5, 6]. By inhibiting pathogen absorption and dissemination, especially of dangerous microbes, collagen has a special ability to protect and speed up wound healing [7]. Collagens derived from bovine, pig, and poultry sources are the most commonly used and commercially viable in the production of collagen products [4] However, the use of bovine and pig collagens is not acceptable by some religious and ethnic groups. There are also infectious and contagious diseases associated with pigs and cattle, such as Bovine Spongiform Encephalopathy (BSE). Therefore, the applications of animal-derived collagen are frequently contentious and limited [1, 2]. Due to their low molecular weight and small particle size, marine collagens like fish skin, bone, cartilage, and scales—which come from both marine vertebrates and invertebrates—are more bioavailable than porcine or bovine collagen and have a higher absorption capability (up to 1.5 times more efficiently into the body) [8] and faster bloodstream circulation [9]. In terms of amino acid content and biocompatibility, marine-based collagens are comparable to traditional bovine and pig collagen [10]. Fishbone, scales, and skins, which are consumed everyday in many regions of the world and produce a significant quantity of waste (between 50% and 70% of the original raw materials, which is generated from fish), can be used to make fish collagen.[11]

Collagen is a key element in the healing of wounds; it serves as a natural structural framework or substrate for the development of new tissue and is involved in all stages of wound healing, including homeostasis, inflammation, proliferation, and remodeling [8]. Endogenous collagen, which is composed of three lengthy chains of amino acids shaped like helicoids, is the type of collagen produced by living things. Collagen is made up of polypeptide chains with the repeating sequence (GlyXY)_n, where X and Y can be any amino acid, but are most frequently proline and hydroxyproline (Hyp) [9,10]. As people age, are exposed to ultraviolet light, and use cigarettes, collagen begins to break down. The breakdown of collagen causes wrinkles and aging. Therefore, it is crucial to find alternative sources of collagen for regenerative tissue applications [11,12].

Collagen Molecular Structure

In vertebrate tissues, there are 28–29 different types of collagen, each of which is encoded by at least 45 different genes. These collagens have different structures, sequences, functions, and molecular characteristics. A 300nm long by 1.5–2.0nm wide single collagen molecule cannot manufacture as much collagen as a multicollagen molecule [14]. Basic amino acids make up collagen. "Tropocollagen" sub unit [15]. The enormous structural diversity within the collagen family allows for the classification of members into various groups. Additionally, type I is present in connective tissues like skin, bone, and tendons, type II is present in cartilage tissue, type III is present in muscle tissue, and other kinds are present but only in very minute quantities and are primarily organ-specific [15]. All twenty amino acids are present in collagen. Mammalian collagen contains a lot of imino acids, including proline and hydroxyproline, hydroxylysine, and hydroxyproline [16]. The most common kind of collagen found in mammals and fish is type I collagen, a fibrous collagen with a triple helical structure [17,18]. Furthermore, environmental factors like temperature have an impact on the makeup of amino acids. Collagen extracted from warm-water fish species has been shown to have higher thermal stability than collagen derived from cold-water fish species [16]. There are also reports of variations in thermal stability between warm-blooded mammals and cold-blooded fish. This may be related to the amount or concentration of the amino acid hydroxyproline, which helped to stabilise the collagen's helix structure by participating in interchain hydrogen bonding. The content of hydroxyproline and its function both





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affect the thermal stability of fish collagen [17]. Therefore, compared to collagen generated by cold-water fish like cod, collagen produced by fish grown in warmer temperatures, such as tilapia, will have more imino acids (proline and hydroxyproline) [18,19].

Collagen Marine Sources

Marine collagens derived from sources like fish skin, bone, cartilage, and scales, including both marine vertebrates and invertebrates, have been found to exhibit superior bioavailability compared to collagens sourced from bovine or porcine origins. They demonstrate a higher absorption capability, up to 1.5 times more efficient, into the body [20]. This increased efficiency can be attributed to their low molecular weight and small particle size, facilitating rapid bloodstream circulation [21]. Furthermore, marine-based collagens share similarities with conventional bovine and porcine collagens in terms of their amino acid composition and biocompatibility [22]. Due to their similarities, marine collagens can be used as functional alternatives in a variety of applications. In instance, fish byproducts including fishbone, scales, and skins can be used to make fish collagen (Figure 2a). These byproducts are produced in significant amounts daily as a result of fish consumption and processing in various parts of the world. Due to this, fish shops and processing facilities discard between 50% and 70% of the original raw materials, which results in a substantial quantity of waste [23]. Table 1 represents the sources of collagen.

Extraction of Collagen

The initial step, preparation, varies depending on the kind of raw materials used. To lessen sample contamination, pretreatment procedures like washing, cleaning, and size reduction are required before extraction.[36] After the preparation, a light chemical pretreatment is carried out to improve the extraction's effectiveness and get rid of non-collagenous materials. Generally speaking, several pretreatments (alkaline or acid treatment) can be carried out depending on the source materials and the extraction process. Due to crosslinked collagen in animal connective tissue, pretreatment with a diluted acid or base is utilised to dissolve the collagen before extraction [37].

The raw materials are submerged in the acid solution during the acidic form of pretreatment. The collagen structure is able to expand by two or three times its original volume due to the penetrated solution, which causes the non-covalent inter and intramolecular connections to break [38]. Sodium hydroxide (NaOH) and calcium hydroxide (Ca(OH)₂) are primarily used in the alkaline pretreatment process over a period of time that might range from a few days to several weeks [39]. However, employing NaOH is more practical because of its greater propensity to swell, which makes it easier to extract collagen by speeding up the transfer of mass through the tissue matrix [40]

Extraction Methods

Collagen fibres have a stable inter- and intramolecular hydrogen bond crosslink structure, which makes them insoluble in water. Therefore, to improve the solubilization of collagen proteins and achieve their isolation during the extraction, certain extraction procedures must be used. The main techniques documented in the literature for collagen isolation from fish byproducts include the extraction of acid-solubilized collagen (ASC), extraction of pepsin-solubilized collagen (PSC), deep eutectic solvent (DES), and supercritical fluid (SF) extractions [41]. There are two methods of collagen extraction. Fig 1 represent the extraction procedure of collagen

- (1) Acid soluble collagen extraction
- (2) Pepsin soluble collagen extraction

Acid Soluble Collagen

Collagen's triple helix is hydrolyzed by acids (such HCl and AcOH) and its single chains are made solubilized in solution, where heavyweight proteins are depolymerized into smaller peptides (0.3–8 kDa).[42] One of the most popular substances used to extract collagen from animal and marine sources is AcOH.[43] While the other variables remained constant, the effect of AcOH with a range of 0.2-1.0 M on collagen extraction from sole fish skin was assessed. The greatest collagen yield was 15.968 mg/g at 0.6 M of AcOH when the AcOH concentration was gradually increased. However, the collagen yield decreased after 0.6 M.[44] The aggregated state of collagen molecules and





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AcOH concentration were associated with each other so that the collagen critical aggregation concentration increased from 0.518 to 1.581 mg/mL for alteration from 0.1 to 2.0 M of AcOH concentrations..[43]

Pepsin Soluble Collagen

The second main method for extracting collagen uses pepsin to help break up the triple helix's telopeptide sections, which makes it easier to dissolve collagen peptides in solution and increases extraction yields. A well-known pepsin called PSC is included in the extraction procedure. [45] Pepsin concentration, hydrolysis time, and the solid-liquid (S/L) ratio on pepsin-solubilized collagen are three crucial elements that must be optimised for more beneficial outcomes in order for pepsin-aided AcOH extraction procedures to be effective. [45].When the other extraction parameters remained constant, the impact of pepsin concentration on the extraction yield of pepsin-soluble collagen was examined. The isolation yield significantly increased (66.35% to 79.93) with an increase in pepsin concentration (800 to 1200 U/g).Additionally, it was examined how much pepsin and AcOH were present in the collagen that was isolated from the skin of Nile fish.[46].

Other Methods

Ultrasound Extraction Method

Ultrasound was previously reported as a method for increasing the efficiency of collagen extraction from fish materials. However, the down-side of this method is that ultrasound could negatively impact the physicochemical and molecular characteristics of collagen[36] As a consequence, the use of ultrasonication under the right conditions has a high potential for enhancing the extraction yield of collagen from fish materials. Furthermore, it may enhance the cavitation effect by disrupting the cell walls in skin tissue, resulting in the liberation of collagen[47].

Influence of Extraction Parameter on Collagen Yield

Effect of Temperature on Collagen Extraction

When utilising pepsin, temperature has a direct impact on it. It is best to maintain the temperature moderate (4–10°C), since this enzyme is particularly sensitive to high temperatures (over 60 °C), which could cause it to self-digest and become inactive. Pepsin's cleaving action is typically followed by a brief period of heating to 90 °C to inactivate the enzyme and stop it from further destroying the collagen structures.[48]. However, raising the temperature over collagen's denaturation point would cause the isolated proteins to thermally degrade.[49] Most fish sources of collagen are extracted between 4 and 10 °C, which enables pepsin to break down the crosslinks in the collagen triple helix without compromising the peptides' structural integrity.[50]

Effect of Extraction Time on Collagen Extraction

The diffusion mechanism, which has a substantial time-dependent influence over extraction, means that when extraction time is increased, collagen recovery will also increase. [51] The leached peptides may degrade as a result of prolonged extraction times. In this scenario, the collagen chains begin to be broken down by the acid solution, causing their breakdown and lowering the ultimate extraction yield.[52] The isolation time effect was studied at various times (3–15 h), and the results showed which time has a significant influence so that increasing the extraction time from 3 to 15 h resulted in an increase of 1.72% in the yield.[53]

Effect of Solvent Concentration

While all other experimental variables were held constant, the effect of AcOH concentration on the collagen yield of sole fish skin was studied utilising a concentration range between 0.2 and 1 M. The collagen output rose to 16 mg of collagen/g of fish skin as the AcOH concentration reached 0.6 M. Due to the degrading effect caused by the excess of acid, the collagen output fell to 12.5 mg of collagen/g of fish skin at a concentration of 0.6 M and higher.[54] Organic acids work better at dissolving collagen that isn't crosslinked and rupturing some of the inter-strand crosslinks in collagen.[55]





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Effect of Solid-to-Liquid Ratio

The mass of the liquid solution used for the extraction divided by the volume of the solid collagen source is known as the S/L ratio. The interactions between free protons and the amino acids of the collagen chains are often improved by increasing the quantity of solution, which also improves the breakage of the crosslinks found in the collagen helix. Since a high concentration of acid causes the collagen chains to be fragmented, results in formation of lower molecular weight peptides, a lower solid-to-liquid ratio speeds up the depolymerization rate of the peptides.⁵⁶ A S/L ratio of 1/55 was found to be the ideal condition since it significantly increased the extraction yield between 1/25 and 1/55. Then the extraction yield decreased as the S/L ratio increased from 1/55 to 1/65. The optimal solid-to-liquid ratio for AcOH extractions, according to studies, is midway between 1/40 and 1/60.⁵⁷ Several S/L ratios such as 1/25, 1/35, 1/45, 1/55, and 1/65 to evaluate the influence of S/L ratio on the extraction yield of pepsin-soluble collagen from the skin of gigantic croaker (*Nibeajaponica*) when the pepsin concentration was 1200 U/g and the hydrolysis period was 8 h in 0.5 M AcOH.⁴⁹

Collagen Characterization Methods

FTIR: Fourier transform infrared (FTIR) spectroscopy is a frequently used method for examining the secondary structure of proteins in collagen characterisation. Since FTIR spectroscopy exposes each absorption wavenumber in the spectrum between 500 and 4000 cm⁻¹, it is important. [59,60]. The amide band FTIR spectroscopy confirmed the presence of amide A, B, I, II, and III bands in collagen extracted from bones of *Lutjanus* sp., where amide III showed the triple helix in extracted collagen [61]. Other studies have used FTIR to determine the type and chemical composition of collagen as well as the presence of collagen. For instance characterised PSCs isolated from mackerel (*Scomber japonicus*) bones and skin using FTIR spectra. The results showed that mackerel bones and skin were largely composed of type I collagen, a heterotrimer made up of two identical 1-chains and one 2-chain in the molecular form. ⁵⁰ The FTIR spectra of collagens extracted from seabass scales using ASC and PSC extraction methods also show that the collagen is type I and that the treatment did not harm the functional groups in the triple helix [63]

Sds Page Chromatography

Collagen's molecular weight can be calculated using SDS-PAGE.[58]. The three -chains, specifically (1)2, (2) (M.W. 118, 116 kDa), and one -chain (M.W. 200 kDa), were present in the collagen that was isolated from the skin of sole fish.⁶⁴ Additionally, dimers or trimers (chains) can be seen in the SDS-PAGE depending on how they are put together and whether they have undergone post-translational modification. Two α 1 chains and one α 2 chain (about 100 kDa) are typical for fish collagen.⁶⁵

Circular Dichroism

Similar to other proteins, collagen's secondary structure, binding, and folding properties can be evaluated using a technique called circular dichroism (CD), which measures the differences in light's right- and left-circularly polarised light absorption [67,68] Circular dichroism (CD) may really show whether an isolated collagen molecule is in its original triple helical structure or in its denatured form.[70] Circular Dichroism is a quick technique, but because some proteins fold more slowly than others, such collagen and collagen fragments, it takes longer to study their folding characteristics. Thus, a prefolding should be carried out, especially for proteins whose folding characteristics are unknown. Before performing a circular dichroism (CD) examination, the protein needs to be prefolded for several hours to several days at 25 °C or on ice (in a refrigerator).[68] Collagen's triple helix displays well-defined CD transitions with positive and negative bands at 222 and 195 nm, respectively, in the supercoiled polyproline secondary structure (type II). The fact that gelatin, a denatured form of collagen, lacks a distinctive CD signal can show that the collagen's CD signals are primarily caused by an organised fibril with triple helical units.[69]

Differential Scanning Calorimetry

Differential scanning calorimetry is used to assess the thermal characteristics of collagen (DSC). In the DSC, collagen absorbs heat with increasing heating and begins to unfold at a particular temperature (different for each species).[60] The structure of collagen molecules changes when temperatures rise. Collagen's maximum transition





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and denaturation temperatures are determined by monitoring the calorimetric energy flux.[59] Because amino acids are present in the collagen chain, DSC can be used to assess collagen's heat stability.[59] Because the hydroxyl group in Hyp can act as a hydrogen donor via chains, collagen with a higher Hyp content, for instance, has a higher denaturation temperature. The collagen isolated with acid had a denaturation temperature of 38.17 °C and a change in enthalpy (H) of 0.72 J/g, while collagen extracted with pepsin, which had a higher Hyproline content, showed a maximum denaturation temperature of 39.32 °C and a change in enthalpy (H) of 0.91 J/g. Another study found that seabass (*Lates calcarifer*) skin and swim bladder both had 79 and 83 (residues/1000 residues) of the drug, respectively [59]

Application of Fish Collagen

The use of synthetic medicines to treat wound healing may lead to medication resistance in some burn reactions. Additionally, there are numerous stages involved in wound healing, including coagulation, inflammation, granulation, proliferation, matrix synthesis, angiogenesis, fibrogenesis, wound contractions, and re epithelialization. These are all difficulties with wound healing. As a result, it is important to research drugs made from natural ingredients. Due to how slowly the damage heals, occasionally complications and pain are revealed. Collagen has many uses in biomedicine because of its biocompatibility, biodegradability, and higher ability to permeate lipid-free interfaces. Collagen's significance in biomedicine arises from its capacity to self-arrange and cross-link collagen fibres to create structures with great strength and stability [71,72]

The ability of marine collagen peptides from the skin of Nile tilapia (*Oreochromis niloticus*) to cure wounds was evaluated using in vitro and in vivo testing. The polypeptides that made up the prepared marine collagen peptides had molecular weights of less than 5 kDa, accounting for 99.14% of the total Collagen from Nile tilapia could speed up the healing of wounds in both in vitro and in vivo tests [74]. The collagen electrospun nanofibers obtained from tilapia used as a wound dressing. Electrospun tilapia collagen could help with rat skin regeneration and increased the adhesion, proliferation, and differentiation of human keratinocytes [75]. The jellyfish collagen implant could be exploited to develop therapeutic compounds for cartilage repair [76]. An effective collagen fibril based on swim bladder collagen from Bester sturgeon fish has been created. On the basis of the double network, they created hydrogels. The Young's modulus of the double network hydrogels ranged from 0.26 to 0.93 MPa, the denaturation temperature based on the DSC curve was raised even up to 90 °C, and it also had good biomechanical performance in vivo. They therefore proposed that this hydrogel be used to create artificial cartilage [77] pH-sensitive hydrogel based on fish scale collagen and carrageenan as a drug carrier to increase the bioavailability of allopurinol, a medication for treating gout and high levels of uric acid in the human body. This hydrogel might enhance the drug's bioactivity and physical characteristics in artificial bodily fluids [78]. The ability of tilapia fish collagen to regenerate periodontal tissue in vitro. Using the osteogenic markers ALP, COL I, RUNX2, and OCN at the gene level, the outcomes of cultivated human periodontal ligament cells with hydrolyzed fish collagen were examined. The synthesis of osteogenic-related proteins demonstrated favourable cell survival and osteogenic differentiation [79].

CONCLUSION AND FUTURE PERSPECTIVE

Current research indicates that a great alternative supply of collagen to commercially available sources is marine collagen. The best source of raw material derived from organic sources might be thought of as marine collagen. Additionally, the marine collagen has qualities like great availability, low danger of disease transmission, lack of religious restrictions, and potential for larger collagen yield. The structure and stability of marine collagen from vertebrate and invertebrate species were first briefly discussed in this work. Following that, various techniques for extracting collagen were reviewed, including acid extraction, pepsin-assisted AcOH extraction and ultrasound assisted extraction. Additionally, the effects of various extraction parameters on collagen yield, including temperature, time, solvent, and solid-to-liquid ratio, were also discussed. However, extraction conditions need to be optimised to achieve a better extraction yield. Then, various common techniques for identifying marine collagen were reviewed, including FTIR, SDS-PAGE, circular dichroism, and DSC. Marine collagen is desirable for





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biomaterials applications such as wound dressing and healing, drug delivery, therapies, and tissue engineering and regeneration due to its biocompatibility, water solubility, safety, biodegradability, anti-microbial activity, and functionality.

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Table 1 : Expected molar mass ranges for the peptides of collagen type I. The data for this table has been obtained from.66

Band of type1 collagen	Expected Molar Mass
$\alpha 1$	120 -150 kDA
$\alpha 2$	120 -150 Kda
$\beta 1$	150 – 200kDA

Table 2 : Sources of Collagen

Collagen source	Application	Remark	Reference
Tilapia Fish	Wound	Electrospun tilapia collagen nanofibers may speed up the healing of	24





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(skin)	Dressing	skin wounds when used as a bandage.	
Tilapia (scale)	Oral mucosa tissue	All fish collagen-based scaffolds have the potential to be employed in oral mucosa tissue, according to a histologic examination.	25
Carp fish scale	Drug delivery	The drug's release was also slower than in the control sample, and its stability was increased.	26
Jelly fish	Cartilage tissue engineering	In comparison to pure hydrogels, hybrid constructs made of jellyfish collagen and alginate support hMSC chondrogenic development and offer more stable constructs.	27
Lophisus litilon skin	Wound healing	Due to compatibility, collagen can assist in the healing of ulcers.	28
Sneak heads	Tissue Engineering	Collagen generated from fish scales has the potential to be used as a viable scaffolding material for a variety of biological applications.	29
Atlantic codfish	Wound healing	Tissue regeneration and engineering, Cosmetics, Orthopaedics	30
Eal fish	Wound healing	Blue biomaterial for biomedical application	31
Atlantic Cod (Gadus morua)	Tissue engineering	Collagen showed a concentration-dependent effect in metabolism and on cell adhesion of lung fibroblast MRC-5 cells	32
Sish scale (L. calcarifer)	Corneal tissue engineering	At day 15, 90 to 100% confluent development displayed similar limbal epithelial morphological characteristics.	33
Arothron stellatus fish skin	Wound healing	Collagen from the skin of Arothron stellatus fish, bioactive extract from Coccinia grandis, and the antibiotic ciprofloxacin are used to make the film scaffold.	34

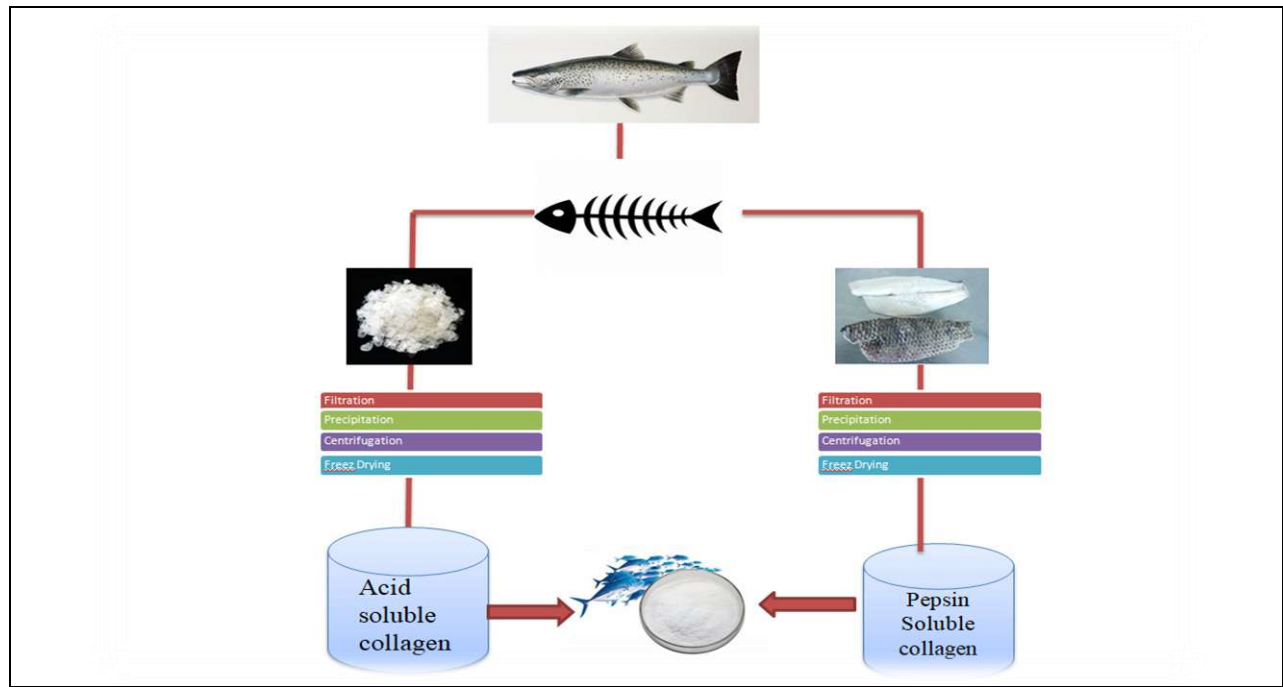


Fig.1:Fish Collagen Extraction Process





A Novel Cluster Head Selection Algorithm Based on Fuzzy Clustering (FC) and Modified Grey Wolf Optimization (MGWO)

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ABSTRACT

The goal of a Wireless Sensor Network (WSN) is to extend the network's life cycle, and topology control is critical to this goal. Particle Swarm Optimization is used to pick cluster heads based on Particle Swarm Optimization (PSO). In high-dimensional space, PSO is simple to slip into a local optimum, and the iterative process has a poor convergence rate. Propose a technique based on Fuzzy Clustering (FC) preprocessing and Modified Grey Wolf Optimization to address this problem (MGWO). First, the FC algorithm is used to create initial clustering for sensor nodes based on their geographical locations, where each sensor node belongs to a cluster with a given probability, and the number of first clusters is studied and discussed. In addition, the fitness function is created with WSN's energy consumption and distance aspects in mind. Finally, the MGWO is used to determine the CH nodes in hierarchical architecture. Experiments reveal that, when compared to standard methods, the proposed strategy was successful in lowering node mortality and prolonging the network life cycle.

Keywords: Modified Grey Wolf Optimization (MGWO), Wireless Sensor Network (WSN), Particle Swarm Optimization (PSO), Fuzzy Clustering (FC), Low-Energy Adaptive Clustering Hierarchy (LEACH).

INTRODUCTION

WSN network life cycle is a key measure of network topology quality, which is usually determined by the time when a particular number of nodes die due to energy depletion. One of the most essential aspects of WSN is topology control, which is critical for lowering communication interference and extending network lifetime. A commonly used and significant topology control approach is the hierarchical topology control algorithm based on clustering mechanism. WSNs are gaining popularity due to their low cost and ease, and they are being used in a variety of



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applications [1]. Sensor nodes in classic WSNs are often powered by batteries. Energy efficiency has become a key concern for WSNs due to the finite stored energy in batteries and the hassle of battery replacement.

Many recent research efforts have been devoted to designing energy-efficient algorithms to extend network lifetime [2], with cluster-based routings being one of them. A sink node and a specific number of clusters are typical components of a clustered WSN. A cluster head (CH) and cluster member (CM) node are found in each cluster. The CHs are in charge of receiving data from the CMs, consolidating the information, and then sending it to the sink. As a result, CHs use more energy than CMs. The CH is usually rotatory selected in a cluster to balance the energy consumption among the nodes. Many cluster-based routing schemes have been developed to help WSNs last longer [3-4]. However, energy consumption of sensors' batteries is unavoidable as long as the battery capacity is finite. Different clustering strategies are used to create energy-efficient WSNs with a longer lifetime. In different communication rounds, the CH positions are rotated among the nodes with the highest energy. To determine the next group of CHs among the nodes in the network, the approach considers the beginning energy, residual energy, and an optimal number of CHs. Then, based on the distances between them and the CHs, member nodes join different CHs to form clusters. To increase the energy efficiency of large-scale WSNs, a combined clustering and routing algorithm is presented [5]. To conduct the CH selection and multi-hop routing simultaneously, this technique uses a back-off timer and gradient routing. The hierarchical topology control approach relies heavily on the selection of CH nodes. LEACH is a well-known hierarchical topology control technique. LEACH's main principle is to choose CH nodes at random in a cyclic fashion, with the energy load of the entire network being evenly divided to each sensor node. The entire network lifetime is thereby increased. When LEACH selects CHs, however, there is a lot of randomness. This will most likely result in an imbalance of leftover energy between nodes, causing certain nodes to perish sooner. LEACH-C is an upgraded variant of LEACH that uses a simulated annealing technique to pick the best CH nodes [6].

In recent years, PSO has been a common approach of optimization that may be used to discover CH nodes and generate superior outcomes. PSO-C is a PSO-based clustering technique in which CH nodes are chosen based on the energy available to nodes as well as the distances between nodes and their CH nodes. PSO has also been utilized to locate CHs based on the distance and remaining energy of member nodes in previous research [7]. However, PSO-based algorithms frequently necessitate additional calculations and complex parameters. In high-dimensional space, PSO is simple to slip into a local optimum, and the iterative process has a poor convergence rate. The proposed work used Fuzzy Clustering (FC) and Modified Grey Wolf Optimization to address this problem (MGWO). This research proposes a novel CH selection approach based on MGWO and the initialization of CH nodes using Fuzzy Clustering (FC). Before starting the network, nodes are separated into numerous clusters of fuzzy subsets, and all of the sub clusters will run in parallel, reducing the size and time of each subset's computation. The rest of this paper is laid out as follows. In Section 2, related work is discussed. The model of CH selection in hierarchical topology control is discussed in Section 3. In section 4, its suggest the Fuzzy Clustering (FC) preprocessing approach as well as a modified GWO that takes numerous factors into account. Section 5 examines the evaluation of the FCMGWO algorithm as well as the analysis of the obtained results. Finally, in Section 6, discuss the key conclusions and future work.

LITERATURE REVIEW

Different algorithms for energy-aware sensor node clustering have been researched in the literature, motivated by the fact that energy efficiency plays a critical role in the WSN to extend the network's life time. The low-energy adaptive clustering hierarchy is one of the most popular and commonly utilised sensor node clustering algorithms (LEACH). LEACH is a probabilistic method that selects CH at random in each iteration. Despite the fact that LEACH reduces energy usage while increasing network Life Time (LT) when compared to static clustering and the Minimum Transmission Energy (MTE) method, it has several drawbacks. For example, LEACH can choose an SN with the least



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leftover energy as a CH later, lowering the network's LT. The researchers have created a number of alternative clustering algorithms to improve the efficiency of LEACH, such as Power-Efficient Gathering in Sensor Information Systems (PEGASIS), which is a chain-based technique. PEGASIS groups SNs into a chain, with each SN communicating only with its immediate neighbours. Every round, each SN in the chain has a turn transmitting data to the base station. PEGASIS saves more energy than LEACH, but its instability and significant latency make it unsuitable for large-scale networks. Ali et al [8] suggested an ARSH-FATI-based Cluster Head Selection (ARSH-FATI-CHS) combined with a heuristic called Novel Ranked-based Clustering (NRC) to reduce sensor node communication energy consumption while improving network Life Time (LT) in WSN. Unlike other population-based algorithms, ARSH-FATI-CHS dynamically shifts between exploration and exploitation of the search process during run-time to obtain a better performance-to-cost ratio and a higher network LT. During CH selection, ARSH-

FATI-CHS evaluates residual energy, communication distance factors, and workload. Simulate the planned ARSH-FATI-CHS and create various results to determine the WSN's LT performance. Compare the proposed results to state-of-the-art PSO to show that the ARSH-FATI-CHS strategy enhances the network's LT.

Zhu et al [9] developed an Improved Soft-k-means (IS-k-means) clustering algorithm to balance node energy consumption and extend the lifetime of the network in WSNs. To begin, apply the concepts of Clustering by Fast Search and Find of Density Peaks (CFSFDPs) and Kernel Density Estimation (KDE) to improve the soft k-means clustering algorithm's initial cluster centre selection. Then, using the soft-k-means' flexibility, reassign member nodes at the cluster's boundary based on their membership probability to balance the number of nodes per cluster. The notion of multiCHs is also used to balance the energy consumption of clusters. When compared to various clustering techniques from the literature, extensive simulation results show that the proposed algorithm may postpone the first node death, the half of node death, and the last node death on average for small-scale WSNs with single-hop transmission. Mehmood et al [10] presented LEACH-VH, a novel cluster-based routing protocol in which a new node type called Vice CH (VH) is introduced in addition to CH. The node with the highest residual energy among all nodes in a cluster is chosen as the CH, and the node with the second highest residual energy is chosen as the VH, which serves as the CH's backup node. The selected VH enters sleep mode, and when the CH's energy falls below a certain threshold, the VH awakens to operate as the CH and selects its VH. When compared to the Low Energy Adaptive Clustering Hierarchy (LEACH) routing system, the lifetime of a WSN increased by up to.

Salem and Shudifat [11] proposed a Low Energy Adaptive Clustering Hierarchy (LEACH) for extending the lifetime of the network and its energy in WSN. LEACH protocol, a cluster routing protocol that extends LEACH by finding a CH based on the shortest distance from the base station in order to reduce power consumption in CH nodes and throughout the network. As a result, the findings demonstrate LEACH's capacity to extend network lifetime while also decreasing and minimising power usage. Bidaki et al. [12] introduced an updated version of the LEACH protocol that uses the Kmeans clustering method to choose better nodes and hence extend the network lifetime in WSN. The proposed technique aims to build symmetric clusters and enhances network lifetime by lowering the average intra-cluster communications distance. When the sink node is located far away, it additionally evaluates the sink location and selects CH nodes that will use less energy to handle cluster members. As a result of the sensed data being sent to the closest CH, the suggested clustering technique can extend the network lifetime. Umbreen et al [13] developed Energy-Efficient Mobility based Cluster head Selection (EEMCS) for the lifetime enhancement of wireless sensor networks. The CH is chosen depending on specific criteria that have a significant impact on the sensor's energy consumption. The mobility level, remaining energy, distance to sink, and density of neighbours are used to compute each node's weightage. Single-hop/multi-hop communication is used for inter-cluster communication. Simulations are carried out using MATLAB. In terms of load balancing, network stability, energy depletion, and throughput, the suggested technique EEMCS outperforms the existing algorithms CRPD, LEACH, and MODLEACH. EEMCS uses significantly less energy and has a substantially longer network lifetime than other existing protocols.





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Al-Baz and El-Sayed [14] proposed a Node Ranked-LEACH to improve total network lifetime in WSN. Proposed research focuses on contemporary hierarchical routing techniques that rely on the LEACH protocol to improve WSN performance and lifespan. Based on the node rank algorithm, the proposed protocol improves the total network lifetime. To choose the CH of each cluster, the node rank method considers both path cost and the number of linkages between nodes. This upgrade, which may be represented as a CH, represents the true importance of a given node to success. In comparison to prior versions of LEACH protocols, the suggested method eliminates random process selection, which causes unexpected failure for some CHs in other LEACH versions, and it provides a decent performance in terms of network lifetime and energy usage.

Lin and Wang [15] proposed the Game theory based Energy Efficient Clustering routing protocol (GEEC) to extend the total network lifetime in wireless sensor networks. GEEC, which is a type of clustered routing protocol, uses an evolutionary game theory mechanism to attain both energy exhaust equilibrium and lifetime extension. Finally, thorough simulation tests are carried out. In comparison to the other two types of well-known clustered routing protocols, the experimental results show a significant increase in energy balance and energy conservation.

Problem Model for Clustering in WSN

Clustering is a key concept in WSN topology control, in which some nodes in the network are designated as CH nodes. CH nodes form the backbone network, in which other member nodes can be switched to hibernate mode to save energy, and the network's energy consumption is balanced by rotating the CH nodes on a regular basis. The network life cycle is also lengthened at the same time. A round is the name for the process of selecting CH nodes and reconstructing a network. The network model that was employed had the following attributes.

- Stochastically deploy sensor nodes in the region of interest, with node placements remaining stationary once deployed.
- Information acquired by sensor nodes can be relayed over a long distance.
- Each sensor node holds a set quantity of energy, which diminishes as information is transferred.
- In the WSN, there is a fixed-position base station (BS) that serves as the network's sink node.
- Each sensor node has the ability to process data as well as communicate data to the BS.

With the information transfer, the energy of sensor nodes would gradually deplete. When a sensor node's energy is gone, the node is considered dead. The network is declared dead when the number of dead nodes reaches a certain level. The goal of topology control is to make the network's life cycle as long as possible.

Energy Model: The standard LEACH energy model, in which both transmitters and receivers require energy. The radio electronics and power amplifier in the transmitter dissipate energy, and the radio electronics in the receiver dissipate energy.

The energy fading model is divided into two types based on the distance between a transmitter and a receiver node: free space and multipath. Set a threshold value d_0 , and when the transfer distance is less than d_0 , the energy consumption is proportional to the squared distance; otherwise, the consumption is proportional to the distance's fourth power. When transferring 1 bit data across a distance of d , the energy consumption is determined as equation (1).

$$E_{Tx}(l, d) = \begin{cases} l \cdot E_{elec} + l \cdot \epsilon_{fs} \cdot d^2, & \text{if } d < d_0 \\ l \cdot E_{elec} + l \cdot \epsilon_{fs} \cdot d^4, & \text{if } d \geq d_0 \end{cases} \quad (1)$$

and when receiving 1 bit data, the energy consumption of the receiver is given in equation (2).

$$E_{Rx}(l) = l \cdot E_{elec} \quad (2)$$

where E_{elec} is the electronics energy, depending on the energy dissipated per bit to run the transmitter or the receiver, and $\epsilon_{fs} \cdot d^2, \epsilon_{fs} \cdot d^4$ are the energy cost of signal amplifier under two communication modes depending on the distance between transmitter and receiver.





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where E_{elec} is the electronics energy, and ϵ_{fs} is the energy dissipated per bit to operate the transmitter or receiver. $\epsilon_{fs} \cdot d^2, \epsilon_{fs} \cdot d^4$ is the signal amplifier's energy cost in two communication modes, dependent on the distance between transmitter and receiver.

The data fusion model implies that regardless of the number of nodes in a cluster, each node collects and sends 1 bits to the CH, and the CH compresses the overall information received to 1 bits. EDA is the energy cost of data aggregation.

PROPOSED METHODOLOGY

Because MGWO offers dynamic optimization capabilities, it has a significant benefit in handling the topology control problem in WSN. To choose the CHs, use the traditional MGWO algorithm. Fuzzy clustering is used to initialize before communication. The fitness function is designed with the goal of lowering the network's overall energy consumption while taking into account the maximum Euclidean distance between member nodes and their CHs, as well as the maximum distance between CHs and the base station.

Proposed Method of Initialization using Fuzzy Clustering (FC)

Proximate nodes are easier to assign to the same cluster during the clustering process, owing to the lesser energy required for transmission between nodes in close proximity. As a result, before the communication process, offer a method of initialization that divides sensor nodes into numerous fuzzy initial subsets using the Fuzzy Clustering (FC) model based on node positions. On a probabilistic basis, each node in the network belongs to one of the original subsets. Each node is assigned to an initial subset based on probability at the start of each round. Then, each subset works in parallel to choose CHs and transmit signals to the base station, reducing the computation's size and duration.

Fuzzy Clustering (FC) Model

The basic set is partitioned into multiple disjoint subsets with objects that are somehow comparable in conventional deterministic clustering. Real clusters, on the other hand, are frequently much more complicated in practise, and the belongingness of items to them is more or less ambiguous. As a result, such clusters are more hazy subsets of the original set than its sharp components. The state of clustering is expressed by a $n \times k$ matrix $M = [w_{ij}] (1 \leq i \leq n, 1 \leq j \leq k)$ in fuzzy clustering [16], which is a partition of a set of n items $Y = y_1, y_2, \dots, y_n$ into k fuzzy cluster C_1, C_2, \dots, C_k . The degree of belongingness of the i th object to the j th cluster is represented by w_{ij} . The matrices $M = [w_{ij}]$ must meet the following requirements:

- For each object y_i and cluster $C_j, 0 \leq w_{ij} \leq 1$.
- For each object $y_i, \sum_{j=1}^k w_{ij} = 1$.
- For each cluster $C_j, 0 < \sum_{i=1}^n w_{ij} < n$.

c_j represents the center of the cluster $C_j, 1 \leq j \leq k$. $dist(y_i, c_j)$ is the distance between the object y_i and the cluster center c_j , and it shows the degree of belongingness of object y_i to cluster C_j . The closer the item x_j is to the cluster centre C_j , the more likely it is that object x_i belongs to the related cluster C_j . To satisfy the conditions of matrix $M = [w_{ij}]$, use $\frac{1}{dist(x_i, c_j)^2}$ to define the degree of belongingness of object y_i to cluster C_j , and then normalise to derive the definition of the degree of belongingness w_{ij} , which is indicated in equation (3).

$$w_{ij} = \frac{\frac{1}{dist(x_i, c_j)^2}}{\sum_{l=1}^k \frac{1}{dist(x_i, c_l)^2}} \tag{3}$$





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Soft clustering is another name for fuzzy clustering. It permits an object to be a part of more than one cluster. To calculate fuzzy clustering, utilize an expectation maximization technique and construct k distinct clusters.

Method of Determining the Number of Clusters

For fuzzy clustering to manage the granularity of clustering and strike a fair balance between compressibility and accuracy, the right number of clusters is critical. For each cluster, the sum of squared error (SSE) is defined as

$$SSE(C_j) = \sum_{i=1}^n w_{ij}^p \text{dist}(y_i, c_j)^2 \quad (4)$$

where $p(p \geq 0)$ is a factor determining the priority weighting of the degree of belongingness w_{ij} .

The SSE for fuzzy clustering with k clusters can be used to measure the degree of the fit of the data, defined as equation (5).

where $p(p \geq 0)$ is a factor that determines how the degree of belongingness w_{ij} is prioritised.

The SSE for fuzzy clustering with k clusters, defined as equation, can be used to measure the degree of data fit (5).

$$SSE(C_j) = \sum_{i=1}^n \sum_{j=1}^n w_{ij}^p \text{dist}(y_i, c_j)^2 \quad (5)$$

The SSE inside each cluster can be reduced by increasing the number of clusters. The reason for this is because while there are more clusters to capture finer features of data objects, the objects in a cluster are more similar. Calculate the SSE(k) and draw the curve of SSE(k) on the variable k for a certain number of clusters $k > 0$. The appropriate cluster number is implied by the first (or most significant) inflection point on the curve.

Proposed Initialization Process Based on Fuzzy Clustering

Propose a mechanism for dividing wireless sensor nodes into k clusters at the outset. To begin, use the elbow approach to determine the optimal number of clusters. Then, using the fuzzy clustering method, calculate the matrix $w_{ij}, 1 \leq i \leq n; 1 \leq j \leq k$.

Before each round, assign each node to the appropriate cluster based on its degree of affiliation to that cluster. If node y_i meets the following criteria, it is applied to cluster C_j .

$$\sum_{l_1=1}^{j-1} w_{il_1} \leq r < \sum_{l_2=1}^j w_{il_2} \quad (6)$$

where r is a random number with a uniform distribution between 0 and 1 and represents a random number with a uniform distribution between 0 and 1. The conventional MGWO technique is then used to choose CHs in each initial subset in parallel, and node messages are delivered to the base station.

A. Design of Objective Function

Topology control aims to reduce overall energy usage, which is primarily driven by communication between nodes. According to research, the distance between nodes has an impact on energy consumption. As a result, the following three elements are taken into account.

1) Maximum average distance from a member node to its CH node





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The subset is partitioned into K clusters, each with N_i member nodes, $i = 1, 2, \dots, K$, and the maximum average distance between KCH nodes is defined as equation (7).

$$dist_1 = \max_{i=1,2,\dots,K} \left\{ \frac{\sum_{j=1}^{N_i} d(CM_{ij}, CH_i)}{N_i} \right\} \tag{7}$$

The distance between member node CM_{ij} , and its CH_i , is $d(CM_{ij}, CH_i)$.

2) Maximum distance from cluster head nodes to the base station

$$dist_2 = \max_{i=1,2,\dots,K} \{d(CH_i, BS)\} \tag{8}$$

3) Total network energy consumption

The overall network energy usage for a round of data cycle is defined as equation (9).

$$E_{sum} = \sum_{i=1}^K \left(E_{CH}^i + \sum_{j=1}^{N_i} E_{mem}^{ij} \right) \tag{9}$$

E_{CH}^i is the energy consumption for CH_i during a round, and E_{mem}^{ij} is the energy consumption for a member node in cluster i during a round, where K is the number of CH nodes. All three aspects should be taken into account simultaneously. However, the data for each of them differs in dimension and magnitude from the data for the others. A normalizing function in equation (10) is used to transform the data into a comparable level in order to synthesize the above indicators.

$$y = \frac{2}{\pi} \tanh^{-1}(x) \tag{10}$$

Equation is used to define the objective function (11)

$$f = \alpha \cdot dist_{t_1} + \beta \cdot dist_{t_2} + \gamma \cdot E_{tsum} \tag{11}$$

where $dist_{t_1}$ is the maximum average distance, $dist_{t_2}$ is the maximum distance from CH nodes to base station, and total energy consumption is the total energy consumption. With $\alpha + \beta + \gamma = 1$, E_{tsum} , and α, β, γ are positive elements that determine the priority weighting of $dist_{t_1}, dist_{t_2}, E_{tsum}$. Assume that $dist_{t_1}$ and $dist_{t_2}$ have a minor impact on the cost function, but E_{tsum} has a slightly higher impact due to energy being a major factor in WSN. As a result, we set $\alpha = 0.2, \beta = 0.3, \gamma = 0.5$.

Proposed Cluster Head Selection Method using Modified Grey Wolf Optimization (MGWO)

Topology control is used to choose K CH nodes from a list of candidates in order to minimise the objective function, which can be thought of as an optimization problem. With the expansion of the scale and complexity of WSN, traditional algorithms have numerous limits, however MGWO is a very effective way for handling such optimization problems.

Problem Model for Cluster Head Selection

CH nodes consume more energy than the other nodes in the clusters, according to the energy model. The length of the network life cycle is the most important metric for evaluating topology control performance. To avoid premature "death" of some CH nodes, the energy consumption should be allocated to every node in the network when selecting CH nodes. Compare each node's remaining energy against that of the entire network, and if the remaining energy is larger than the average degree, the node is added to the CH candidate set. The CH nodes in the candidate set are then chosen using MGWO to minimise the objective value. Meanwhile, in the WSN





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clustering process, the number of CH nodes is an important element. The method for calculating the number of clustering head nodes is shown in Equation (12).

$$K = \frac{S\sqrt{n \cdot \varepsilon_{amp}}}{\sqrt{2\pi(n \cdot E_{stat} + \varepsilon_{amp} \cdot d_{avd}^2)}} \quad (12)$$

where S is the size of the WSN detecting zone, n is the number of sensor nodes, ε_{amp} is the signal-enlargement amplifier's factor, E_{stat} is the energy cost for a node to transmit 1 bit data, and d_{avd} is the CH's maximum coverage range.

Proposed Method using Grey Wolf Optimization (GWO)

The GWO algorithm is based on the hunting behaviour of grey wolves, who prefer to hunt in packs. Grey wolves have a rigid social dominance four-level hierarchy, with packs ranging in size from 5 to 12. GWO was inspired by grey wolves' social intelligence, which prefers to live in groups of 5-12 individuals. This method considers four levels in order to imitate GWO's leadership hierarchy: alpha, beta, delta, and omega. Alpha, who can be both male and female and are the pack's leaders, is in charge of making decisions (such as hunting, sleeping location, and wake-up time). Beta is known for assisting alpha in making judgments, and its primary role is to provide feedback suggestions. Scouts, sentinels, guardians, elders, and hunters are all roles Delta plays. Omega wolves are ruled by Delta, who obeys alpha and beta wolves. Every other wolf must obey the omega wolves.

The best grey wolf candidate is termed alpha (α), and they are the dominant wolves in the pack in the social hierarchy of grey wolves. The alpha wolves' subordinates, known as beta (β), are the second best in the hierarchy. If the pack's alpha wolves aren't present, the pack will be led by beta wolves. Omega (ω)wolves are the lowest-ranking wolves. All other wolves must bow to the omega wolves, and they must eat last in a pack. Delta (δ) refers to the wolves in their pack who are not alpha, beta, or omega. The delta wolves must obey the alpha and beta wolves in their pack, but they must have dominance over the omega wolves [17]. In the GWO, the hunting process is guided by, and wolves follow them.

The following formula can be used to calculate GWO's encircling behaviour:

$$\vec{X}(t+1) = w \cdot \vec{X}_p(t) + \vec{A} \cdot \vec{D} \quad (13)$$

where \vec{A}, \vec{C} are coefficient vectors, \vec{X}_p is the prey's position vector, X represents the location of wolves in a d -dimensional space, d is the number of variables, w is the inertia weight, (t) is the number of iterations, and \vec{D} is denoted as follows:

$$\vec{D} = |\vec{C} \cdot \vec{X}_p(t) - \vec{X}(t)| \quad (14)$$

where \vec{A}, \vec{C} are written as follows:

$$\vec{A} = 2\vec{a} \cdot \overrightarrow{c_1} \cdot \vec{r}_1 - \vec{a} \quad (15)$$

$$\vec{C} = 2 \cdot \overrightarrow{c_2} \cdot \vec{r}_2 \quad (16)$$

where \vec{r}_1, \vec{r}_2 vectors generated at random in the range $[0,1]$. The acceleration coefficients c_1, c_2 represent the contribution of the knowledge element and the social factor, respectively.

According to the equation below, a is the encircling coefficient, which decreases linearly from 2 to 0 as the number of rounds increases:





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$$a = 2 - 2 \left(\frac{t}{T_j} \right) \tag{17}$$

T_j is the number of CHs for each initial cluster, and t is the number of iterations. In the grey wolf hunting procedure, alpha is regarded as the best candidate for the job, with beta and delta assuming knowledge of the prey's likely location. As a result, the three best solutions found till a given iteration are preserved, forcing others (such as omega) to change their positions in the decision space to match the best place. The technique for updating positions can be determined as follows:

$$\vec{X}(t + 1) = \frac{\vec{x}_{ik1} + \vec{x}_{ik2} + \vec{x}_{ik3}}{3} \tag{18}$$

where the variables x_1, x_2, x_3 are specified and calculated as follows:

$$\vec{x}_{ik1} = \vec{X}_{k\alpha} - A_1 \cdot (\vec{D}_\alpha) \tag{19}$$

$$\vec{x}_{ik2} = \vec{X}_{k\beta} - A_2 \cdot (\vec{D}_\beta) \tag{20}$$

$$\vec{x}_{ik3} = \vec{X}_{k\delta} - A_3 \cdot (\vec{D}_\delta) \tag{21}$$

where $\vec{x}_{ik1}, \vec{x}_{ik2}$ and \vec{x}_{ik3} stand for the coordinate of CH k at a given iteration t .

Where, A_1, A_2 and A_3 are calculated as in above Equation. $\vec{D}_\alpha, \vec{D}_\beta, \vec{D}_\delta$ are calculated below equation.

where $\vec{x}_{ik1}, \vec{x}_{ik2}$ and \vec{x}_{ik3} are the coordinates of the CH k at iteration t

A_1, A_2 and A_3 are calculated as in the previous Equation $\vec{D}_\alpha, \vec{D}_\beta, \vec{D}_\delta$

$$\vec{D}_\alpha = |\vec{C}_1 \cdot \vec{X}_{k\alpha} - \vec{X}| \tag{22}$$

$$\vec{D}_\beta = |\vec{C}_2 \cdot \vec{X}_{k\beta} - \vec{X}| \tag{23}$$

$$\vec{D}_\delta = |\vec{C}_3 \cdot \vec{X}_{k\delta} - \vec{X}| \tag{24}$$

where $\vec{C}_1, \vec{C}_2, \vec{C}_3$ are computed using the equation above.

Modified Grey Wolf Optimization (MGWO)

The best three answers are utilised to update the position of each wolf in each generation or iteration of the GWO. Omega wolves make up a bigger proportion of the population and have lower fitness levels than alpha, beta, and delta wolves. The diversification ability of GWO in quest of better solutions can be improved by moving the weaker wolves in a directed method. The MGWO (Modified Grey Wolf Optimization) technique is presented. The wolves are ranked in ascending order of fitness in each generation. The top half are dubbed grey wolves, whereas the bottom half are dubbed upgraded grey wolves. Each upgraded grey wolf is paired with a master wolf to learn from. The following equations will be used by the wolves to learn from the master:

$$D_L = \omega |C_4 \cdot (x_{ikM} - x_{ikI})| \tag{25}$$

D_L is the distance between a master and slave wolf, $\omega \in [0, 1]$ is the learning coefficient, C_4 is derived by equation (25), x_{ikM} is a master wolf, x_{ikI} is an improved wolf, and S and M are evaluated using equation (26). In the case of a population of N wolves,

$$I = M + \frac{N}{2} \quad M = 1, 2, 3 \dots \tag{26}$$

The new continuous position of the upgraded wolf is derived using equation principles as follows:

$$x_{ikn} = x_{ikM} - A_4 \cdot D_L \tag{27}$$





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where x_{ikn} is the continuous solution and A_4 is calculated according to equation (27). Because feature selection is a binary problem, continuous solutions must be binary as well.

$$x_{ikd}(t+1) = \begin{cases} \text{if } I(x_{ikn}) > \text{rand} \\ 1 \\ 0, & \text{otherwise} \end{cases} \quad (28)$$

where x_{ikd} is a new binary solution for a better wolf in dimension d , $\text{rand} \in [0, 1]$, and I is a sigmoid function defined by

$$I(x) = \frac{1}{1 + \exp(-10 * (x - 0.5))} \quad (29)$$

When all wolves' positions are changed, Equation (28) is used, but rand is now set to 0.5. The upgraded wolves can now be incorporated with the population's master grey wolves and passed down to the next generation. The nonlinear control parameter adopted in (30) is used in place of to increase the number of iterations in the exploration stage.

$$a = 2 \left(1 - \frac{t^2}{T_j^2} \right) \quad (30)$$

RESULTS AND DISCUSSION

When a node's contained energy falls below zero, it is termed dead. The network is termed dead when the number of dead nodes reaches a certain threshold. Experiments are undertaken to mimic the life cycle of the network, including comparisons to the LEACH algorithm and the KBPSO algorithm, to demonstrate the efficiency of the proposed technique (FCMGWO).

Parameter Settings of Simulation Environment

The base station is created on the coordinates (x_s, y_s) . sensor nodes are randomly dispersed throughout the region of S . Assume that each data package has a set length of l , which is also taken into account. Table 1 shows the parameters that have been set.

Analysis of Life Cycle

Because the starting energy of nodes has an impact on the life cycle of a WSN, this experiment is broken into two parts:

1. Each node has the same beginning energy of 0.5J.
2. Node energy is evenly distributed between 0.3J and 0.7J.

Furthermore, the position of BS has a major impact on the WSN. The Base Station (BS) positions vary between (250,250), which is in the network's heart, and (500,575), which is on the outskirts of the monitored area. The FCMGWO, LEACH, and KBPSO algorithms are used to search for all possible scenarios. When the network's redundancy is substantial, the impact of the death of a few nodes on the network's performance is minimal. Then, as part of the network life cycle, consider node mortality. The association between node mortality and rounds is depicted in Figures 1 and 2.

As shown in Figures 1 and 2, when the BS positions are the same, regardless of whether the beginning nodes have equal energy or not, FCMGWO performs better than the other two algorithms, and the death time with FCMGWO is



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longer. The fundamental reason for this is that the proposed protocol FCMGWO allows for effective CH selection, which decreases communication between nodes' energy usage. At the same time, cluster leaders are given priority over nodes with low remaining energy, balancing the energy consumption of each network node and preventing some nodes from dying prematurely. As a result, the network's lifespan is extended. This is due to the fact that CHs need less energy to transmit messages to the BS at the centre. FCMGWO, on the other hand, outperforms the KBPSO and LEACH algorithms regardless of where the BS is located. In reality, the redundancy of network coverage is usually controlled within a particular range from a cost standpoint. In this instance, it is requested that all nodes in the network survive as long as possible in order to ensure network connectivity. The quality of service across the network will be dramatically reduced if one node fails. Then the WSN living rate is the primary attention indication. Figures 3 and 4 show the shifting curve of the node's living rate as well as the network life cycle. The curve slopes of FCMGWO are less than those of LEACH and KBPSO, indicating that the dying process is more gentle. This is the result of FCMGWO's consideration of both energy and distance, which apportions the energy consumption to each node, guaranteeing that none of the nodes runs out of energy too soon, essentially lengthening the life cycle

Total Data Messages Received at the Base Station

Figures 5 and 6 indicate the total number of data messages received at the BS. The figures show that the BS in the middle can receive more messages than the BS on the periphery. Furthermore, the proposed technique outperforms LEACH and KBPSO in terms of data message delivery. The reason for this is that the suggested method FCMGWO considers both energy and distance when selecting CHs. CHs are likely to be chosen from nodes with more remaining energy, ensuring network functionality and more data messages to the BS.

CONCLUSION AND FUTURE WORK

This research proposes a novel CH selection policy based on fuzzy clustering (FC) and MGWO for hierarchical topology control CH selection. The FC is used to cluster nodes at the start. The fitness function in the modified GWO is developed with three elements in mind: the distance from a cluster node to the CH node, the distance from the CH node to the base station, and the least energy consumption. The CH selection is then done with the updated GWO. The suggested technique can dramatically minimize node mortality and thus increase the network lifetime, according to simulation results. Plan to use (1) hybrid optimization algorithms to solve the problem of CH selection in the future, (2) try different clustering algorithms for initial clustering of nodes within the region, and design more appropriate algorithms for initial clustering to reduce the amount of computation and extend network lifetime.

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Table 1: Settings of Parameters

Variable	Parameter	Value
S	Distribution area	500 × 500
n	Number of nodes	100
(x_s, y_s)	Location of the base station	(250,250) or (500,500)
l	Length of every data package	4000bit
d_0	Threshold used in energy model	200
E_{elec}	Electronics energy	50Nj/bit





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E_{DA}	Energy cost for data aggregation	5nJ/bit
e_{fs}	Amplifier coefficient ($d < d_0$)	10pJ/bit/m ²
e_{amp}	Amplifier coefficient ($d \geq d_0$)	0:0013pJ/bit/m ⁴
p	Factor used in fuzzy clustering	1
α	Factor in objective function	0.2
β	Factor in objective function	0.3
γ	Factor in objective function	0.5
c1	Acceleration coefficient	2
c2	Acceleration coefficient	2
ω	Inertia weight	Decline from 1.4 to 0
V_{max}	Maximum of the velocity	200

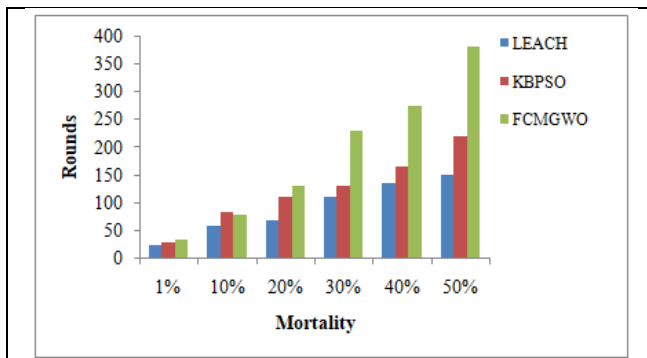


Figure 1: Relationship Between The Node Mortality and Rounds With Equal Energy With Bs At (250,250)

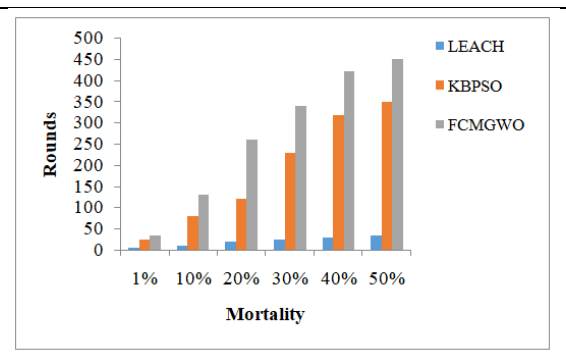


Figure 2: Relationship Between the Node Mortality and Rounds with Unequal Energy with BS at (250,250)

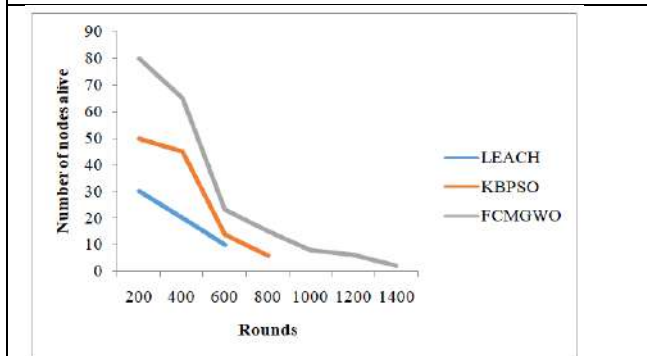


Figure 3: Number of Nodes Alive with Equal Energy With Bs At (250,250)

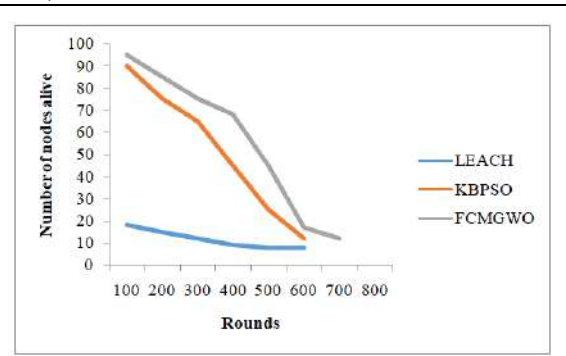


Figure 4: number of nodes alive with unequal energy with bs at (250,250)





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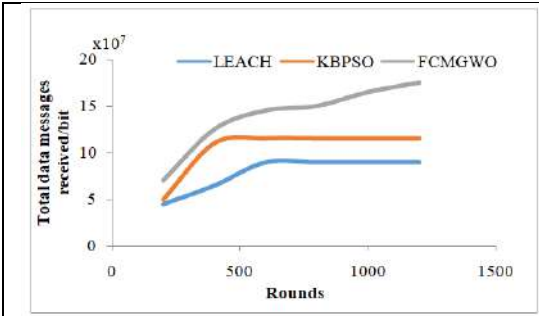


Figure 5: Total Data Messages Received At The BS (250,250) with Equal Energy

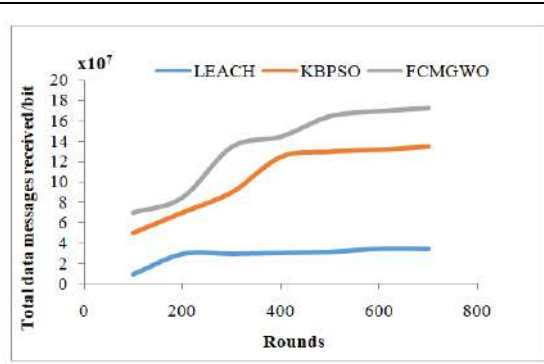


Figure 6: total data messages received at the bs (250,250) with unequal energy





A Study of Life Satisfaction and Personality traits of Healthy, Overweight, and Obese Adolescents

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ABSTRACT

The current research aimed at examining the relationship between life satisfaction and personality traits of healthy, overweight, and obese adolescents. It further aimed to find the difference if any in life satisfaction of healthy, overweight, and obese adolescents. The adolescents were grouped under three categories based on the body mass index. The current study utilizes a descriptive survey which was done using Big five personality questionnaire and multi-dimensional life satisfaction scale that was administered among students studying in schools of Jaipur. The results were analyzed using correlation and one-way ANOVA. The findings indicated that personality traits showed significant correlation with most of the life satisfaction dimensions in all the groups. Results of ANOVA indicated that significant pair wise differences exist on all the three groups of healthy, overweight, and obese adolescents with healthy adolescents having high means on all the dimensions of life satisfaction.

Keywords: family, self, personality, body weight, obesity, health, BMI

INTRODUCTION

The transition phase between childhood and adulthood is called the adolescence. This phase is between the years 10-19 years. It is an important stage that lays the foundations for both physical and psychological health. This stage is characterized by rapid modifications in cognition and psychosocial development. The prevalence of adolescent obesity has greatly increased and has emerged as a challenge in the public health domain. Adolescent obesity has both short-term and long-term health issues. Both physical and psychological ailments are associated with overweight and obesity. The recent COVID-19 pandemic reported significant associations between dysfunctional



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health, mental health pressures, and substance abuse [1]. Weight gain was subsequently associated with an increase in unhealthy eating behaviors, a significant decrease in physical activity, and deteriorating mental health of the adolescents [2]. This ultimately results in weight gain. Other than this, the environment in which we live, our home, the society also influence our mental health. The pre judices and discrimination associated with larger body size, commit to increasing mental health problems. Overweight adolescents are subjected to labeling which includes irresponsible, unfit, undesirable, ugly, and are also liable to bear high health care costs and more negative outcomes. These types of judgmental remarks not only make the individual guilty but give rise to negative feelings about oneself. In the long run, these comments lower self-esteem as well as lead to other mental health problems. Moreover, high body weight also becomes a problem when certain daily life activities depend on it. For example, the ride seats in an amusement park are naturally designed to fit normal-sized children and adults. Likewise, seats in an airplane also have a similar pattern. Therefore, being denied fun, entertainment and flights are some problems that an individual faces when they have high body weight. A study conducted by Baile *et al* (2020) on exploring the association between weight status, health-related quality of life and life satisfaction among adolescents. Approximately 1200 students participated and completed Health Behavior in School-aged children questionnaire. The students were then segregated under four groups of underweight, healthy, overweight, and obese. The findings indicated high health related quality of life and high life satisfaction was shown by boys as compared to girls. The obese groups had significantly low levels of both health-related quality of life and life satisfaction as compared to the healthy group. To conclude, overweight is associated with variety of psycho-social problems and is considered one of the most crucial and immediate health problems of today. [3] A study conducted by Sutin and Terracciano (2019) explored whether the relationship between personality traits and body weight extends to social attitudes. They examined around 1300 participants who were mothers with children, and they completed personality questionnaire, weight related attitudes and social interactions. The findings revealed that both high extraversion and high neuroticism were related to more negative attitudes towards individuals with overweight and obesity as well as they had high engagement in fat talk with their peers and around their children. In addition to this, high conscientiousness was related to fewer negative attitudes and interactions, but they had greater phobia towards obesity.[4]

METHODOLOGY

The purpose of the current study was to explore the relationship between life satisfaction and personality traits of healthy, overweight, and obese adolescents. A sample of 350 students were included in the study. The sample constituted 165 healthy, 113 overweight, and 72 obese adolescents under the age range of 14-19 years who were from English medium schools of Ajmer and Jaipur. A performa was designed which included socio-demographic details like height, weight, diet preference, grade, etc., along with life satisfaction and personality questionnaires. For the measurement of life satisfaction, the multi-dimensional student life satisfaction scale (MSLSS) was used and for personality, the Big five personality inventory (BFI-XS-2) was used. The BFI-XS-2 was developed by Christopher J. Soto and Oliver P. John (2017).The questionnaire has 30 items distributed among five traits- extraversion, agreeableness, conscientiousness, negative emotionality, and open-mindedness.

The Multi-dimensional Student Life Satisfaction Scale (MSLSS)- This scale was developed by Scott Huebner (1994). The scale of 40 items was distributed among five subscales of family, friends, school, living environment, and self.

Data Analysis

Following the administration of questionnaires, the students were segregated into three categories based on their obtained body mass index scores. The statistical analysis was done using descriptive, correlation, and one-way ANOVA through SPSS software.





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RESULTS AND DISCUSSION

The aim of the study was to examine the relationship between life satisfaction and personality traits of healthy, overweight, and obese adolescents. The study also aimed to see the difference in life satisfaction of healthy, overweight, and obese adolescents. Based on the aim, it was hypothesized that there is a significant positive relationship between life satisfaction and personality traits of healthy, overweight, and obese adolescents. It was also hypothesized that there will be significant difference in the life satisfaction and personality traits of healthy, overweight, and obese adolescents. With reference to the means and standard deviations obtained following the analysis, it was seen that on the subscale of **family**, healthy adolescents had high satisfaction when compared to the other two groups (as indicated in **Table 4.1**). This is because healthy adolescents have better perceptions of family qualities like good communication, boundaries, safe space, and security, all of which keep them satisfied and improve their quality of life. On the subscale of **friends**, healthy adolescents had a slightly higher mean when compared to the other two groups. This implies that healthy adolescents have reciprocated friendships which keeps them included in activities where a partner is needed. On the **school** subscale, healthy adolescents also had a higher mean as compared to the other two groups. This implies that healthy adolescents are obedient, they do not have problems with discipline, and are always motivated to participate in school activities. On the subscale of **living environment**, healthy adolescents had a slightly higher mean when compared to the other two groups. This implies that healthy adolescents have safer environments and neighborhoods which increases their likelihood to engage in physical activities and outdoor games. Lastly, on the subscale of **self**, healthy adolescents had a higher mean as compared to the other two groups. This implies that healthy adolescents engage in high physical activity, which is an indicator of healthy body mass, which is an important determinant of good self-worth. For the trait of **extraversion**, healthy adolescents had a high mean as compared to the two other groups. This is because high levels of extraversion are significantly associated with a lower risk of physical inactivity. On the trait of **agreeableness**, overweight adolescents had a similar mean as healthy adolescents. This is because the trait of agreeableness is considered a protective factor for obesity. The trait is also associated with sensitivity and concern for others. On the trait of **conscientiousness**, healthy adolescents had a high mean as compared other two groups. This might be due to the associations of the sub-factors of conscientiousness trait like the tendency to be organized and disciplined to the habits of healthy adolescents in maintaining a proper diet plan and nutritional balance. On the trait of **negative emotionality**, obese adolescents had the highest mean as compared to the two other groups this is because high neuroticism levels are related to poor health and well-being. Lastly, on the trait of **open-mindedness**, overweight adolescents had high slightly higher mean than healthy adolescents. This is because overweight adolescents consider themselves perfectly healthy their perceptions of daily stressors, and life challenges, resemble the perceptions of a healthy adolescent hence open-mindedness is related to characteristics like creativity, insightfulness, curiosity, as well as excitement to seek new experiences which are shown by healthy adolescents.

With reference to the aim of this study, the relationship between levels of life satisfaction and personality traits of healthy, overweight, and obese adolescents, the results indicated that **healthy adolescents** showed a significant positive correlation between personality traits and subscales of life satisfaction (as indicated in **Table 4.2**). The trait of extraversion revealed a significant positive correlation with family, living environment, and self-subscale of life satisfaction. The trait of agreeableness revealed a significant positive correlation with family, friends, and self-subscale. The trait of conscientiousness revealed a significant correlation with family, friends, living environment, and self-subscale. The trait of negative emotionality did not reveal significant correlation. Lastly, the trait of open-mindedness also did not reveal significant correlation. On the contrary, **overweight adolescents** showed significant positive correlation between personality traits and subscales of life satisfaction except for negative emotionality. The trait of extraversion revealed significant positive correlation with friends and living environment subscale. The trait of agreeableness revealed significant positive correlation with family, friends, school, and self-subscale. The trait of conscientiousness revealed significant correlation with family, friends, living environment, and self. The trait of negative emotionality revealed significant negative correlation with all the subscales. Lastly, the trait of open-mindedness revealed significant positive correlation with family, friends, and school subscale.



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Similarly, **obese adolescents** showed significant positive correlation between personality traits and subscales of life satisfaction except for negative emotionality. The traits of extraversion, agreeableness, and conscientiousness revealed significant positive correlation with all the subscales of life satisfaction. Whereas significant negative correlation was observed between negative emotionality and all the life satisfaction subscales. The trait of open-mindedness revealed significant positive correlation with family, friends, living environment, and self-subscale.

Overall, the results indicated that the correlation between extroverts and family satisfaction is high for obese adolescents ($r = .627, p < .01$). This finding does not line with the current review of literature. This change in the families of obese adolescents regarding their acceptance in the family could be a result of the awareness about the importance of mental health. Nowadays obese adolescents tend to smile easily, like to meet people, and take a personal interest in others. Although they are mindful of their weight but make no effort to lose it. The healthy group also showed significant positive correlation between extraversion and family subscale. This implies that healthy adolescents who are outgoing and talkative, are surrounded by supportive family environment which provides them satisfaction and happiness.

The correlation between extroverts and friends satisfaction, is also high for obese adolescents ($r = .664, p < .01$). Overweight adolescents also revealed significant correlation between extraversion and friends subscale. This could be due to the changing times where being socially active is an important part of life, be it on the internet (social influencer) or in the society. A study conducted by Marengo et al (2020) aimed to examine the interplay between extraversion, neuroticism, and social media addiction. They used passive Facebook user data and mapped it to a scale of social media addiction. They concluded that adolescents who scored high on extraversion and neuroticism are prone to risk of social media addiction [5]. Obese and overweight adolescents like to be around multiple people and yearn for others if they are alone for too long. The correlation between extroverts and school satisfaction is significant only for the obese group ($r = .553, p < .01$). This implies that obese adolescents do not face difficulty in maintaining school decorum and they are happy to go there and have positive relationships with their teachers and friends. This may also be possible as the rate of obesity has become so prevalent that more than average of the classmates come under the obese group. On the contrary, healthy adolescents revealed negative correlation which suggests that may be teachers are more inclined and aware about the obese group which shifts their attention from the healthy group which decreases their satisfaction with the school environment. The correlation between extroverts and living environment is significant for all the three groups but is high for the obese group ($r = .639, p < .01$). This indicates that adolescents irrespective of their body mass and who are extroverts in nature were comfortable and satisfied by the sound privacy in their living environment.

The suitable conditions make it optimal to stay indoors. They perceive their living environment as a safe place to enhance their physical, mental, and emotional well-being. Lastly, the correlation between extroverts and self-subscale is significant for healthy group and obese group but high for the latter group ($r = .663, p < .01$). This implies that adolescents who are extroverts tend to have enhanced pleasure-related behaviors which promote not only self-satisfaction but also social satisfaction. Adolescents who are healthy, they have high physical and psychological self-satisfaction. On the contrary, extraversion is also associated positively with outcomes like lack of symptom decrease, weight gain/BMI, risky behaviors, and success/failure. The results indicate that the correlation between agreeableness and family satisfaction is significant for all the three groups but high for obese adolescents ($r = .656, p < .01$). This implies that obese adolescents are cooperative, polite, friendly, and kind individuals who have strong family support but engage themselves in emotional eating and external eating [6]. The correlation between agreeableness and friends satisfaction is significant for all the three groups but high for the obese group ($r = .675, p < .01$). This implies that highly agreeable people may stress over failure because they are worried about letting people down. This stress hinders in the way of successful weight loss as stress can make it difficult to resist temptation. The correlation between agreeableness and school satisfaction is significant for both overweight and obese group but high for the latter group ($r = .548, p < .01$).



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This implies that agreeableness has a direct effect on anti-social behaviors (general distress which causes mood and anxiety symptoms) and has a positive correlation with positive school environment (school justice, student-teacher relationship, and student-student relationship) [7]. The correlation between agreeableness and living environment showed a significant positive relationship only in the obese group ($r = .575, p < .01$). This indicates that favorable living conditions like the availability of unhealthy, processed food, and high-calorie food in contrast with limited access and high price for healthy foods are a contributor to the development and encouragement of overweight [8]. Lastly, the correlation between agreeableness and self-scale was significant in all the three groups but high in the obese group ($r = .631, p < .01$). This implies that agreeableness influences self-rated health as agreeableness is regarded as an instrumental trait that acts indirectly by guiding to achievements or social situations. It gives a sense of control, competence, and supportive relationships which positively affects self-esteem and well-being. The results indicate that the correlation between conscientiousness and family subscale was significant for all the three groups but high for the obese group ($r = .691, p < .01$). This indicates that obese adolescents who have the characteristics of conscientiousness abstain from showing aggression and can control their impulses in relationships [9]. The correlation between conscientiousness and friends subscale was significant on all the three groups but high for the obese group ($r = .716, p < .01$). This indicates that conscious adolescents are trustworthy, self-disciplined, and prefer teamwork with their peers and companions irrespective of their body mass. The correlation between conscientiousness and school subscale was significant only for obese adolescents ($r = .566, p < .01$). This indicates obese adolescents perform well at school, manage their school-life balance, and are successful in learning which helps them to lead a happier life. The correlation between conscientiousness and living environment was significant on all the three groups but high for the obese group ($r = .669, p < .01$). This indicates that conscientious adolescents flourish in favorable living environment conditions like availability of food, medical services, and nearby market areas irrespective of their body mass index. Lastly, the correlation between conscientiousness and self-satisfaction was significant for all the three groups but high for the obese group ($r = .696, p < .01$). This indicates that conscious adolescents are satisfied with their sense of self, are motivated, and goal-directed, and show perseverance in daily life situations irrespective of their body weight.

The results indicate that the correlations between negative-emotionality and family satisfaction was significant for both overweight and obese groups but high for the latter group ($r = -.636, p < .01$). This implies that poor family functioning promotes negative emotions and obesity in adolescents. They perceive that they are surrounded by unsupportive family environments which gives rise to inability to control negative emotions. The correlation between negative emotionality and friends was significant for both overweight and obese groups but high for the obese group ($r = -.678, p < .01$). This implies that engagement in unhealthy behaviors like drinking, smoking, eating high-fat snacks, etc. with peers and friends leads not only to obesity but also results in long-term addiction of these behaviors post adolescence. The correlation between negative emotionality and school subscale was also significant for both overweight and obese groups but high for the obese group ($r = -.610, p < .01$). This implies that obese adolescents are victims of bullying and ragging because of their high body weight, they tend to experience negative emotions like anxiety, depression, nervousness, and lose confidence later in life. The correlation between negative emotionality and living environment was significant for both overweight and obese groups but high for the obese group ($r = -.717, p < .01$). This implies that negative life situations contribute to neuroticism, which enables failure of coping mechanisms and hence promotes weight gain. Lastly, the correlation between negative emotionality and self-subscale was significant for both overweight and obese groups but high for the obese group ($r = -.627, p < .01$). This implies that obese adolescents are always surrounded by a cloud of negative emotions which decrease their sense of self. The results indicate that the correlation between open-mindedness and family subscale was significant for both overweight and obese groups but high for obese adolescents ($r = .325, p < .01$). This implies that obese adolescents are receptive to enjoying new experiences, they explore and try out new food items. An open-minded adolescent adds closeness and positivity to a family environment.

The correlation between open-mindedness and friends was significant for both overweight and obese groups but high in the obese group ($r = .309, p < .01$). This implies that open-minded adolescents have better relationships with peers and their partners. They tend to agree to things that their friends ask. They remain inclined towards trying out



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new restaurants with their peers. The correlation between open-mindedness and school subscale was significant only for the overweight group ($r = .215, p < .05$). This implies that being overweight is so common nowadays that this group receive special care because of their weight to enhance their school experience. The correlation between open-mindedness and living environment was significant only for obese adolescents ($r = .282, p < .05$). This implies that since open-minded adolescents are adventurous, they flourish best in areas where they are in the proximity to try new things daily. They notice changes in their environments quite easily. Lastly, the correlation between open-mindedness and self-subscale was significant only for the obese group ($r = .302, p < .01$). This implies that open-mindedness gives a positive sense of self to obese adolescents.

They are best at assessing the minute details of life. Their practicality facilitates them to highlight the positive sides in different situations while neglecting the negativities. With reference to the second aim of this study, the difference in life satisfaction of healthy, overweight, and obese adolescents was seen using one-way ANOVA and post hoc Tukey analysis. It was seen that significant differences were observed on the subscales of life satisfaction i.e., family, friends, school, living environment, self, and groups of body mass index i.e., healthy, overweight, and obese adolescents (as indicated in **Table 4.3**). Family functioning of healthy, overweight, and obese adolescents is different in various aspects. Healthy and overweight adolescents have love, care, and support for their family members which gives them security and a sense of belonging. Obese adolescents have slightly different familial environments. They have less supportive family environments which include family stress, absence of either the mother or father, maternal depression, unappealing, non-stimulating home, and lack of parental warmth, love, and acceptance [10]. Both healthy and overweight/obese adolescents have friends who promote behaviors according to their body type. Groups of healthy adolescents promote more physical activity and promote healthy eating behaviors in contrast to groups of overweight and obese adolescents who promote sedentary lifestyles and risky health behaviors [11]. Although the school setting remains the same for healthy, overweight, and obese adolescents, yet obese adolescents face additional difficulties like bullying, teasing, body shaming, ridicule, and judgment because of their heavy bodies. These factors not only affect their academic performance but also give rise to demotivation and isolation from the school environment. On the living environment subscale, rural areas tend to have low obesity rates as the supermarkets and residences have significant distance which aids in increasing the ability to practice healthy behaviors like walking which prevents obesity. Healthy adolescents have high satisfaction with themselves because self-rated health is suggested as a health indicator among adolescents. Both life satisfaction and self-rated health mirror an adolescent's contemplative judgment of which his or her life is going well.

CONCLUSION

It was concluded that the prevalence of overweight and obesity has risen so much that it is very common to find that majority of the adolescents have high body weight. This has negatively impacted the perception of parents, teachers, and peers to become over-protective and over-aware of the psychology of an obese adolescent. They have prioritized the psychological well-being of an overweight and obese adolescent by promoting positive family, school, living environment over the physical well-being of the adolescent. This shift in the perception of the caregivers is harmful in the long run as physical health is equally important as the psychological health.

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Table 4.1 Means and Standard Deviation for study variables of life satisfaction, personality traits, and body mass

Variables	Healthy (n = 165)		Overweight (n = 113)		Obese(n = 72)	
	M	SD	M	SD	M	SD
Family	4.72	1.16	4.28	1.49	3.31	1.19
Friends	4.23	.78	4.10	.88	3.02	1.55
School	4.08	.53	3.88	.71	3.09	1.22
Living Environment	3.77	.64	3.63	.86	2.60	1.28
Self	4.84	.91	4.33	1.37	3.24	1.85
Extraversion	19.95	3.37	19.50	3.16	18.03	4.59
Agreeableness	20.42	4.21	20.43	4.09	17.78	5.66
Conscientiousness	19.83	2.88	19.69	3.37	17.13	4.42
Negative emotionality	17.28	3.60	17.67	3.77	19.97	5.03
Open-mindedness	18.71	2.75	18.81	2.85	17.33	2.61

index of healthy, overweight, and obese adolescents.





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Table 4.2 Correlations between life satisfaction and personality traits of healthy, overweight, and obese adolescents.

Variables	Family			Friends			School			Living Environment			Self		
	Healthy	Overweight	Obese	Healthy	Overweight	Obese	Healthy	Overweight	Obese	Healthy	Overweight	Obese	Healthy	Overweight	Obese
Extraversion	.206**	.150	.627**	.145	.211*	.664**	-.135	.140	.553**	.240**	.209*	.639**	.233**	.180	.663**
Agreeableness	.220**	.474**	.656**	.272**	.551**	.675**	.036	.340**	.548**	.123	.169	.575**	.294**	.363**	.631**
Conscientiousness	.321**	.351**	.691**	.193*	.448**	.716**	.040	.154	.566**	.227**	.199*	.669**	.280**	.377**	.696**
Negative Emotionality	-.037	-.191*	-.636**	-.001	-.270**	-.678**	.100	-.195*	-.610**	.087	-.319**	-.717**	.110	-.201*	-.627**
Open-Mindedness	-.088	.233*	.325**	.044	.229*	.309**	-.071	.215*	.173	.041	.150	.282*	.009	.181	.302**

Note. * $p < .05$. ** $p < .01$.

Table 4.3 Means, Standard Deviations, One-Way ANOVA and Group Comparisons across groups of body mass index on subscales of life satisfaction.

Variables	Healthy	Overweight	Obese	F(2,347)	η^2
	M(SD)	M(SD)	M(SD)		
Family	4.72(1.16)a	4.28(1.49)b	3.31(1.91)c	23.616*	.12
Friends	4.23(.789)a	4.10(.881)b	3.02(1.55)c	37.406*	.17
School	4.08(.534)a	3.88(.717)b	3.09(1.22)c	41.018*	.19
Living Environment	3.77(.647)a	3.63(.863)b	2.60(1.28)c	46.629*	.21
Self	4.84(.916)a	4.33(1.37)b	3.24(1.85)c	37.734*	.17

Note. Means with different subscripts differ significantly from each other. * $p < .001$.





An Examination of Internet Retail Purchasing Patterns among College Students: Exploring Consumer Behavior in Online Shopping for Products and Services

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ABSTRACT

This study looks into the factors that influence college students' decisions to shop online. Using focus groups as a research tool, this exploratory study conducted qualitative research. A content analysis program was used to look at the transcripts of the data. The data analysis process revealed several key factors that influenced college students to make online purchases, including the use of apps for online shopping, the frequency with which online shopping is used, the products you frequently buy online, your satisfaction with the online shopping experience, the efficiency of online purchases, and the effectiveness of return policies for online purchases. Random sampling was employed as the sample method in a study that used a standard questionnaire and 120 samples to obtain data. Overall, the study's conclusions help online retailers and marketers better comprehend college students' online buying preferences, allowing them to create marketing strategies that will give them a competitive advantage. The results of this study strengthen previous research on Indian customers' online retail purchasing habits.

Keywords: online-shopping, online-Purchase, service behaviour.



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INTRODUCTION

Using the internet, which is effectively an endless market, a client living in any nation can enter a contractual relationship with a trader operating in any other country. From this angle, buying consumer goods from any international web seller based outside of the buyer's country of residence constitutes a cross-border transaction. Consideration of whether to buy the chosen item from a website is especially crucial in accordance with customs due to the variations in the legal and linguistic surroundings, as well as occasionally in the company. a shop owned by foreign traders. Due to the enormous and endless market that the internet offers, even though there is a greater distance involved, the consumer may instantly purchase the desired goods by making a few clicks from home or work, saving time and energy. Additionally, clients with limited mobility may find it simpler to shop online. The customer can always place an order because they do not have to go to the retailer's store and are not limited by the business's operating hours. Due to the availability of commodities that can be purchased from locations other than the customer's own, the range of goods is significantly greater. Customers can also request delivery to their homes or places of employment. Online deals are easy to compare, enabling buyers to buy products that meet their unique needs and have the best terms (price, quality, other discounts).E-commerce gives companies unmatched opportunities to increase their market share, expand internationally at a low cost, and reduce costs. The principal applications of electronic commerce, issues with and fixes for its implementation, and services needed to support it are the main subjects of this article. This essay will also demonstrate how numerous organizational functional domains have been impacted by online shopping. The exchange of goods and services, the transfer of money or data, or both, over an electronic network—most frequently the internet—is referred to as online shopping. These business dealings can be between consumers, businesses, or even between consumers and other businesses.

NEED OF THE STUDY

Online shopping has significantly increased in popularity as a result of its convenience, speedy transactions, time savings, attractive sales promotions, etc. Although these factors are motivating, there are other barriers, such as the anxiety some internet users experience when providing their credit card number or other private information. Because online shopping is still in its infancy, there are no set rules that consumers must adhere to.

OBJECTIVES OF THE STUDY

1. To analyse the online buying behaviours of college students to buy goods and
2. services from internet retailers.
3. To look at the age of the respondents and frequency of using online shopping sites.
4. To look at the educational qualification of the respondents and satisfied with the
5. experience of online shopping

SCOPE OF THE STUDY

The study's main focus was on how college students shop online. Online purchasing is the main driving force behind this expansion in retail. Customers no longer need to go outside to shop. It has significantly changed how consumers purchase by placing the shopping process at their fingertips via computers and mobile devices. The main result of online purchasing has been the freedom for people to shop whenever they want, from anywhere. They are no longer need to wait until the business opens before making a purchase. While it has been possible to shop online for some time, the use of mobile has propelled e-commerce to new heights because consumers can utilize the device at any point in the sales cycle.



**Shahul Ammed and Nagarajan****LIMITATIONS OF THE STUDY**

Only college students should use online stores to purchase products and services. Due to the small sample size, the population as a whole cannot be accurately represented. The accuracy of the statistics could be affected by the respondent's own prejudice.

LITERATURE SURVEY

Ajzen and others (2010) have investigated how it affected consumers' perceptions of online shopping. I chose this subject because research on online shopping demonstrates that endogenous and exogenous factors, such as consumer characteristics, environmental factors, product characteristics, previous online shopping experiences, and trust in online shopping, both influence perceptions and intentions to shop online. Ali, Pervaiz (2010) has looked at Norwegian internet shoppers' satisfaction and loyalty in their study, "Online Shopping Customer Preference and Loyalty in Norway." Less than half of Norwegians are devoted to their online retailers, according to the survey's findings, although the majority of them are satisfied with online shopping. Islam, M. A., and Eri, Y. (2011) a study on "Indian Consumer Online Shopping Behavior." Finding out how various components of online shopping connect to customer purchase behavior was the main objective of the study. The author used an independent sample test technique to analyze the data. The author concludes that there are differences between consumers' purchasing behaviors whether they purchase in physical places and online after analyzing the data. At Jaipur National University, there were no appreciable disparities in the responses between male and female management students. The respondents have a favorable opinion of online purchasing.

According to Davis (2011)'s investigation, more attractive online stores were developed. This questions the necessity of studying what motivates consumers to shop online. To completely understand consumer perceptions of online shopping and their plans to engage in it, a framework must be employed to organize the complex system of influences brought on by these numerous factors. One advantage of e-retailers, according to Yu-Chen Chen et al. (2012), is their ability to give their customers in-depth information. On the other side, the concept of information overload contends that, above a certain point, having more information leads to inferior quality but a better subjective situation with regard to making decisions about purchases. Essay on modelling consumer behaviour in online purchase situations is a paper by Ying (2015). He examined the patterns of online shopping throughout a number of sessions. Shopping cart abandonment affects a lot of online storefronts. He looked at abandoned shopping carts in the context of online food purchasing. He specifically developed a combined model for selecting the cart, the order, and the amount to buy. The connections between the mistake words show how interrelated the three judgments are. A review of the available data shows that not all shopping cart abandonments result in lost sales. The unfulfilled orders are regularly completed by customers who collect abandoned shopping carts.

By using variables including the length of their shopping journey, the time since their last visit, the number of items in their basket, and the value of the bargain, customers are urged, among other things, to complete their abandoned shopping. Important managerial suggestions are given to marketers by the study on how to handle the problem of shopping cart abandonment. Limayem and Khalifa (2015) have analysed employed well-respected behavioral theories to explain online buyer behaviour in their 2015 study, "Drivers of internet shopping." The next stage was to identify the key factors influencing online purchases and evaluate each one's relative importance. An ongoing survey study was used for this. The researcher used simple charts and tabulation as tools for data analysis. The researcher concluded after analyzing and interpreting the data that Indian customers are becoming addicted to internet shopping and that they have many of the same traits as the rest of the world. The results demonstrate that views toward online shopping, expectations of the consequences of doing so, and social influence all have a significant influence on consumers' intentions. Shanshan Ma and others, 2016. Consider the two marketing strategies used by a manufacturer: selling a single product in a physical store or differentiating the product with a feature that isn't necessary and selling it in both a physical store and an online store. You can divide consumers into two groups based on whether or not they are loss averse. The adaptability of the manufacturer for online marketing is a subject of this



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essay. If so, how does the producer choose a reasonable discount price, and how many products should the producer make available via each channel? We determine the best discount method and product quantity under the conditions of different online business margins and varying expected consumer valuation. Finally, we look at how predicted customer value, valuation fluctuation, and loss aversion influence the ideal discount price and expected profit.

2018's Rakhi Thakur, this study aims to investigate the role of consumer participation in online review authoring, with a focus on specifically online shopping. Customers are increasingly utilizing online shopping as their primary screen, and marketers are taking advantage of this trend to engage customers in interactive communication, which makes it even more suited for boosting customer engagement. But this area of research is only now getting started. The current study is among the first empirical ones to look at how customer involvement influences the production of internet reviews. This study advances our understanding of marketing in the areas of consumer interaction, online reviews, and online purchasing behavior. Additionally, suggestions on how businesses might benefit from customers' online participation are given to retailers, along with advertising for better management.

Anjala S. Krishen, et al. (2019) Online has evolved from a fundamental basis to an adaptive one for shopping environments due to the diversity of online shoppers. User irritation brought on by information overload is the cause of the demand. The researcher employed simple charts and tabulation as tools for data analysis. After analyzing and evaluating the data, the researcher concludes that Indian customers are more dependent on internet shopping and enjoy a variety of its benefits. We employed a feedback control theory-based approach to solve the problem of consumer information overload online in a flexible manner. To demonstrate the usefulness of this feedback control, the feedback controller was evaluated using a design science methodology.

Menon (2020) has investigated, if consumers have a positive attitude regarding the Internet and a positive online shopping experience, they are more inclined to use it as a medium for making purchases. Escapism, pleasure, and arousal are three hidden features of the "enjoyment" construct that we identify in our theory. "Escapism" is described as the pleasure one experiences from engaging in pursuits that are absorbing enough to provide as an escape from the stresses of daily life. The term "pleasure" refers to the degree of happiness, delight, or pleasant sensations had while making an online purchase. The research's sample size was 150 respondents. The researcher used ANOVA (analysis of variances) methodologies and basic percentage analysis to analyse the data.

RESEARCH METHODOLOGY

Research Design: Descriptive research design was employed in the study.

Sampling Design: This investigation, random sampling was used as the sample method.

Sampling Size: 120 sample

Tools and Techniques: In this study used SPSS V23 Software for all my analysis data and interpretation. Percentage analysis is one of the most widely used statistical methods for reviewing data. Correlation

DATA ANALYSIS AND INTERPRETATION**Age of the respondents**

Source: Primary Data The above table shows that the classification of the respondents on the basis of age. 20.0% of the respondents are belongs to the below age group of 20years, 54.2% of the respondents are belongs to the age group of 21-30 years, 10.0% of the respondents are belongs to the age group of 36-50 years and the remaining 15.8% of the respondents are belongs to the age of above 50 years.

Gender of the Respondents

Source : Primary Data The above table shows that the classification of the respondents on the basis of their gender.31.7% of the respondents are male and 68.3% of the respondents are female.



**Shahul Ammed and Nagarajan****Marital Status of the Respondents**

Source : Primary Data The above table shows that the classification of the respondents on the basis of marital status.30.0%ofthe respondents are married and the remaining 70.0%of the respondents are unmarried.

Educational Qualification of the Respondents

Source : Primary Data The above table shows that the classification of the respondents on the basis of educational qualification.48.3% of the respondents were completed UnderGraduate,33.3% of the respondents were completed Post Graduate and remaining 18.3% of the respondents are having other educational Qualification.

App Using For Online Shopping

Source: Primary Data The above table shows that App using for online shopping.25.8% of the respondents are using Flip kart, 23.3%ofthe respondents are using Amazon, 20.8% of the respondents are using Snap deal, 20.0% of the respondents are using Mynthra and remaining 10.0% of the respondents are using other online shopping sites.

Frequency of Using Online Shopping Sites

Source: Primary Data The above table shows that the respondents are classified on the basis of frequency of using online sites. 41.7% of the respondents are using monthly once, 10.0% of the respondents are using twice in a month, 16.7% of the respondents are using more frequently and remaining 31.7% of the respondents are using the online shopping sites rarely.

Product often purchased by you Through Online

Source: Primary Data The above table shows that product often purchased by you through online. 11.7%of the respondents are purchasing food items . 34.2% of the respondents are purchasing clothing, 20.0% of the respondents are purchasing Stationery, 25.8% of the respondents are purchasing Make up items and remaining8.3%of the respondents are purchasing others.

Satisfied With the Experience of Online Shopping

Source: Primary Data The above table shows that satisfied with the experience of online shopping, 35.8% of the respondents are highly satisfied. 45.8% of the respondents are satisfied, 10.0%of the respondents are not satisfied, and the remaining 8.3%of the respondents are not highly satisfied.

Online Purchase is More Efficient than Offline Purchase

Source: Primary Data The above table shows that online purchase is more efficient than offline purchase. 28.3% of the respondents are strongly agree, 41.7% of the respondents are agree ,20.0% of the respondents are strongly disagree and remaining 10.0% of the respondents are disagree.

Return Policy is Efficient for Online Purchase

Source: Primary Data The above table shows there turn policy is efficient for online purchase.90.0% of the respondents said return policy is efficient for online purchase, and10.0%of the respondents said return policy is not efficient for online purchase.

Correlation Analysis

In this table shows that the relationship between educational qualification of the respondents and satisfied with the experience of online shopping

Correlations

** .Correlationissignificantatthe0.01level(2-tailed).

This is a positive (.889) 88%correlation Pearson correlation significance (0.000). There are relationships between





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educational qualification of the respondents and satisfied with the experience of online shopping.

Suggestion

Online retailers can concentrate on enticing deals and discounts to appeal to college students. Online marketers should take tracking difficulties into account and guarantee timely product delivery to customers. Online retailers may also think about partnering with other private delivery services to supply their products to stores. The suggestion is that the online shops should focus on other product categories besides footwear for college students. For a boost in sales, online shops can also concentrate on the quality and pricing issues. For further sales growth, it is also advised to verify authenticity and safety when using internet sites and applications.

CONCLUSION

In conclusion, college students prefer to shop online and get goods from a variety of brands. Students also have more options for purchasing goods online than in real stores because to these shopping channels. Nowadays, ordering the majority of items is best done online. There is no requirement to go into stores and haggle with sales people. There won't be any more waiting in lines to check out and acquire your purchases. Without wasting much more money, time, or energy, anyone from anywhere can shop in peace. For college students to have a comfortable private purchasing experience, authenticity and user-friendliness can also be emphasized on.

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Table 1: Age of the respondents

S.No	Age	No. of Respondents	Percentage
1	Below20Years	24	20.0
2	21-30Years	65	54.2
3	36-50Years	12	10.0
4	Above50Years	19	15.8
	Total	120	100.0

Table 2: Gender of the Respondents

S.No	Gender	No. of Respondents	Percentage
1	Male	38	31.7
2	Female	82	68.3
	Total	120	100.0

Table 3: Marital Status of the Respondents

S.No	Marital Status	No. of Respondents	Percentage
1	Married	36	30.0
2	Unmarried	84	70.0
	Total	120	100.0





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Table 4: Educational Qualification of the Respondents

S.No	Educational Qualification	No. of Respondents	Percentage
1	Under Graduate	58	48.3
2	Post Graduate	40	33.3
3	Others	22	18.3
	Total	100	100.0

Table 5 : App Using For Online Shopping

S.No	App Using for Online Shopping	No. of Respondents	Percentage
1	Flipkart	31	25.8
2	Amazon	28	23.3
3	Snapdeal	25	20.8
4	Mynthra	24	20.0
5	Others	12	10.0
	Total	120	100.0

Table 6: Frequency of Using Online Shopping Sites

S.No	Frequency	No. of Respondents	Percentage
1	Monthly once	50	41.7
2	Twice in a month	12	10.0
3	Frequently	20	16.7
4	Rarely	38	31.7
	Total	120	100.0

Table 7: Product often purchased by you Through Online

S.No	Product	No. of Respondents	Percentage (%)
1	Food items	14	11.7
2	Clothing	41	34.2
3	Stationery	24	20.0
4	Makeup items	31	25.8
5	Others	10	8.3
	Total	120	100.0

Table 8: Satisfied With the Experience of Online Shopping

S.No	Satisfied with the Experience	No. of Respondents	Percentage (%)
1	Highly Satisfied	43	35.8
2	Satisfied	55	45.8
3	Neither satisfied nor dissatisfied	00	00.0
4	Not Satisfied	12	10.0
5	Not Highly Satisfied	10	8.3
	Total	120	100.0





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Table 9: Online Purchase is More Efficient than Offline Purchase

S.No	More Efficient	No. of Respondents	Percentage (%)
1	Strongly Agree	34	28.3
2	Agree	50	41.7
3	Neither agree nor disagree	00	00
4	Disagree	24	20.0
5	Strongly Disagree	12	10.0
	Total	120	100.0

Table 10: Return Policy is Efficient for Online Purchase

S.No	Return Policy	No. of Respondents	Percentage (%)
1	Yes	108	90.0
2	No	12	10.0
	Total	120	100.0

Correlations

	Educational Qualification Of The Respondents	Satisfied With The Experience Of Online Shopping
Educational Qualification Of The Respondents Pearson Correlation Sig. (2-Tailed) N	1	.889**
		.000
	120	120
Satisfied With The Experience Of Online Shopping Pearson Correlation Sig. (2-Tailed) N	.889**	1
	.000	
	120	120





The Role of Mass Media in Enhancing Scientific Temper among University Students

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ABSTRACT

Scientific temper is pivotal in eradicating the scourge of blind belief and superstition. The much-touted demographic dividend in India can be tapped only when the youth imbibe empirical evidence over anecdotal or faith-based claims. In the age of a growing infodemic, the onus of enhancing scientific temper of its audience lies with the media. The limited research on the media's role and responsibility in developing scientific temper among university students gives the research its importance in paving the way for enhanced media coverage for promoting critical thinking among the youth. Employing the idea of Agenda-Setting theory and Media Salience, the researchers conducted an opinion survey among university students in Bhubaneswar, Odisha to map their perspective on scientific temper, belief in pseudoscience and impact of mass media in opinion formation about rational thinking.

Keywords: Scientific Temper, Pseudoscience, Mass Media, Agenda-Setting, Opinion Formation

INTRODUCTION

Infodemic and Need for Reliable Information

In the present day and age, after a global pandemic, there has been a growing demand for information but an even greater production and dissemination of information. Unfortunately, a large proportion of this disseminated information has contributed negatively by re-affirming regressive beliefs and practices among the general masses. Rovetta and Castaldo (2022) define infodemic as “an information epidemic that can lead to engaging in dangerous behavior.” Further they state that media resonance and how information is presented to the public through the mass



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media influence infodemic. Unverified or biased media coverage on scientific issues is potent in inflicting an adverse effect on the perception of the masses leading to discrimination and a decline in stability. This has in turn challenged the fabric of social harmony affecting public health, and development. Therefore, the need to instil a scientific temper, a spirit of inquiry, and healthy scepticism has become critical to the growth of society.

Scientific Temper and its Significance in India:

A scientific temperament could be defined as an attitude of rational thinking and refers to an individual's inclination towards informed and evidence-based decision-making in every-day life. Mentioned in The Discovery of India by Jawaharlal Nehru as a solution to scientific problems as well as life's challenges, "Scientific Temper" has also found its place in the 42nd Amendment of the Indian Constitution in 1976. As a fundamental duty of all the citizens of India, Article 51 A(h) of the Indian Constitution states, "It shall be the duty of every citizen of India to develop scientific temper, humanism and the spirit of inquiry and reform. Furthermore, National Science Day of 2014 was dedicated to "Fostering Scientific Temper" by The National Council for Science and Technology Communication, Govt. of India. From healthcare, upholding human rights, education, disaster management, and more, everything requires logical interventions and reasoning. Therefore, with a teeming population of over 1.4 billion people spread across a land mass of about 3.3 million sq. kilometres with over 65% of its people being below 35 years of age, the development and enhancement of scientific temper among its youth is pivotal in ensuring the wellbeing and development of the country.

Importance of Media in Dissemination of Scientific Information

Misinformed coverage on health issues like HIV AIDs, Depression still causes stigma affecting the health care system, the patients, and the society adversely. The superstitious beliefs and practices associated with health issues also lead to endangering life as well as resources and the COVID-19 Pandemic is a testament to that. Moreover, the lack of scientifically informed coverage on Homophobia, Racial Discrimination, and other forms of discrimination leads to violation of Human Rights and undermines the Human Resources of the nation. Emphasis on the enhancement of Scientific Temper can better equip the citizenry to deal with the fear of the unknown with reason and compassion. Last but not least, the enhancement of Scientific Temper can direct the intellectual faculties in the direction of development and propel the youth on the path of nation-building. Therefore, this research will help understand the perception of Indian Youth on the role of media in enhancing Scientific Temper.

Theoretical Framework

The media play a central role in influencing audiences' cognitions and attitudes. They impact the manner in which public perceive and respond to the social world. The agenda-setting theory coined by Maxwell McCombs and Donald Shaw (1972) refers to the ability of the mass media through news coverage of specific issues in shaping the audience perception about the relative importance and salience of such news stories. By providing strong cues and continuous attention to a particular issue, media coverage impacts the way people rank the most important news story. By framing stories with a particular slant, the media influences people by telling them what to think about both in an explicit and implicit manner. The priority given to a news generates public discourse. Thus, power of the media lies in its ability to focus public attention and set the agenda. Media Salience refers to the degree to which certain issues grow into prominence or stand out among others while also looking into the shaping of individual perception on the issue. It states that the issues growing into prominence are the ones that the public considers important and is aware of referring to first-level agenda-setting theory or object salience. However, in addition to enhancing media exposure to certain issues or 'objects', media also plays an important role in creating public opinion around the issue by emphasizing specific aspects of the issue and presenting it in a way to grab the attention of the audience referring to second-level agenda setting or attribute salience. The theory brought evidence of the power of the media in shaping public opinion. That stands true for the discourses on science and scientific temper as well. The lack of understanding and to some extent, alienation of scientific temper could be attributed to the limited coverage of science, the portrayal of science, as well as an increased coverage of issues dealing with pseudoscience. However, with the use of agenda-setting power of the media, the narrative of scientific temper can be enhanced to a huge extent.



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REVIEW OF LITERATURE

Franzen, Weingart & Rodder (2011) forwarded the concept of 'medialization' which refers to the mutual relation between science and mass media. They argue that mass media gives legitimacy to science among the public. Thus, media attention leads to public support for science. Boykoff (2015) highlights the important role played by media in shaping the construction and maintenance of discourse about science. Media representations create narratives for communicating science to the public through the important role of translation and interpretation. Media portrayals are an important factor in public understanding and engagement with science. Schafer (2011) terms mass media as the main source of information about science for most of the people in our society. Further, the author states that media play a strong role in pushing science issues onto public agenda. Therefore, the news media acts as a tool of agenda building for science issue. Weingart & Guenther (2016) call for democratization of science whose core element is engagement with the public. They term credibility of communication and trust in the communication as the most important factors in science communication. Liang et al (2014) talk of building a buzz about new scientific research by using cross-media channels that include legacy journalistic outlets, new media and personal social networks. They suggest use of multiple online channels can act as amplification for public outreach. Suleski & Ibaraki (2010) through their research tell us that scientific literacy among the public can be raised by news media coverage. But the modern scientific community has to take the responsibility of communication as public always turn to mainstream media for science news. Bucchi and Trench (2021) provide a perspective on science communication as social conversation which they feel expands and deepens its quality as it becomes more of an interactive communication. They talk of long-term continuity in communication which can take the form of a culture.

Objectives of the Study

- 1) The study is an attempt to gauge the perspective of university students about scientific temper and its utility.
- 2) The study will try to decipher the role of mass media in developing scientific temper among the university students based on their responses to the survey.

RESEARCH METHODOLOGY

This research used survey method where a questionnaire through google form was used to collect the data from 100 students of different universities located in Bhubaneswar, Odisha. They are Birla Global University, Utkal University, RD Womens University and KIIT University. The students were selected through purposive sampling method and the age category of the respondents range from 18-24 years. As university students, they regularly use mass media for accessing news and information in their everyday life.

Findings

The following is a brief summary of the findings reached at after analysing the respondents' response.

- 64.4% of the students consume news and information from media sources on a daily basis and the rest of them on a weekly basis.
- 67.3% of the students consume news and information from online news websites while for the rest, the sources of news and information were newspapers, television and social media platforms
- 79.2% of the students said that they trusted the media as a reliable source of information.
- 84.1% of the students believed that the media has a significant influence on public opinion formation.
- 83.2% of the students believed that the media plays a very vital role in shaping the audience perception about the relative importance and salience of such news stories.
- 26.7% of the students shared that the horoscopes and pseudoscientific content from various media sources, has a 'Significant influence' on people's beliefs and in their decision makings while 56.4% students mentioned that such content has 'Some influence'. This makes it clear that the majority of the respondents believe that the horoscopes and pseudoscientific content has an influence on people.



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- Only 13.9% of the students said that they were very familiar with the concept of Scientific Temper. 40.6% of them said that they were somewhat familiar with the concept, 35.6% mentioned that they were not very familiar while 9.9% of the students said that were not at all familiar with the concept of Scientific Temper.
- When described what scientific temper meant as enshrined in the Constitution of India, 96% of students believed that enhancing scientific temper is important.
- When asked if the media can play a significant role in enhancing scientific temper, 82.2% of the students agreed to it.
- When it comes to the type of media content that can be effective in enhancing scientific temper, among the multiple options given, 46.5% said that the news articles can be an effective way while 49.5% said that documentaries can play an important role. Further, 47.5% students said podcasts can be an important way to enhance scientific temper, 44.6% to educational YouTube channels and social media discussions respectively and 1% of students said that memes play a vital role in enhancing scientific temper.
- Lastly, when asked on what aspects of scientific temper should the media emphasize, 58.4% of the students mentioned that evaluating the sources of information should be emphasized. Further, 51.1% said that there is a need for questioning assumptions. 63.4% mentioned that analysing evidence is a major aspect and 39.6% said that the media should emphasize on recognizing biases. Finally, 38.6% of the students said that the media should emphasize on identifying logical fallacies.

The objective of this study was to understand the perspective of university students about scientific temper and the role of mass media in enhancing the same. The findings suggest that media plays a very vital and significant role in enhancing scientific temper especially among university students where majority believe in media as a reliable and trustworthy source of information. The findings also suggest that majority of the students agreed that media has a prominent role in shaping and influencing opinion formation among people. The research findings highlighted that various media content in the form of news articles, documentaries, podcasts, educational videos and social media discussion are an effective way to promote scientific temper. Further, the findings underscored that media holds the responsibility to engage and encourage people to question the assumptions, evaluate the source of information and analyse the evidence to arrive at informed opinions, especially among university students who are constantly exposed to various news and information across several media platforms.

CONCLUSION

Mass media serves as a powerful tool for setting the agenda of issues that society should focus on. The utility of the agenda-setting function of mass media lies in its profound impact on raising awareness and shaping the discourse about scientific temper among the students. It provides a platform for informed discussions on important issues. By disseminating accurate information and debunking pseudoscientific claims, media outlets can serve as critical educators in combating pseudoscience which has proliferated in the age of digital information.

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A Comprehensive Analysis on the Intelligent VLSI Systems Design and Applications

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ABSTRACT

With the increasing research advances in the Integrated Circuit (IC) technology, the design complexity also increases and this in turn increases the variations in the circuit development process and reduces the turnaround time in any IC chip manufacturing. The existing methodologies are not automated, resource-intensive and most importantly time –consuming. These challenges necessitate the need to develop advanced technologies. Recently, Artificial Intelligence (AI) has shown an increased potential in enabling automated modules and techniques for processing the complex tasks in the VLSI design, development and testing. The integration of emerging AI technologies such as Machine Learning (ML) and Deep Learning (DL) in the manufacturing process of Very Large Scale Integration (VLSI) devices greatly reduces the processing time required for understanding data abstraction levels in VLSI models. The design and development of intelligent VLSI models improve the overall yield of Integrated circuits. This research study reviews the AI algorithms and models that are currently employed in VLSI designing process. Finally, this study also discusses about the challenges associated with it while implementing highly intelligent design and its future scope.

Keywords: Very Large Scale Integration (VLSI), Artificial Intelligence, Machine Learning, Deep Learning, Integrated Circuits





INTRODUCTION

The electronics industry particularly the field of Integrated Circuits (ICs) is currently experiencing a technological revolution with the introduction of semiconductor technologies like Complementary metal-oxide semiconductor (CMOS), Metal-Oxide Semiconductor Field-Effect Transistor (MOSFET), etc. These technologies are playing a predominant role in developing modern day chips or microchips [1]. Furthermore, the number of transistors embedded in a same or single chip has increased unprecedentedly in recent times. In the micro/nano electronics industry, the ultimate downscaling of transistors has resulted in improved circuit device performance. However, the integration of complex digital circuits on a same chip is achieved by using the modern VLSI technology [2]. The increased requirement of small and portable electronic devices among people has now resulted in developing power-efficient designs with advanced features. The state-of-the-art VLSI models are currently used to meet the emerging electronics industry requirements. The downscaling of circuits (goes up to sub3nm approx.) has become a key factor for achieving a higher device performance [3].

On the other hand, the downscaling also results in reducing the transistor dimensions and creating many challenges like increased circuit process complexity, increased leakage, decreased gain and increased sensitivity to the process variations. Further, these challenges also impact the circuit's process and operations, thereby impacting the propagation delay, timing and overall chip yield [4]. The nano-scale increase in process variations is considered as one of the major reasons for yield loss. When compared to CMOS, the Field-Effect Transistor (FET) is highly tolerant to the process variations [5]. Even in FET, the model performance is affected by circuit scaling. This results in the requirement to introduce advanced technologies in the VLSI design flow to enable enhanced circuit optimization and deliver enhanced performance. The performance of any Electronic Design Automation (EDA) tool depends on the used electronic chip's turnaround time. [6] With the existing design constraints, the rule-based methodologies consume more time to produce an optimal solution. Also, the existing methodologies are mostly not automated and time-sensitive, resulting in a delay. When an issue arises, it will be a tedious task for the designers to know about the root issues and fix it. Artificial Intelligence (AI) is recently preferred for solving various challenges in different fields. AI mimics the human intelligence to interpret human like decisions while executing the complex tasks. As the subsets of Artificial Intelligence (AI), Machine Learning and Deep Learning techniques are currently used for analysing the data, enabling logical reasoning, predicting the results and perceiving the outcome for future reference. ML/DL models has the ability to perceive the data patterns and make decision at high computational speed. The application of ML/DL algorithms is endless in VLSI circuit design and technology. Various opportunities are available in VLSI design and EDA technology for integrating ML/DL solutions to automate the IC design and manufacturing process [7]. The existing analog and digital ICs are highly dependent on CAD tools in various design levels from initial stage to developing final layouts. The advanced CAD design tools used for VLSI design process are becoming more complex due to increased number of transistors used in a single chip. The ML/DL algorithms are used to achieve automated chip fabrication solutions. This research study summarizes the utilization of ML/DL algorithms in VLSI design flow [8].

EXISTING METHODOLOGIES

The idea of integrating Artificial Intelligence (AI) in VLSI design has started in earlier 1980s [9], a period when researchers have analysed the scope, objective and necessity of introducing AI algorithms in CAD design tools, which are used in different VLSI design levels (both in internal and external design). Researchers have also explored and showcased the significance of including AI extensions in CAD tools [10]. Some researchers have [11] focused on applying AI algorithms in IC manufacturing to leverage design assistance and automation. The state-of-the-art AI and ML technologies have gained increased research attention from the EDA researchers involved in the design, development and application of VLSI technology. Recently, Neural Networks (NNs) are also implemented in designing the analog and digital VLSI circuits [12]. Some researchers have also reviewed the optimization of physical



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circuit design with the data analytics [13]. A research group have also listed out the opportunities and challenges in implementing machine learning algorithms in asynchronous VLSI design and also developed a design recommendation model to suggest an appropriate ML algorithm based on their required RTL logic, circuit synthesis and routing [14]. The IC testing process is also reviewed by implementing ML/DL techniques. The existing research works have also detailed the utilization of ML/DL algorithms in the areas of power analysis, physical circuit design, fault diagnosis, and analog design analysis [15]. Some research studies have also highlighted the application of machine learning in the microchip designing process [16]. Here, the reinforcement learning approach is introduced to analyse the circuit design space and other time related complexities to achieve good results. The introduction of AI in electronic design automation has greatly assisted the circuit designers to optimize the design flow. A comprehensive analysis has also been presented to integrated ML/DL in different circuit levels [17]. Recently, a detailed overview of incorporating deep learning and machine learning techniques in VLSI design is discussed in [18]. The design levels of any VLSI circuit included an internal and external design. The general design flow is depicted in Figure 2 and 3. The detailed analysis on the introduction of AI/ML algorithms are presented in the section 3.

AI in VLSI Design Flow

In recent times, Artificial Intelligence and machine learning plays a significant role in almost all the scientific and technological domains. The big data generated in every field can be analysed in the form of data patterns and it can be stored for future analysis and predictions [19]. These learning patterns can also be applied to solve various real-time challenges. There are three main types of Machine learning approaches such as reinforcement, unsupervised, and supervised learning approaches.

AI Models & Algorithms**Supervised Learning**

Supervised learning included two main tasks: regression continuous functions and classification, regression is a statistical approach mainly used to numerically predict the. Also, both the regression and classification can be considered as the learning function to predict the mapping function. [20] The most significant challenge is this learning function requires more labeled training data, which is very challenging for various VLSI applications. The well-known supervised algorithms include, Random Forest (RF), Decision Tree (DT), and Support Vector Machine (SVM).

Unsupervised Learning

In contrary to supervised learning method, unsupervised learning can process the unlabelled data. However, achieving the required output for a given input vector will remain as a highly challenging task. The applications of unsupervised learning include, principal component analysis, dimensionality reduction and clustering. The most well-known algorithms include hierarchical clustering, k-nearest neighbour and k-means clustering.

Deep Learning

Deep learning is highly suitable for large-scale data processing and build complex data processing models. Artificial Neural Network (ANN) is an example of deep learning model. It is a mathematical function that maps the input and output values. Comparatively, Deep Neural Networks (DNNs) have the ability to implement complex mapping [21]. These AI/ML/DL advancements have the increasing scope to address the challenges associated with IC and microchip design and manufacturing. The application of AI model in different abstraction levels are detailed below

Implementation**Circuit Level**

The circuit level simulation plays a vital role in any electronic device modelling. The performance analysis of nano-level circuits is becoming quite challenging through simulation due to the existing environmental circumstances. Predicting or analysing the functional performance variations earlier in the circuit design cycle may increase the overall yield. This aspect depends mainly on the capability of simulation tools. By integrating ML/DL algorithms in



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CAD tools, the chip's performance and turnaround time can be restored with minimal design modifications [22]. Recently, researchers have proposed various methodologies for characterizing the power leakage, propagation delay and accurate estimation of IR drop levels. Different ML/DL are now analysed for its suitable implementation in the process of circuit modelling, including the techniques such as ANNs, Response Surface Modelling (RSM) and other ensemble techniques.

Architecture Level

More dynamic VLSI architectures are developed with the introduction of AI/ML techniques. Different AI based architectures have enhanced the VLSI technology [23]. The integration of neural network algorithms in semiconductor design helps to achieve higher bandwidth with enhanced performance. VLSI design improvements and adjustments are done for satisfying the requirements of implementing edge applications with enhanced reliability, high processing speed, reduced implementation cost and time. The AI based VLSI architectures are now predominantly used in various applications such as signal and speech processing, Internet of Things (IoT) models and automobiles. The evolving techniques include, DNN based memory architecture (near memory and data processing), introducing DNN models for ensuring synchronous flow of data from memory to the systolic arrays [24].

System Level

The deep learning capability is now influencing significant modifications in the System-on-Chip (SoC) architecture. ML/DL models introduce novel processing technologies with large-scale computations, advanced memory architecture, and high-speed connectivity. AI based SoC models have the ability ensure the IC operations in memory-constrained architectures present in mobile phones, automobiles, and IoT- Communication applications [25]. Field Programmable Gate Array (FPGA) is the well-known and widespread programmable circuit devices that accelerate and implement AI technologies on hardware. Digital modules such as Digital Signal Processing (DSP) models, ALUs and digital multipliers are easily and efficiently implemented using Neural Network (NN) models. The primary advantage of integrating Neural Networks (NNs) is its ability to efficiently realize high-speed circuits without considering the increasing number of components in the circuit. NNs can also maintain a trade-off between the off-chip(external) and internal memory [26]. Despite the hype, DL based SoC architectures are still remaining in the nascent stage with integrated processors and memory architectures. More research works will be initiated in this evolving domain the near future.

Physical Design Level

The physical design process of VLSI circuits have various combinatorial challenges, which usually requires many iterations to reach the solution. Scaling process will also increase the circuit design complexity with more Design for Manufacturing (DFM) challenges. Traditionally, the manual correction and fixing solutions are used. However, these manual methods fail to satisfy the market requirements. Also, in the next stage, the circuit design becomes more sensitive to the environment challenges. To combat these challenges, machine learning techniques enable quality physical design and at different abstraction levels. Recently, the transferrable chip operations and its representations are done by using Reinforcement Learning (RL) model [27]. Machine learning techniques are used to analyse the data-path benchmarks. AI based EDA tools are used to enhance the process of clock tree synthesis. The automated results produced by CNN is used to revolutionize the VLSI design cycle and performance. In particular, the neural networks architecture is used to report the valuable feedback as well as the solutions for solving various modelling complexities at different physical design stages.

Challenges and Opportunities for ML/DL in VLSI

At present, the utilization of computationally efficient methodologies to estimate an output based on the inputs is gaining a significant research interest in the domain VLSI CAD based circuit modelling. To enhance the yield and reliability, the VLSI design must be tuned optimally for enabling low power dissipation, reduce circuit dimension and achieving higher throughput [28]. In future, more fast and accurate device estimation techniques are required



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during the circuit design and modelling process. The exiting models verifies only the effect of process variations to improve the yield, further to guarantee the enhanced design quality, the dominant parameters that cause process variations should be identified. The analysis of the VLSI models' sub system behaviour plays a crucial role in its implementation. The introduction of ML/DL approach can increase the statistical rate of analysis of any memory designs. AI frameworks are used to implement high-level dynamic digital circuits in real-time hardware modules.

NNs can be used in embedded automation models found in IoT sensor modules, automobiles, cameras, etc. which require high speed classifiers and accelerators. Most importantly, the cost involved in testing a VLSI chip can be greatly reduced by integrating AI algorithms [29]. Integrating and implementing these state-of-the-art techniques in the design flow of VLSI is potential challenge for the CAD designers. The major challenges for the designers is the lack of availability of licensed DL/ML algorithms with debugging codes. However, implementation generating high-yield can be achieved by critically integrating ML/DL knowledge in CAD designers [30]. The limited availability of data can be extended id the data flow process is efficiently captured and processed. The microchip manufacturing industries need to explore more about the introduction of distributed systems for monitoring microchip workflows and enable more data and model driven optimizations to enhance the design quality [31].

CONCLUSION & FUTURE SCOPE

The ML/DL techniques will help to overcome various challenges in the IC industry. Even though, there are various existing methods to design, develop and test VLSI circuits, a proper and systematic way to enable design workflows still remains as a challenge. Developing a well-structured methodology with automated data processing capabilities using ML/DL algorithms at different IC design levels resolve the challenges to a greater extent. Nevertheless, the VLSI domain will face challenges while training the EDA tools and models with its limited data availability. Future advances in different ML/DL programming and quantum computing based methods have the potential to result in significant improvements in the EDA industry.

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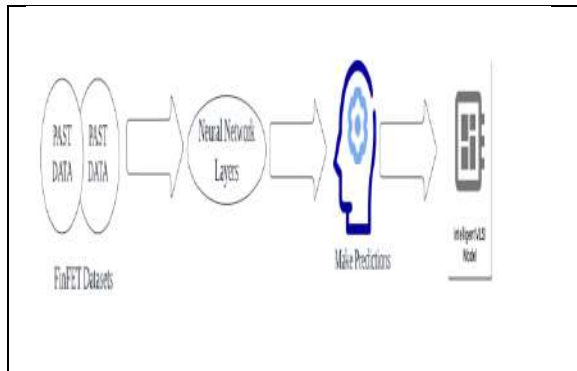


Figure 1: Introduction of ML/DL in Chip Design Process

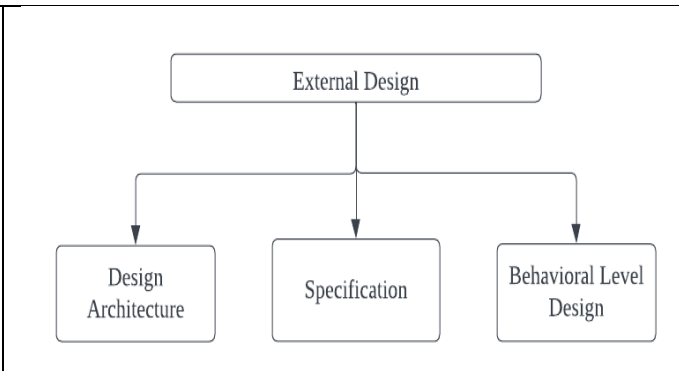


Figure 2: External Design Flow of VLSI Chip

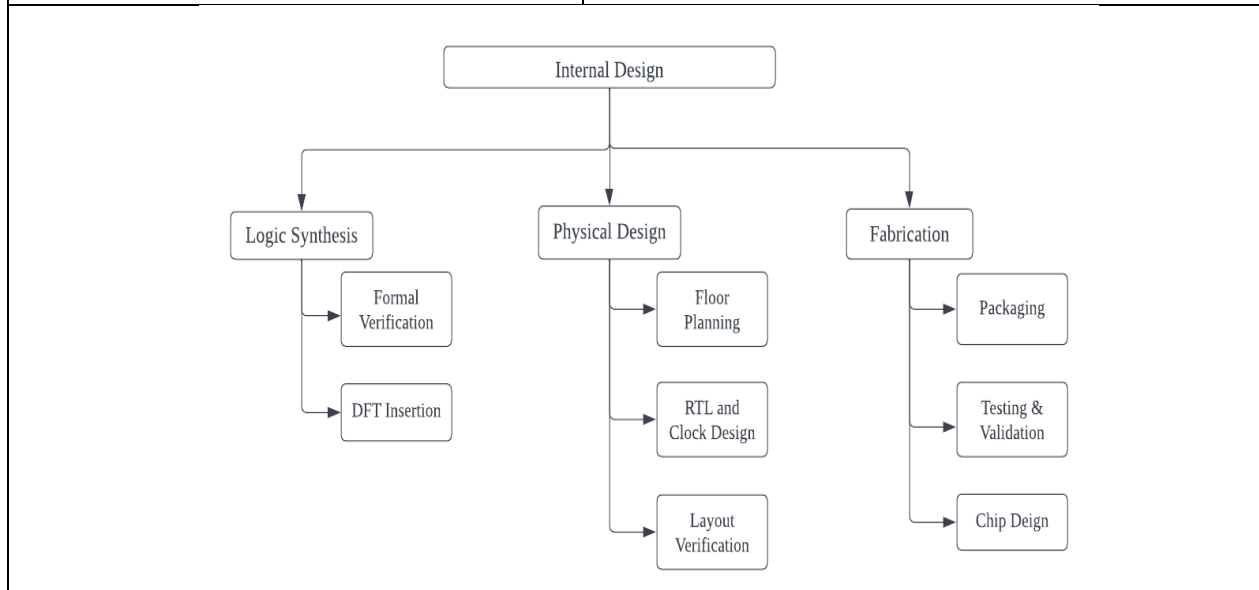


Figure 3: Internal Design Flow of VLSI Chip





IoT based Automatic Water Level Monitoring and Controlling System

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ABSTRACT

Yet just 3% of the water is fresh water suited for human consumption, despite the fact that 70% of the earth's surface is covered by water. Also, due to the expanding urban population, water conservation is essential in the modern environment. Most of the time, water spills when filling the overhead tanks, causing severe water loss for regular human needs. In order to address this issue, the IoT plays a major role to effectively utilize the water. Smart Water Level Controlling System [WLCS] was built on the Internet of Things and mobile devices has been developed to reduce the water wastage. This model can be used in any environments that can assist the wastage of liquid resources. This efficiently reduces water loss by keeping track of the volume of water in the overhead tank of home and notifying the user. This method makes it very comfortable for the user to regulate the system via mobile phone, preventing water loss from overhead tank overflow and also underflow. The total model can be monitored and operated using mobile phone or the web that includes the usage of water, level of water, leakage of water and also the other parameters like temperature etc.

Keywords: Internet of Things, Cloud, IoT Node, Sensors, M2M





INTRODUCTION

Water distribution is one of the concerns that receive less attention in metropolitan environments. Water-related problems abound, but one minor one is conflict between residents in flats over access to water that meets their needs. Water is the primary element used in daily living, whether for home or commercial purposes. Our ecology is being negatively impacted by excessive water waste. Water shortages brought on by excessive wasting may trigger a variety of environmental issues, including droughts, climate change, rising pollution, and increased human demand. It is crucial to use and manage water properly because fresh water is not readily available in large quantities. It is vital to keep a watch on water waste in all areas, including residential, commercial, and industrial setups. There is an immediate need to have an eye on the wastage of water across various sectors. This project's goal is to create an automatic water tank level and pump control system that has a variety of features for controlling the water pump in accordance with the amount of water in the storage tank system. An ultrasonic sensor positioned on the storage tank is utilized to detect the water level. This sensor is used to determine when the water level in the overhead tank is higher or lower. Node MCU controller is used to automate the process of pumping water to the overhead storage tank. In accordance with the information received, it operates the sensors that measure the water level and turns on and off the pump.

1. To design an automatic water tank level mechanism monitoring and to control the level of water quantity in the tank.
2. To keep track of the water level in the tank, which determines how much water is stored inside, to determine if it drops below a predetermined level while the motor is on and rises when it is off, eventually rises when the water is cut off.
3. To display the state of pump, levels of water and the level of main tank
4. To ON/OFF automatically by monitoring the water level in the main tank.

In most recent years, the adoption of internet and its applications has expanded quickly. Without the internet, it would be challenging because everyone depends on it for their profession. Moreover, wireless sensor networks—low power gadgets comprising a processor, storage, power supply, a transmitter, and one or more sensors— are becoming commonly employed. In this project, we will integrate these two in order to collect data from the aquatic environment, present it on the website, and do so utilizing wireless networks. A network of locally intelligent devices (such as sensors and actuators) known as the "Internet of Things" (IoT) shares control mechanisms to push and pull status and command information from the networked world. Internet of Things, then, refers to a network of physical devices that may collect data from sensors and transmit it to a server or computer across a network. The Machine to Machine (M2M) communication, which is capable of communication without human intervention, is also closely tied to the Internet of Things. This paper will define the system that will channel water from the first to the final user in the utilized environments. The primary reason for using IOT is its global networking capability to automatically control and monitor the level of the overhead tank without the need for human involvement. Also, by connecting to the Blynk server, we can monitor and operate the complete system from anywhere in the globe.

LITERATURE REVIEW

The authors in [1] offered a concept for a water level monitoring system that incorporates a PIC microcontroller and an LCD screen to alert the person in responsibility. The water level is continuously monitored, and when it reaches the critical level, the data is displayed on the LCD display panel. To reduce the possibility of water scarcity in the water supply, the system has been checked for proper operation. In paper [2] the researchers offered a concept of water level management using ultrasonic sensor (automation) to determine the level of the water and displaying on the LCD screen using ultrasonic sensor. The paper [3] proposed the design of monitoring system of the water level with an incorporation of GSM module which is too vigilant to the person in-charge by the help of Short Message Service (SMS). The water level is continuously monitored, and information about the issue has been sent via SMS to the appropriate in-charge phone. To reduce the possibility of water scarcity in the water supply, the system has been





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checked for proper operation. This notion of the PLC ground automated operation of detection of water in monitoring & distribution system was put forth in [4]. It enables us to detect the water monitoring automatically in accordance with the usage in specific locations. In [5] the authors proposed the Automatic water tank level monitoring and controlling system using Arduino uno board the system automatically controls the levels of water preventing the overflow from the overhead tank and controls the pump if the level of water is below the determined margin in the overhead tank. The authors in [6] proposed the indication of the water level with LED'S using Arduino uno. The red light used to indicate the water is about to finish and the green light used to represent that water in the tank is about to fill. Here we are using the IoT based system for controlling and monitoring of the water or any liquid crystals that makes more interactive interface to be operated.

Proposed Model

The goal of this work is to implement an automated water tank and pump to control the system that automatically regulates water/liquid levels to avoid overflow from the overhead tank and controls the pump if the level of water/liquid is below the established margin in the overhead tank. In this project, we have extended the water level monitoring and control by using the cloud platform and internet as shown in fig.1. There is possibility of multi-device connected by using Blynk apps and open ended cloud platforms. By using Blynk, the device can be monitored and controlled using mobile device and web control across the globe. The sensing part of the performing system includes ultrasonic sensor. The sensing information is being given to Node MCU. The Node MCU is configured to turn on the pump and buzzer automatically when the water/liquid level falls below a certain threshold. As the water/liquid level drops below the set level, the buzzer begins to buzz in high frequency. The controller activates the pump when the water/liquid level reaches the crucial level, and it begins pumping the liquid. The water/liquid will continue to be pumped and the tank will continue to fill without any issues. The water/liquid buzzes with a low frequency sound when it reaches a predetermined maximum level, and the pump turns off automatically if the tank is full.

Experimental Setup and Results

This system can monitor the level of water just by using our mobile phone from anywhere in the world. The only thing that we need is a Wi-Fi network in the vicinity of our tank. We made this project using a Node MCU esp8266 Wi-Fi module, ultrasonic sensor, and Blynk app. On the top of the water container lid, we place an ultrasonic sensor to read the level of the water container. The ultrasonic sensor is used for distance measurement by sending ultrasonic waves. The basic principle of ultrasonic distance measurement is based on ECHO. When sound waves are transmitted in environment, they return back to the origin as ECHO after striking on any obstacle. The only calculation of this system is the traveling time of both sound waves (outgoing time and returning time to origin after striking on any obstacle). And after few calculations it is possible to get the results Node MCU processes the data and gives us the data of water level and valve/pump status is saved with a timestamp. Each and every data obtained from the node has its timestamp and the Microcontroller node (Node MCU) transmits data to the Blynk server. The Blynk server also provides configuration information to the microcontroller. Water container height, Max upper-level limit, lower-level limit, mode, and on/off the pump are configuration parameters that are broken down into two modes, auto and semi-auto. If the water level is below the lower-level limit and the pump/valve is in automatic mode, the water will automatically fill the container and stop when it reaches the upper level limit or is equal to it.

In semi-auto mode, the microcontroller operates like auto mode if on/off is in the on position, but if on/off is in the off position, the pump or valve will remain off until on/off is in the on position. Also, we can use a relay module in order to control the motor to fill the tank, sitting anywhere in the world. We can not only just monitor the water level but also (control the Water level) fill the tank from anywhere in the world as shown in fig.2. The different parameters for the water tank like max level of tank, min level of tank, threshold value and also the total capacity of water tank are considered for the evaluation of the work for automatic controlling and monitoring of water tank from anywhere and any place. Table 2 describes the pump on/off scenario and also the status of the buzzer. The flow chart of the



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proposed model is given below. The proposed experimental setup was given in fig.3 and fig.4. The water level usage and tank liquid level and temperature of the liquid are given in fig.6, fig.7 and fig.8. The readings can be observed in cloud and Blynk app as shown in fig.3 and fig.5.

Algorithm

Step 1: Firstly, we want to establish a stable private Wi-fi connection to the existing Node MCU System and create a private Blynk server application interface and connect mobile and multiple devices to the connected server.

Step 2: Now pull the data values and measure the distance (height of the water level) by using ultrasonic sensor.

Step 3: Now compare the Water level with the constraint values of MAX and MIN values from the initial values declarations in the code dumped in the Node MCU.

Step 4: If the value of water level is less than the minimum value ($\text{Water level} < \text{MIN}$) then buzzer gets buzzes with high frequency of sound and automatically Motor also gets ON.

Step 5: Else if water level is in between the max and min value ($\text{MAX} \leq \text{Water level} \leq \text{MIN}$) then buzzer gets OFF, but the motor is still in ON mode.

Step 6: Else water level is greater than max value ($\text{Water level} > \text{MAX}$) then the buzzer gets ON and the pump motor Gets turned OFF.

Step 7: The temperature and pressure of the liquid is also observed.

CONCLUSIONS

Here, we created a circuit that uses IOT to control and track the water level in an above tank. Also, it reduces the issue of water waste brought on by improper home monitoring. The essential components are a Wi-Fi device, a Node MCU, and an ultrasonic sensor. To begin with, it must be determined whether our module is linked to Wi-Fi. If connected, it will immediately display the water level on any web-linked devices (mobile) or in the web. It regularly checks the tank's water level. To prevent water loss, the water pump will automatically start if the level exceeds the lower limit that has been established and cease when it reaches the higher limit of the tank. The model is designed in such a way that it saves electricity, cost, and mostly reduces the traditional water overflow challenges. In future we are planning to extend the system with water quality and also the predictive analysis of water usage at a particular scenario.

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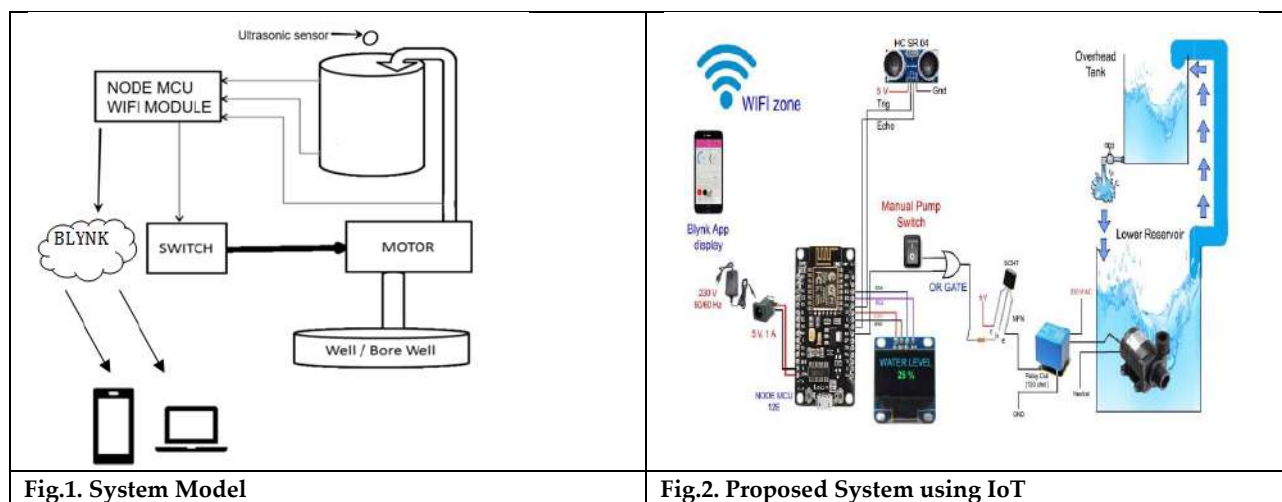
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Table 1: Hardware and Software Components

SL.NO	TYPE	Description
1	HARDWARE REQUIREMENTS	NODEMCU
		Relay module
		5V Motor
		Buzzer
		Battery
		Ultrasonic Sensor
		Connecting Wires
2	SOFTWARE REQUIREMENTS	Arduino IDE
		Blynk App & Server

Table2. Different levels of Water indication table

SL. No	Water level	Buzzer Status	Pump/Motor Status
1	Min	ON (HIGH FREQUENCY)	ON
2	Min<Water Level<Max	OFF	ON
3	Max	ON (LOW FREQUENCY)	OFF





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Fig.3. Experimental setup



Fig.4. System Prototype

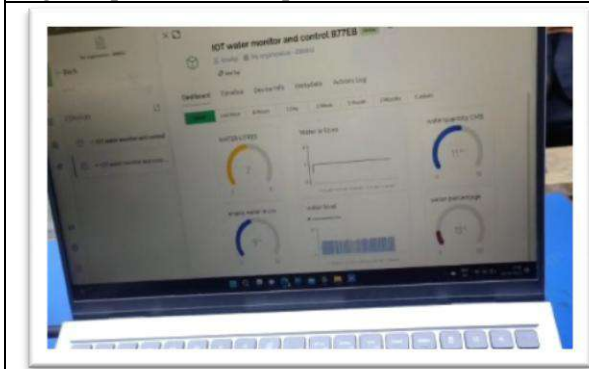


Fig.5. Cloud based representations

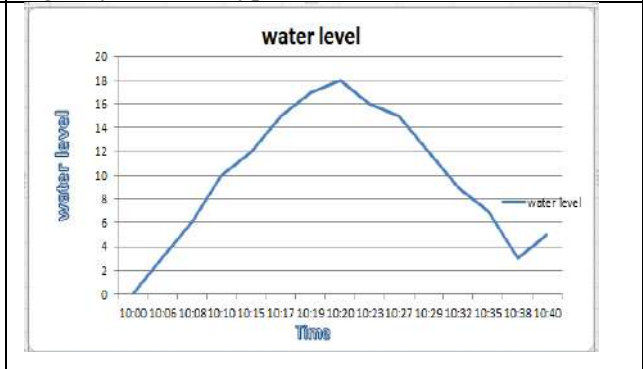


Fig.6. Timestamp based water level usage

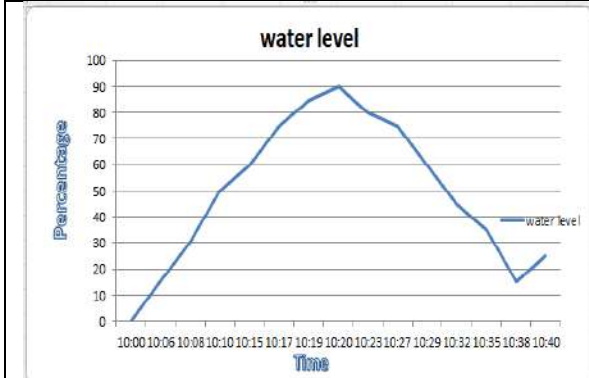


Fig.7. Water Usage

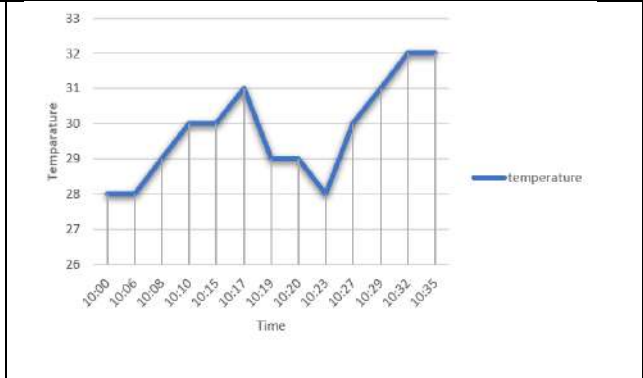


Fig.8. Liquid temperature





Generalized Inverse of Centrosymmetric and K–Centrosymmetric 2×2 Neutrosophic Fuzzy Matrices

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ABSTRACT

A method for finding the generalized inverse of Centrosymmetric and k–Centrosymmetric Neutrosophic Fuzzy Matrices is provided in this paper. We discussed various g-inverse associated with a regular Neutrosophic Fuzzy Matrices and obtain characterization of set of all inverses by using Centrosymmetric and K–Centrosymmetric Neutrosophic Fuzzy Matrices. We proved sum, product and scalar multiplication of two Centrosymmetric Neutrosophic Fuzzy Matrices is again a Centrosymmetric Neutrosophic Fuzzy Matrices and also focusing on the fundamental principles and theorems of Centrosymmetric and k- Centrosymmetric Neutrosophic Fuzzy Matrices, as well as examples.

Keywords: Centrosymmetric NFM, k- Centrosymmetric NFM, Generalized inverse.

INTRODUCTION

Zadeh [1] first introduced fuzzy sets (FSs) in 1965. These are traditionally defined by their membership value or grade of membership. Assigning membership values to a fuzzy set can sometimes be challenging. Atanassov [2] introduced intuitionistic FSs to solve the problem of assigning non-membership values. Smarandache [3] introduced the concept of neutrosophic sets (NSs) to handle indeterminate information and deal with problems that involve imprecision, uncertainty, and inconsistency. Fuzzy matrices are used to solve certain kinds of issues. Many researchers have since completed numerous works. Only membership values are addressed by fuzzy matrices. These matrices cannot handle values that are not membership. The generalized inverse (g-inverse) deals with matrix inverse generalization for both singular and non-square matrices Kim and Roush [8] have discussed Generalized





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fuzzy matrices. Pradhan and Pal [10] have studied The Generalized Inverse of Atanassov’s IFM. Pradhan and Pal [11] have studied Some results on Generalized Inverse of IFM. The generalized inverse of matrices is applicable in many field, likely power, robotics, image processing and signal processing. Ann Lec [1] has introduced Secondary symmetric and skew symmetric secondary orthogonal matrices. Cantoni and Butler [2] have studied Eigenvalues and eigenvectors of symmetric centrosymmetric matrices. James Weaver [7] has discussed Centrosymmetric matrices their basic properties eigen values and eigenvectors. Punithavall [12] has studied Symmetric-Centro Symmetric Fuzzy Matrices. Elumalai and Rajesh kannan [3] have focused on k - Symmetric Circulant, s - Symmetric Circulant and s – k Symmetric Circulant Matrices. Elumalai and Arthi [4] have studied Properties of k - CentroSymmetric and k – Skew CentroSymmetric Matrices.

Gunasekaran Mohana [5] have studied k-symmetric Double stochastic, s-symmetric Double stochastic, s-k-symmetric Double stochastic Matrices. Hazewinkel and Michiel [6] have focused on Symmetric matrix. Meenakshi [9] has studied Fuzzy Matrix: Theory and Applications. Anandhkumar [13,14,15] has studied Pseudo Similarity of NFM, On various Inverse of NFM and Reverse Sharp And Left-T Right-T Partial Ordering On NFM .Aim of this paper is to describe generalized inverse of Centrosymmetric, k- Centrosymmetric Intuitionistic Fuzzy Matrices and to discuss some basic principles and theorems of Centrosymmetric and k- Centrosymmetric matrices, as well as examples.

Research Gap

Punithavalli presented the concept of Centrosymmetric and K–Centrosymmetric Fuzzy Matrices. Here, we have applied the concept of Centrosymmetric and K–Centrosymmetric 2x2 Neutrosophic Fuzzy Matrices .We have examined some of the results and extended both concepts to NFMs. We discussed various g-inverse associated with a regular matrices and obtain characterization of set of all inverses by using Centrosymmetric and K–Centrosymmetric NFM.

Preliminaries and notations

P^T is the Transpose of P if P is a Centrosymmetric NFM. Let k denote a fixed distinct transposition product in S_n and K represent the permutation NFM. Clearly K meets characteristics like $K^T = K$ and $K^2 = I$.

Definitions and theorems

Definition:1.1Centrosymmetric NFM(CSNFM):A Square NFM which is symmetric about the centre of its array of elements is called CS,thus $P = [p_{ij}]_{CS}$ if $p_{ij} = p_{n+1-i, n+1-j}$. If K denotes the $n \times n$ NFM with $\langle 1, 1, 0 \rangle$ on the counterdiagonal and $\langle 0, 0, 1 \rangle$ everywhere else (i.e. $K_{i, n+1-i} = \langle 1, 1, 0 \rangle$; $K_{i, j} = \langle 0, 0, 1 \rangle$ if $j \neq n + 1 - i$), then P is CSNFM iff $PK = KP$.

Example:1 Let us consider the IFM

$$P = \begin{bmatrix} \langle 0.7, 0.2, 0.4 \rangle & \langle 0.4, 0.2, 0.3 \rangle \\ \langle 0.4, 0.2, 0.3 \rangle & \langle 0.7, 0.2, 0.4 \rangle \end{bmatrix} \text{ and } K = \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix}$$

$$\text{Then } PK = \begin{bmatrix} \langle 0.4, 0.8, 0.3 \rangle & \langle 0.7, 0.8, 0.4 \rangle \\ \langle 0.7, 0.8, 0.4 \rangle & \langle 0.4, 0.8, 0.3 \rangle \end{bmatrix}, KA = \begin{bmatrix} \langle 0.4, 0.8, 0.3 \rangle & \langle 0.7, 0.8, 0.4 \rangle \\ \langle 0.7, 0.8, 0.4 \rangle & \langle 0.4, 0.8, 0.3 \rangle \end{bmatrix}.$$

Definition: 1.2If P Centrosymmetric Neutrosophic Fuzzy matrices (NFM) $P \in (NFM)_n$ is called k-Centrosymmetric NFM if $P = KP^TK$

Definition 1.3Suppose p and q are two NFM elements $p = \langle p_{ij\alpha}, p_{ij\beta}, p_{ij\gamma} \rangle, q = \langle q_{ij\alpha}, q_{ij\beta}, q_{ij\gamma} \rangle$, are component wise addition and multiplication are described as,





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$$p + q = \langle \max \{p_{ij\alpha}, q_{ij\alpha}\}, \max \{p_{ij\beta}, q_{ij\beta}\}, \min \{p_{ij\gamma}, q_{ij\gamma}\} \rangle$$

$$\text{and } p \cdot q = \langle \min \{p_{ij\alpha}, q_{ij\alpha}\}, \min \{1 - p_{ij\beta}, 1 - q_{ij\beta}\}, \max \{p_{ij\gamma}, q_{ij\gamma}\} \rangle$$

Definition 1.4 (Transpose) The transpose P^T of an NFM $P = [p_{ij}]_{m \times n}$ is defined as $P^T = [p_{ji}]_{n \times m}$ where $p_{ji} = \langle p_{ji\alpha}, p_{ji\beta}, p_{ji\gamma} \rangle$.

Definition 1.5 (IFPM) If each row and each column contains accurately one $\langle 1, 1, 0 \rangle$ and all other entries are $\langle 0, 0, 1 \rangle$ in a square NFM, it is known as intuitionistic Fuzzy permutation matrix.

Definition 1.6A basis D of an intuitionistic fuzzy vector space W is standard basis iff whenever $d_i = \sum_{j=1}^n a_{ij} d_j$ for

$$d_i, d_j \in D \text{ and } a_{ij} \in [0, 1] \text{ then } a_{ij} d_i = d_i$$

Generalized Inverse

This section shows the g-inverse of an NFM. We also described a method for finding the g-inverse of a Centrosymmetric and k- Centrosymmetric NFMs.

Definition: 2.1 For NFM $P \in (NFM)_{m \times n}$ and another NFM $K \in (NFM)_{n \times m}$ satisfies the given equation

- (i) $PKP = P$ (g-inverse)
- (ii) $KPK = K$ (2-inverse)
- (iii) $(PK)^T = PK$, (Least square g- inverse of P or P{1,3} inverses)
- (iv) $(KP)^T = KP$, (P{1,4} inverses).

Theorem: 1 Let P be a Centrosymmetric NFM with a standard basis of non-zero rows. If P satisfies the equation $PKP = P$ with the maximum and minimum process for some NFM K , then K is a generalized inverse of P .

Proof: A standard basis is formed by the non-zero rows of an NFM P .

If $KP = Z$, Therefore the rows of Z and the rows of P rearranged.

Then Z is an idempotent NFM,

i.e., $Z = Z^2$, with the similar row space as P and non-zero rows forming a standard basis as well. Therefore the standard basis is unique,

$$\Rightarrow P = ZK, \text{ where } K \text{ is permutation matrix.}$$

Therefore,

$$PK^T P = ZKK^T ZK$$

$$= ZZK \quad (KK^T = I)$$

$$= ZK$$

$$= P$$

$$PKP = P \quad (K^T = K)$$

Therefore, K is 2-inverse.

Example: 2 Consider the NFM, $P = \begin{bmatrix} \langle 0.6, 0.2, 0.4 \rangle & \langle 0.8, 0.2, 0.3 \rangle \\ \langle 0.8, 0.2, 0.3 \rangle & \langle 0.6, 0.2, 0.4 \rangle \end{bmatrix}$, $K = \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix}$

$$KP = \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix} \begin{bmatrix} \langle 0.6, 0.2, 0.4 \rangle & \langle 0.8, 0.2, 0.3 \rangle \\ \langle 0.8, 0.2, 0.3 \rangle & \langle 0.6, 0.2, 0.4 \rangle \end{bmatrix} = \begin{bmatrix} \langle 0.8, 0.8, 0.3 \rangle & \langle 0.6, 0.8, 0.4 \rangle \\ \langle 0.6, 0.8, 0.4 \rangle & \langle 0.8, 0.8, 0.3 \rangle \end{bmatrix}$$





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$$PKP = \begin{bmatrix} \langle 0.6, 0.2, 0.4 \rangle & \langle 0.8, 0.2, 0.3 \rangle \\ \langle 0.8, 0.2, 0.3 \rangle & \langle 0.6, 0.2, 0.4 \rangle \end{bmatrix} \begin{bmatrix} \langle 0.8, 0.8, 0.3 \rangle & \langle 0.6, 0.8, 0.4 \rangle \\ \langle 0.6, 0.8, 0.4 \rangle & \langle 0.8, 0.8, 0.3 \rangle \end{bmatrix}$$

$$PKP = \begin{bmatrix} \langle 0.6, 0.2, 0.4 \rangle & \langle 0.8, 0.2, 0.3 \rangle \\ \langle 0.8, 0.2, 0.3 \rangle & \langle 0.6, 0.2, 0.4 \rangle \end{bmatrix}$$

Theorem:2 For Centrosymmetric NFM $Q \in F_n$, if Q^+ exists $\Leftrightarrow (KQ)^+$ exists.

Proof : For Centrosymmetric NFM $Q \in F_n$, if Q^+ exists then $Q^+ = Q^T$

$\Rightarrow Q^T$ is a generalized inverse of Q , then $QQ^TQ = Q \Rightarrow Q^TQQ^T = Q^T$

Therefore, Q^T is a $\{2\}$ inverse of Q .

Since both QQ^T and Q^TQ are symmetric.

Hence $Q^+ = Q^T$

Q^+ exists $\Leftrightarrow QQ^TQ = Q$

Q^+ exists $\Leftrightarrow KQQ^TQ = KQ$

Q^+ exists $\Leftrightarrow (KQ)(KQ)^T(KQ) = KQ$ where $K^2 = I$

Q^+ exists $\Leftrightarrow (KQ) \in (KQ)\{1\}$

$\Leftrightarrow (KQ)^+$ exists

Example:3 Consider the IFM, $Q = \begin{bmatrix} \langle 0.8, 0.2, 0.4 \rangle & \langle 0.6, 0.3, 0.4 \rangle \\ \langle 0.6, 0.3, 0.4 \rangle & \langle 0.8, 0.2, 0.4 \rangle \end{bmatrix}$, $K = \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix}$

Theorem:3 If $P \in (NFM)_n$ is k-Centrosymmetric NFM, then K is a least square g- inverse of P .

Proof : It is enough to show

I. $PKP = P$

II. $(PK)^T = PK$

By theorem (1), (i) is easily verified

Let $P \in (NFM)_n$ is K -centrosymmetric NFM

$P = KP^TK$

$PK = KP^TK.K$

$PK = KP^TK^2$ ($K^2 = I$)

$PK = KP^TI = KP^T$

$(PK)^T = K^T P^T = KP^T$ ($K^T = K$)

$(PK)^T = KP^T$

Therefore, $(PK)^T = PK$

Example: 4

Let us consider the NFM, $P = \begin{bmatrix} \langle 0.8, 0.1, 0.4 \rangle & \langle 0.6, 0.3, 0.4 \rangle \\ \langle 0.6, 0.3, 0.4 \rangle & \langle 0.8, 0.1, 0.4 \rangle \end{bmatrix}$, $K = \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix}$

$$PK = \begin{bmatrix} \langle 0.8, 0.1, 0.4 \rangle & \langle 0.6, 0.3, 0.4 \rangle \\ \langle 0.6, 0.3, 0.4 \rangle & \langle 0.8, 0.1, 0.4 \rangle \end{bmatrix} \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix} = \begin{bmatrix} \langle 0.6, 0.9, 0.4 \rangle & \langle 0.8, 0.7, 0.4 \rangle \\ \langle 0.8, 0.7, 0.4 \rangle & \langle 0.6, 0.9, 0.4 \rangle \end{bmatrix}$$





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$$(PK)^T = \begin{bmatrix} \langle 0.6, 0.9, 0.4 \rangle & \langle 0.8, 0.7, 0.4 \rangle \\ \langle 0.8, 0.7, 0.4 \rangle & \langle 0.6, 0.9, 0.4 \rangle \end{bmatrix}$$

Theorem:4 If $P \in (NFM)_n$ is k-Centrosymmetric NFM, then K is a {1,4} generalized inverse of P.

Proof : It is enough to show

- (i) $PKP = P$
- (ii) $(KP)^T = KP$

By theorem (1) ,(i) is easily verified

Let $P \in (NFM)_n$ is K-Centrosymmetric matrix

$$\begin{aligned} P &= KP^TK \\ K &= K.KP^TK \\ KP &= K^2 P^TK \quad (K^2=I) \\ KP &= IP^TK = P^TK \\ (KP)^T &= P^TK^T = P^TK \quad (K^T=K) \\ (KP)^T &= P^TK \end{aligned}$$

Therefore, $(KP)^T = KP$

Example:5

Consider the IFM, $P = \begin{bmatrix} \langle 0.5, 0.1, 0.2 \rangle & \langle 0.4, 0.1, 0.7 \rangle \\ \langle 0.4, 0.1, 0.7 \rangle & \langle 0.5, 0.1, 0.2 \rangle \end{bmatrix}, K = \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix}$

Centrosymmetric Neutrosophic Fuzzy Matrix

This part, depicts the Centrosymmetric of an NFM.

Lemma: If P and Q are Centrosymmetric NFM over a field F, then P + Q, PQ, and cP are Centrosymmetric NFM for all c in F.

Proof: By using definition:1

Example:6

Consider the IFM $P = \begin{bmatrix} \langle 0.6, 0.2, 0.4 \rangle & \langle 0.8, 0.2, 0.3 \rangle \\ \langle 0.8, 0.2, 0.3 \rangle & \langle 0.6, 0.2, 0.4 \rangle \end{bmatrix}, Q = \begin{bmatrix} \langle 0.8, 0.8, 0.3 \rangle & \langle 0.6, 0.8, 0.4 \rangle \\ \langle 0.6, 0.8, 0.4 \rangle & \langle 0.8, 0.8, 0.3 \rangle \end{bmatrix}$

$$\begin{aligned} P+Q &= \begin{bmatrix} \langle 0.6, 0.2, 0.4 \rangle & \langle 0.8, 0.2, 0.3 \rangle \\ \langle 0.8, 0.2, 0.3 \rangle & \langle 0.6, 0.2, 0.4 \rangle \end{bmatrix} + \begin{bmatrix} \langle 0.8, 0.8, 0.3 \rangle & \langle 0.6, 0.8, 0.4 \rangle \\ \langle 0.6, 0.8, 0.4 \rangle & \langle 0.8, 0.8, 0.3 \rangle \end{bmatrix} \\ &= \begin{bmatrix} \langle 0.8, 0.8, 0.3 \rangle & \langle 0.8, 0.8, 0.3 \rangle \\ \langle 0.8, 0.8, 0.3 \rangle & \langle 0.8, 0.8, 0.3 \rangle \end{bmatrix} \end{aligned}$$

Therefore, A+B is centrosymmetric

$$PQ = \begin{bmatrix} \langle 0.6, 0.2, 0.4 \rangle & \langle 0.8, 0.2, 0.3 \rangle \\ \langle 0.8, 0.2, 0.3 \rangle & \langle 0.6, 0.2, 0.4 \rangle \end{bmatrix} \begin{bmatrix} \langle 0.8, 0.8, 0.3 \rangle & \langle 0.6, 0.8, 0.4 \rangle \\ \langle 0.6, 0.8, 0.4 \rangle & \langle 0.8, 0.8, 0.3 \rangle \end{bmatrix}$$

$$PQ = \begin{bmatrix} \langle 0.6, 0.2, 0.4 \rangle & \langle 0.8, 0.2, 0.3 \rangle \\ \langle 0.8, 0.2, 0.3 \rangle & \langle 0.6, 0.2, 0.4 \rangle \end{bmatrix}$$

Therefore, AB is centrosymmetric





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$$cA = \langle 0, 0, 1 \rangle \begin{bmatrix} \langle 0.7, 0.2, 0.3 \rangle & \langle 0.4, 0.6, 0.5 \rangle \\ \langle 0.4, 0.6, 0.5 \rangle & \langle 0.7, 0.2, 0.3 \rangle \end{bmatrix} = \begin{bmatrix} \langle 0, 0.8, 1 \rangle & \langle 0, 0.4, 1 \rangle \\ \langle 0, 0.4, 1 \rangle & \langle 0, 0.8, 1 \rangle \end{bmatrix}$$

Therefore ,cA is centrosymmetric

K-Centrosymmetric Neutrosophic Fuzzy Matrix

This part, depicts the K- Centrosymmetric matrices of an NFM.

Theorem: 5 Let $P \in (NFM)_n$ is k-Centrosymmetric NFM then $P^T = KPK$.

Proof:Let $P \in (NFM)_n$ is k-Centro symmetric NFM

$$\begin{aligned} K PK &= KP^TK \text{ where } P = P^T \\ &= P^TKK \text{ where } KP^T = P^TK \\ &= P^TK^2 = P^T \end{aligned}$$

Example:7 Consider the IFM $P = \begin{bmatrix} \langle 0.7, 0.2, 0.4 \rangle & \langle 0.4, 0.2, 0.5 \rangle \\ \langle 0.4, 0.2, 0.5 \rangle & \langle 0.7, 0.2, 0.4 \rangle \end{bmatrix}$, $K = \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix}$

$$AK = \begin{bmatrix} \langle 0.7, 0.2, 0.4 \rangle & \langle 0.4, 0.2, 0.5 \rangle \\ \langle 0.4, 0.2, 0.5 \rangle & \langle 0.7, 0.2, 0.4 \rangle \end{bmatrix} \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix} = \begin{bmatrix} \langle 0.4, 0.8, 0.5 \rangle & \langle 0.7, 0.8, 0.4 \rangle \\ \langle 0.7, 0.8, 0.4 \rangle & \langle 0.4, 0.8, 0.5 \rangle \end{bmatrix}$$

$$KAK = \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix} \begin{bmatrix} \langle 0.4, 0.8, 0.5 \rangle & \langle 0.7, 0.8, 0.4 \rangle \\ \langle 0.7, 0.8, 0.4 \rangle & \langle 0.4, 0.8, 0.5 \rangle \end{bmatrix} = \begin{bmatrix} \langle 0.7, 0.2, 0.4 \rangle & \langle 0.4, 0.2, 0.5 \rangle \\ \langle 0.4, 0.2, 0.5 \rangle & \langle 0.7, 0.2, 0.4 \rangle \end{bmatrix}$$

$$KAK = A^T$$

Theorem: 6 If P,Q are both k-Centro symmetricNFM , then PQ is as well.

Proof :P and Q are both k-Centro symmetricNFM if $P = KP^TK$ and $Q = KQ^TK$.

We know that, P^T and Q^T are also k-Centro symmetric NFM then $P^T = K PK$ & $Q^T = KQK$.

To prove PQis k-Centro symmetric NFM

It's enough to show , $PQ = K(PQ)^TK$

$$\text{Now } K(PQ)^TK = KQ^TKP^TK$$

$$= K[(KQK)(KPK)]K \text{ where , } P^T = KPK \text{ and } Q^T = KQK$$

$$= K^2 QK^2P K^2 \text{ Properties of K- Centro SymmetricNFM,}$$

$$=QP \text{ Where } K^2 = I$$

$$=PQ \text{ Where, } PQ = QP$$

Example:8 Consider the NFM, $P = \begin{bmatrix} \langle 0.8, 0.2, 0.4 \rangle & \langle 0.6, 0.4, 0.2 \rangle \\ \langle 0.6, 0.4, 0.2 \rangle & \langle 0.8, 0.2, 0.4 \rangle \end{bmatrix}$, $K = \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix}$ and

$$B = \begin{bmatrix} \langle 0.6, 0.4, 0.5 \rangle & \langle 0.7, 0.3, 0.6 \rangle \\ \langle 0.7, 0.3, 0.6 \rangle & \langle 0.6, 0.4, 0.5 \rangle \end{bmatrix}$$

$$PQ = \begin{bmatrix} \langle 0.8, 0.2, 0.4 \rangle & \langle 0.6, 0.4, 0.2 \rangle \\ \langle 0.6, 0.4, 0.2 \rangle & \langle 0.8, 0.2, 0.4 \rangle \end{bmatrix} \begin{bmatrix} \langle 0.6, 0.4, 0.5 \rangle & \langle 0.7, 0.3, 0.6 \rangle \\ \langle 0.7, 0.3, 0.6 \rangle & \langle 0.6, 0.4, 0.5 \rangle \end{bmatrix}$$





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$$\begin{aligned}
 &= \begin{bmatrix} \langle 0.6, 0.6, 0.5 \rangle & \langle 0.7, 0.7, 0.6 \rangle \\ \langle 0.7, 0.7, 0.6 \rangle & \langle 0.6, 0.6, 0.5 \rangle \end{bmatrix} \\
 (PQ)^T &= \begin{bmatrix} \langle 0.6, 0.6, 0.5 \rangle & \langle 0.7, 0.7, 0.6 \rangle \\ \langle 0.7, 0.7, 0.6 \rangle & \langle 0.6, 0.6, 0.5 \rangle \end{bmatrix} \\
 (PQ)^T K &= \begin{bmatrix} \langle 0.6, 0.6, 0.5 \rangle & \langle 0.7, 0.7, 0.6 \rangle \\ \langle 0.7, 0.7, 0.6 \rangle & \langle 0.6, 0.6, 0.5 \rangle \end{bmatrix} \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix} \\
 &= \begin{bmatrix} \langle 0.7, 0.4, 0.6 \rangle & \langle 0.6, 0.3, 0.5 \rangle \\ \langle 0.6, 0.3, 0.5 \rangle & \langle 0.7, 0.4, 0.6 \rangle \end{bmatrix} \\
 K(PQ)^T K &= \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix} \begin{bmatrix} \langle 0.7, 0.4, 0.6 \rangle & \langle 0.6, 0.3, 0.5 \rangle \\ \langle 0.6, 0.3, 0.5 \rangle & \langle 0.7, 0.4, 0.6 \rangle \end{bmatrix} \\
 &= \begin{bmatrix} \langle 0.6, 0.6, 0.5 \rangle & \langle 0.7, 0.7, 0.6 \rangle \\ \langle 0.7, 0.7, 0.6 \rangle & \langle 0.6, 0.6, 0.5 \rangle \end{bmatrix} \\
 K(PQ)^T K &= PQ
 \end{aligned}$$

Theorem: 7 If $P \in (NFM)$ is k-Centrosymmetric NFM then PP^T is likewise k-Centrosymmetric NFM.

Proof : Let $P \in (NFM)_n$ is said to be k-Centrosymmetric NFM, then $P = KP^T K$

If P^T also k-centrosymmetric NFM then $P^T = KP K$

To prove that, $PP^T = K(PP^T)^T K$

$$\begin{aligned}
 K(PP^T)^T K &= K[(P^T)^T P^T] K \\
 &= K[(PP^T)] K
 \end{aligned}$$

$$= (PP^T) K K$$

$$= (PP^T) K^2 \quad \text{Where } K^2 = I$$

$$= PP^T$$

Example:9

Consider the NFM, $P = \begin{bmatrix} \langle 0.4, 0.2, 0.3 \rangle & \langle 0.2, 0.4, 0.5 \rangle \\ \langle 0.2, 0.4, 0.5 \rangle & \langle 0.4, 0.2, 0.3 \rangle \end{bmatrix}, K = \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix}$

$$PP^T = \begin{bmatrix} \langle 0.4, 0.2, 0.3 \rangle & \langle 0.2, 0.4, 0.5 \rangle \\ \langle 0.2, 0.4, 0.5 \rangle & \langle 0.4, 0.2, 0.3 \rangle \end{bmatrix} \begin{bmatrix} \langle 0.4, 0.2, 0.3 \rangle & \langle 0.2, 0.4, 0.5 \rangle \\ \langle 0.2, 0.4, 0.5 \rangle & \langle 0.4, 0.2, 0.3 \rangle \end{bmatrix}$$

$$= \begin{bmatrix} \langle 0.4, 0.4, 0.3 \rangle & \langle 0.2, 0.6, 0.5 \rangle \\ \langle 0.2, 0.6, 0.5 \rangle & \langle 0.4, 0.4, 0.3 \rangle \end{bmatrix}$$

$$(PP^T)^T = \begin{bmatrix} \langle 0.4, 0.4, 0.3 \rangle & \langle 0.2, 0.6, 0.5 \rangle \\ \langle 0.2, 0.6, 0.5 \rangle & \langle 0.4, 0.4, 0.3 \rangle \end{bmatrix}$$

$$(PP^T)^T K = \begin{bmatrix} \langle 0.4, 0.4, 0.3 \rangle & \langle 0.2, 0.6, 0.5 \rangle \\ \langle 0.2, 0.6, 0.5 \rangle & \langle 0.4, 0.4, 0.3 \rangle \end{bmatrix} \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix}$$





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$$\begin{aligned}
 &= \begin{bmatrix} \langle 0.2, 0.6, 0.5 \rangle & \langle 0.4, 0.4, 0.3 \rangle \\ \langle 0.4, 0.4, 0.3 \rangle & \langle 0.2, 0.6, 0.5 \rangle \end{bmatrix} \\
 K(PP^T)^T K &= \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix} \begin{bmatrix} \langle 0.2, 0.6, 0.5 \rangle & \langle 0.4, 0.4, 0.3 \rangle \\ \langle 0.4, 0.4, 0.3 \rangle & \langle 0.2, 0.6, 0.5 \rangle \end{bmatrix} \\
 K(PP^T)^T K &= \begin{bmatrix} \langle 0.4, 0.4, 0.3 \rangle & \langle 0.2, 0.6, 0.5 \rangle \\ \langle 0.2, 0.6, 0.5 \rangle & \langle 0.4, 0.4, 0.3 \rangle \end{bmatrix} \\
 K(PP^T)^T K &= PP^T
 \end{aligned}$$

Note: If $P \in (NFM)_n$ is k-Centrosymmetric NFM then P^2 is also k-centrosymmetric NFM.

Theorem:8 If $P \in (NFM)_n$ is k-centrosymmetric NFM then $P + P^T$ is also k-centrosymmetric NFM.

Proof : Let $P \in (NFM)_n$ is said to be k-Centrosymmetric NFM, then $P = K P^T K$

If P^T also k-centrosymmetric NFM, then $P^T = K P K$

To prove that $P + P^T = K(P + P^T)^T K$

$$K(P + P^T)^T K = K(P^T + (P^T)^T)K$$

$$= K(P^T + P)K$$

$$= (P^T + P)K.K$$

$$= (P^T + P)K^2$$

Where, $K^2 = I$

$$= (P^T + P) = (P + P^T)$$

Note: If $P \in (NFM)$ is k-centrosymmetric NFM then $A - A^T$ is likewise k-centrosymmetric NFM.

Example:10

Consider the NFM, $P = \begin{bmatrix} \langle 0.8, 0.2, 0.6 \rangle & \langle 0.2, 0.4, 0.7 \rangle \\ \langle 0.2, 0.4, 0.7 \rangle & \langle 0.8, 0.2, 0.6 \rangle \end{bmatrix}, K = \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix}$

Theorem:9 If P and Q are k-Centrosymmetric NFM then $P+Q$ is also k-Centrosymmetric NFM.

Proof : If both P and Q are k-centrosymmetric NFM if $P = K P^T K$ & $Q = K Q^T K$

Since P^T and Q^T are also k-Centrosymmetric NFM then $P^T = K P K$ and $Q^T = K Q K$.

To show that $P+Q$ is k-centrosymmetric NFM matrix

To prove that $P+Q = K(P+Q)^T K$

$$\text{Now } K(P+Q)^T K = K(P^T + Q^T)K$$

$$= K P^T K + K Q^T K = P + Q$$

Example:11

Consider the NFM, $P = \begin{bmatrix} \langle 0.7, 0.2, 0.3 \rangle & \langle 0.6, 0.2, 0.4 \rangle \\ \langle 0.6, 0.2, 0.4 \rangle & \langle 0.7, 0.2, 0.3 \rangle \end{bmatrix}, B = \begin{bmatrix} \langle 0.4, 0.2, 0.6 \rangle & \langle 0.5, 0.3, 0.4 \rangle \\ \langle 0.5, 0.3, 0.4 \rangle & \langle 0.4, 0.2, 0.6 \rangle \end{bmatrix}$

$$A + B = \begin{bmatrix} \langle 0.7, 0.2, 0.3 \rangle & \langle 0.6, 0.2, 0.4 \rangle \\ \langle 0.6, 0.2, 0.4 \rangle & \langle 0.7, 0.2, 0.3 \rangle \end{bmatrix} + \begin{bmatrix} \langle 0.4, 0.2, 0.6 \rangle & \langle 0.5, 0.3, 0.4 \rangle \\ \langle 0.5, 0.3, 0.4 \rangle & \langle 0.4, 0.2, 0.6 \rangle \end{bmatrix}$$

$$= \begin{bmatrix} \langle 0.7, 0.2, 0.3 \rangle & \langle 0.6, 0.3, 0.4 \rangle \\ \langle 0.6, 0.3, 0.4 \rangle & \langle 0.7, 0.2, 0.3 \rangle \end{bmatrix}$$

$$(A + B)^T K = \begin{bmatrix} \langle 0.7, 0.2, 0.3 \rangle & \langle 0.6, 0.3, 0.4 \rangle \\ \langle 0.6, 0.3, 0.4 \rangle & \langle 0.7, 0.2, 0.3 \rangle \end{bmatrix} \begin{bmatrix} \langle 0, 0, 1 \rangle & \langle 1, 1, 0 \rangle \\ \langle 1, 1, 0 \rangle & \langle 0, 0, 1 \rangle \end{bmatrix}$$





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$$(A+B)^T K = \begin{bmatrix} \langle 0.6, 0.3, 0.4 \rangle & \langle 0.7, 0.2, 0.3 \rangle \\ \langle 0.7, 0.2, 0.3 \rangle & \langle 0.6, 0.3, 0.4 \rangle \end{bmatrix}$$

$$K(A+B)^T K = \begin{bmatrix} \langle 0.7, 0.2, 0.3 \rangle & \langle 0.6, 0.3, 0.4 \rangle \\ \langle 0.6, 0.3, 0.4 \rangle & \langle 0.7, 0.2, 0.3 \rangle \end{bmatrix}$$

$$K(P+Q)^T K = P+Q$$

Note: If P and Q are k-Centrosymmetric NFM then P-Q is also k-Centrosymmetric NFM.

Theorem:10If P is k-Centrosymmetric NFM and K is the NFPM, k=(1 2) then KP is also k-cento symmetric NFM.

Proof: An NFM $P \in (NFM)_n$ is said to be k-Centrosymmetric NFM if $P=KP^T K$

Since P^T is also k-Centrosymmetric NFM if $P^T = K P K$

To show that KP is k-Centrosymmetric NFM

It's enough to show, $KP=K(KP)^T K$

$$\begin{aligned} K(KP)^T K &= K(P^T K^T) K \\ &= K P^T \quad (K^T K = I) \\ &= KP \end{aligned}$$

CONCLUSION

We introduced the concept of Centrosymmetric and k- Centrosymmetric NFMs. We also described a method for finding the g-inverse of a Centrosymmetric and k- Centrosymmetric NFM, which emphasis the fundamental principles and theorems of Centrosymmetric and k- Centrosymmetric NNFM, as well as examples.

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15. Reverse Sharp And Left-T Right-T Partial Ordering On Neutrosophic Fuzzy Matrices





Failure Strength Evaluation of Composite Pressure Vessels Made of Fiber- Reinforced Polymers for Aerospace Applications: A Simplified Simulation Analysis Using Finite Element Method

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ABSTRACT

Keeping the economy and safety into consideration, utilizing the maximum strength of a composite pressure vessel is important in the design of aerospace pressure vessels. Experimental analyses are not always amenable due to the high cost and time. Hence analytical assessment of burst pressure of composite pressure vessels is essential. Assessment of first ply failure pressure is simpler, but insufficient since burst pressure is much higher. Determination of burst pressure by progressive failure method is complex and poses a solution convergence problem due to property degradation. The inclusion of damage models helps to get through the convergence problems. But it is complex to include in the solver and a few researchers have negative remarks on it. Without including the damage model, this paper proposes a simplified procedure using finite element analysis software, Ansys. The software helps to find stresses, strains, and displacement in the individual plies. The maximum stress criterion is followed to assess failure. The extent of degradation has been worked out for the failed layers so as to get through the problem of non-convergence at the same time without sacrificing accuracy. Burst pressure estimations have been verified with literature test results, satisfactorily.

Keywords: aerospace, bursting strength/pressure, composite pressure vessel, progressive failure analysis, finite element analysis.





INTRODUCTION

At present, structural efficiency is of prime importance and concern in aerospace applications. Breathing devices, scuba tanks for divers, oxygen cylinders, and solid rocket motor case are few of the aerospace applications of fiber-reinforced composites [1]. Obviously high specific strength and modulus possessed by fiber-reinforced polymer matrix composite form the basis for being selected as the material for aerospace pressure vessels [2]. Stress rupture needs to be necessarily prevented as it may lead to loss of mission and safety. First-ply failure strength evaluation is primarily needed in the design of composite pressure vessels. Kam et al [3] state that the burst strength of a composite pressure vessel would be much beyond the first ply failure strength. It may be thought as evaluation of first ply failure strength is sufficient but while considering the requirement of lightweight and economy along with safety, bursting strength evaluation is also important [4,5]. Experimental evaluation of first ply failure strength and bursting strength have been fascinating with the development of technology. Kam et al [3] used an acoustic emission set up in which sensors detected the sound produced in the pressure vessel while getting pressurized, till failure. Deformations were measured using strain gauges and data acquisition systems. From the energy – pressure display produced by the system, first-ply failure pressure, as well as ultimate burst pressure, were identified. Shao et al [6]utilized the digital image correlation technique to view the first ply failure initiation and damage propagation until the ultimate bursting. In the light of experimental evidence, many researchers [3,4 and 7] have carried out studies by finite element analysis with reasonable accuracy.Evaluation of first ply failure pressure by programming with classical lamination theory or by the use of finite element analysis packages is in common practice [8,9]. But, burst pressure evaluation is complicated due to the degradation of material properties leading to non-convergence of solutions [4]. There is a need always to reduce the complexities in the analysis such that the designers can adopt the procedure easily. This paper reviews a few of the existing procedures in the numerical investigation for the evaluation of bursting strength of composite pressure vessels. Moreover, a simplified procedure is proposed which is shown to be useful in the prediction of bursting strength of fibre reinforced polymer composite pressure vessels by progressive failure analysis.

A review on progressive failure analysis procedures

Literature including text book [10] talk invariably that one of the following modes would be observed in the failure initiation of composites: fiber breakage, matrix cracking and interface crack propagation. Text book by Kaw [10] outlines the overall procedure and the challenging complexities involved in progressive analysis. It has been declared that the extent of degradation of damaged material properties depends on the philosophy of the user. It prescribes to replace the matrix failed ply with a hypothetical one that has no transverse stiffness, transverse tensile strength and shear strength. It has been mentioned that near zero values avoid singularities in stiffness matrices. Researchers have extensively contributed to this cause either by damage evolution modeling [11-14] or implementing simple procedures on stiffness reduction [15].Damage models help to improve convergence of solutions [4 and 11]. Chang and Chang[12] have demonstrated a damage model that could provide the following information: damage type, quantification of damage, degradation extent, residual strength and failure load. Damage modeling calculates transformed reduced stiffness matrix which represents the damage on incrementing the load. As damage starts to occur stresses and strains are redistributed.

Different researchers approached the problem of damage modeling with different mathematical functions. There is a presentation of a few post-failure theories in reference [13]. Two of the material degradation models used by them are conceptually shown in figure 1 (a & b). In figure 1(a),Petit-Waddoup's method is depicted in which failed lamina gradually unloads. To implement this theory, a high value of negative tangent modulus is prescribed to the failed lamina. Nahas' theory is presented in figure 1(b) wherein failed lamina gets unloaded exponentially. Damage models have been developed by different authors such as Wu et al [16], Sun et al [17], Nagesh [13] and Martins et al [11].Ansys gives stress levels only in the universal coordinate system. The stresses need to be transformed into a material coordinate system every time the layers are degraded. Further, if the damage evolution model is to be included, it is more involved to incorporate in the solution routine. Wu et al [16] inferred from their studies that the





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analysis with damage model underestimates the burst pressure by 9.3% as compared to the analysis without damage evolution. Quasi-static progressive failure analysis by explicit finite element analysis yields favorable calculation efficiency without sacrificing accuracy [4].

The Proposed methodology for material degradation

Having given an understanding of the above recommendations, an algorithm is worked out with finite element analysis using Ansys. Writing of Kaw[10] is to be commended for his clear statements regarding progressive failure analysis. By adopting his recommendations, the matrix failed ply shall be replaced with a hypothetical one that has near-zero transverse stiffness, transverse tensile strength, shear modulus, and shear strength. When the fiber of the ply also fails the ply is to be fully discounted by replacing it with the one having near-zero stiffness and strength in all orientations. He has left the assignment of the extent of degradation to the philosophy of the user in case of failure in one of the modes of composites. Recommendations of multiplication factors with relevant properties according to various authors [13,15,17-19] are compiled in table 1. It is to be noted that following equalities have been considered in the analysis: $E_{33}=E_{22}$, $G_{13}=G_{12}$, and $\nu_{13}=\nu_{12}$. Where, E_{11} , E_{22} and E_{33} are young's moduli in the local coordinate system of fiber. Similarly, G_{12} , G_{23} and G_{13} are shear moduli and ν_{12} , ν_{23} and ν_{13} are Poisson's ratios.

A few researchers including [18] recommended a multiplication factor of 10^{-6} for making the properties to have near-zero values. But this leads to non-convergence very easily. If we use 10^{-1} as a multiplication factor as recommended by a few other researchers [13 and 15], the accuracy is highly sacrificed and the expected response of reduced stiffness could not be observed. Hence in order to make the properties have near-zero values, it is proposed to be multiplied with 10^{-3} . When analyzing with the last ply existing, there may be difficulty in achieving the convergence. In such cases, the allowable number of iterations may be set to a higher value. If it is not working, then the multiplication factor may be used as 10^{-2} as a last resort. The proposed multiplication factors in precise are presented in Table 2. A Similar table may be formed for fiber failure mode.

Analysis Procedure

Finite element analysis software Ansys has been used. Quadratic Shell element type SHELL281 has been utilized for modeling the curved surface; SHELL281 is found suitable for the analysis of shell structures of thin and moderately thick sections. The Quarter symmetric segment of the cylinder is modeled by revolving a line about an axis through 90° . Axial length is kept as half the length of the given cylinder in order to maintain symmetry. Mesh convergence study is made with smaller element sizes and the area is finally meshed with an element size of 1 mm in all the analyses. One end of the cylinder is axially constrained, vertical edges are provided with symmetrical constraints and another end of the cylinder is applied with a meridional stress $\frac{pd}{2}$. Where p is applied internal pressure and d is internal diameter. The internal pressure of 1 MPa is always applied and stresses for higher pressures are evaluated by linear interpolation. Figure 2 shows the geometric model created.

Hoop (σ_{xx}), meridional (σ_{yy}) and shear (τ_{xy}) stresses are picked from the Ansys nodal solutions and they are further transformed into stresses along with fiber (σ_{11}), perpendicular (σ_{22}) and shear (τ_{12}) directions using the transformation matrix. The maximum stress criterion is used to predict failure. Failure pressure is computed by dividing the relevant strength by the corresponding stress. Typically, failure pressure is $\frac{Y_T}{\sigma_{22}}$. Where, Y_T is matrix tensile strength. On observing first ply failure, the ply is identified and reduced stiffness and strength values are assigned to it by a property definition separately made available in the program. Now the second ply failure is identified. The position of the failed lamina, failure pressure, and mode will be known. The procedure would be repeated until the last ply is failed. Failure pressure of the last ply is taken as the burst pressure.

It is obvious that for a single agency it is very difficult to fabricate and conduct all instrumented burst tests. Hence, in order to validate the proposed procedure, published results by various researchers have been utilized. In one of such references [3], authors have experimented with cylindrical composite pressure vessels made of graphite/epoxy





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laminates of each lamina thickness of 0.15 mm. Cylinders with 4 ply, 6 ply and 8 ply laminates of different orientations in symmetric arrangements have been tested for first ply failure pressure and burst pressure. All the cylinders have an external diameter of 40 mm and 230 mm long. They have presented analytical results for first ply failure while not for burst pressure. Hence this attempt verifies the burst pressure evaluated by them experimentally. The properties of the lamina as presented by the authors are shown in Table 3. Table 4 shows the properties of lamina made of E-glass/epoxy composites with which Onder *et al*[7] have conducted experimental studies. All the cylinders have a lamina thickness of 0.4 mm, inner diameter 100 mm and 400 mm long. Moreover, all the cylinders were made of 4 layers both in symmetric and axi-symmetric arrangements.

RESULTS AND DISCUSSIONS

Kam *et al* [3] have tested the composite pressure vessels for first ply failure as well as burst pressure. Their test result displayed from the acoustic emission system for $[54^\circ/-54^\circ/54^\circ]$ Configuration is represented in figure 3. Minor peaks have been excluded in the figure. For this particular configuration, experimental first ply failure pressure is 9.66 MPa and burst pressure is 16.07 MPa. While modeling and analyzing five configurations of the above cylinders, first ply failure pressures obtained have been shown in table 5. Though the result for $[45^\circ/-45^\circ]_s$ has a good agreement, other values are conservative. It was observed that the first ply failure of $[45^\circ/-45^\circ]_s$ configuration occurred in the shear mode as shown in figure 4.

The figure shows how the mode and value of first ply failure pressure are found. The proposed procedure for progressive failure analysis is exercised for the evaluation of the burst pressure of all the five cylinders. In the analysis, it is assumed that once the first ply failure has taken place, the whole ply is failed. But it sustains the load with a reduced stiffness as prescribed in the program. The procedure is repeated layer by layer and the maximum pressure recorded is taken as the burst pressure. Table 5 presents a comparison of analytical results of burst pressure with test values [3]. With regard to the burst pressure prediction, the close agreement is observed. Figure 5 (a) shows the radial displacement of $[90^\circ/0^\circ]_s$ configuration along the axis at first ply failure. Figure 5 (b) shows the radial displacements during the progressive failure of $[90^\circ/0^\circ]_s$ configuration. Figure 6 is a presentation of progressive failure relevant to $[90^\circ/0^\circ/90^\circ/0^\circ]_s$ configuration which has the sequence of failure of ply: 2-4-5-7-1-3-6-8. It is to be noted that the authors [3] analyzed only for first ply failure.

Onder *et al* [7] conducted a burst pressure test as well as analysis in E-glass/epoxy filament wound composite pressure vessels with symmetric and antisymmetric configurations. They analyzed with a program written in Fortran using a derived formulation. Moreover, they have quoted that the finite element method could evaluate only the first ply failure pressure. In this context, the result of the present analysis is of good agreement. One of their efforts was to verify optimum winding angle for filament-wound composite cylindrical pressure vessels to be around 54.75° which is also confirmed in this work. Figure 7 shows a graphical comparison of present analysis with the test results of all the above configurations [7] and in confirmation of an optimum winding angle. Figure 8 shows a good graphical comparison of present analytical results against all the test results [3 and 7]. Most of the results fall within a $\pm 10\%$ variation with the test results. It is to be noted that the authors [7] made a remark about the finite element method that it cannot give close results of burst pressure with the test results. They have shown only the first ply failure pressure and worded as burst pressure.

CONCLUDING REMARKS

There is no unique failure prediction methodology applicable to all composite configurations. Burst pressure estimations are essential in addition to first ply failure prediction in order to ensure safety in lightweight critical applications. Designers need easier approaches in order to assess the failure of composite cylinders designed by





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them. Experimental observations are not always easy. The inclusion of damage evolution models lead to complexity as many modifications are to be included in the solution routine of Ansys. Solution convergence is the problem to be attended to and the same is alleviated without sacrificing accuracy in the present method. The approach is capable of predicting the burst pressure of composite cylindrical pressure vessels satisfactorily.

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Table 1 Recommended Multiplication factors for degradation of properties under matrix failure mode

Reference	E ₁₁	E ₂₂	G ₁₂	G ₂₃	ν ₁₂	ν ₂₃
[10]	1	0.1	1	1	0	1
[11]	1	0.1	1	0.1	1	0.1
[13]	1	0	1	1	0	0
[14]	1	10 ⁻⁶	1	1	1	1
[15]	1	0.1	0.1	1	0.1	1

Table 2 Proposed Multiplication factors for degradation of properties under matrix failure mode

E ₁₁	E ₂₂	G ₁₂	G ₂₃	ν ₁₂	ν ₂₃
1	10 ⁻³	10 ⁻³	10 ⁻³	10 ⁻³	10 ⁻³

Table 3 Properties of composites made of graphite/epoxy [3]

Material constant	Value	Strength parameter	Value
E ₁₁	88.53 GPa	X _T	1560 MPa
E ₂₂ = E ₃₃	6.72 GPa	X _C	1760 MPa
G ₁₂ = G ₁₃	4.03 GPa	Y _T	35.75 MPa
G ₂₃	1.022 GPa	Y _C	178 MPa
ν ₁₂ = ν ₁₃	0.28	S	61.72 MPa
ν ₂₃	0.4		

Table 4 Properties of composites made of E-glass fibre/epoxy [7]

Material constant	Value	Strength parameter	Value
E ₁	36.5 GPa	X _T	1050 MPa
E ₂ = E ₃	15.0 GPa	X _C	938 MPa
G ₁₂ = G ₁₃	6.4 GPa	Y _T	43 MPa
G ₂₃	1.6 GPa	Y _C	106 MPa
ν ₁₂ = ν ₁₃	0.24	S	88 MPa
ν ₂₃	0.22		





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Table 5 Comparison of first ply failure and burst pressure of graphite/epoxy cylinders

Sl.No..	Lamination arrangement	First ply failure Pressure, MPa		Burst pressure, MPa		
		Test [3]	Present analysis	Test [3]	Present analysis	Relative error, %
1	[54°/-54°] _s	7.18	5.158	14.32	14.942	4.34
2	[45°/-45°] _s	3.47	3.712	10.36	11.975	-15.59
3	[90°/0°] _s	5.68	3.466	11.57	11.869	2.58
4	[54°/-54°/54°] _s	9.66	6.130	16.07	15.810	-1.62
5	[90°/0° /90°/0°] _s	10.41	6.973	20.75	24.220	16.72

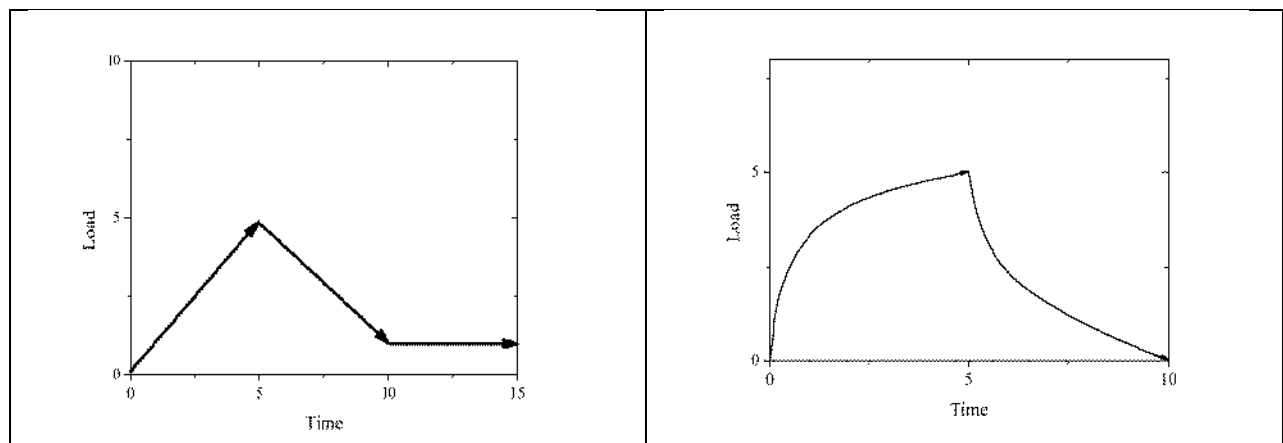


Fig.1 Degradation model of material properties

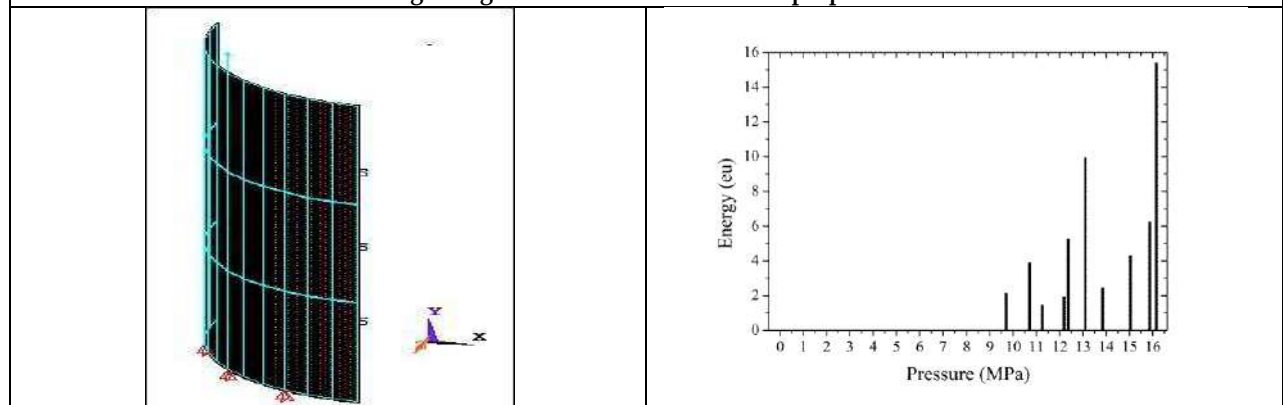


Fig. 2 Geometric model of cylindrical shell

Fig. 3 Results produced for Cylinder [54o/-54o/54o]S through acoustic emission system [3]





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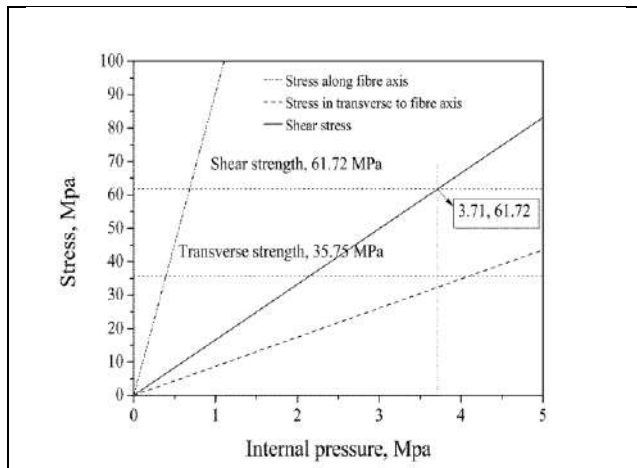


Fig. 4 Shear mode failure of [45o/-45o]S graphite/epoxy cylinder

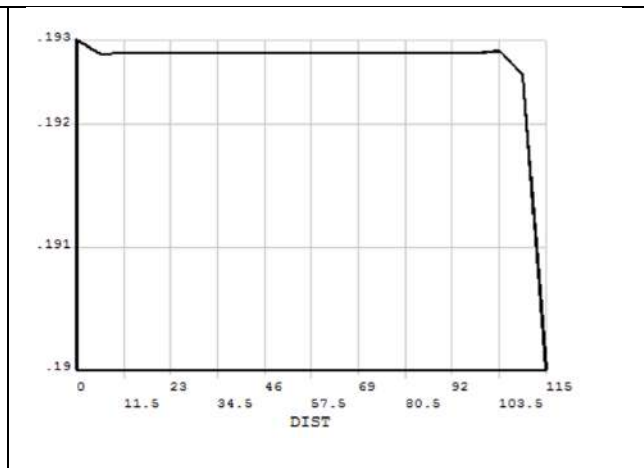


Fig. 5 (a) Radial displacement of graphite/epoxy cylinder [90o/0o]s configuration along the axis at first ply failure obtained from Ansys

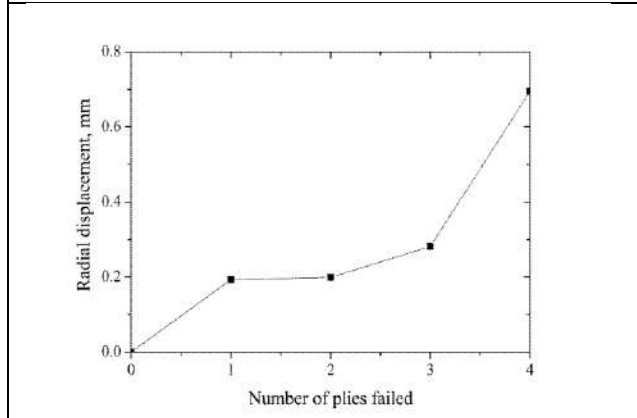


Fig. 5 (b) Radial displacement of graphite/epoxy cylinder [90o/0o]s configuration during progressive failure

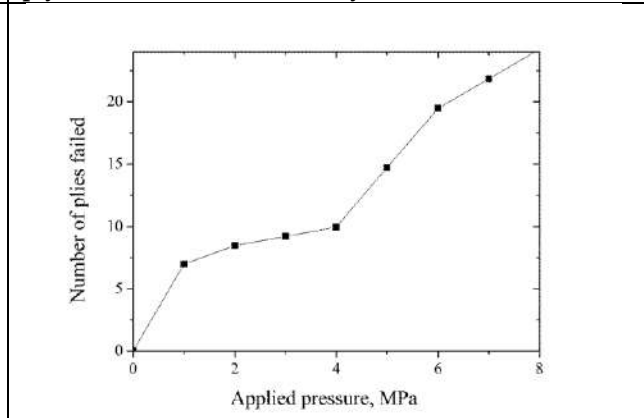


Fig.6 Progressive failure of [90o/0o/90o/0o]S graphite epoxy cylinder

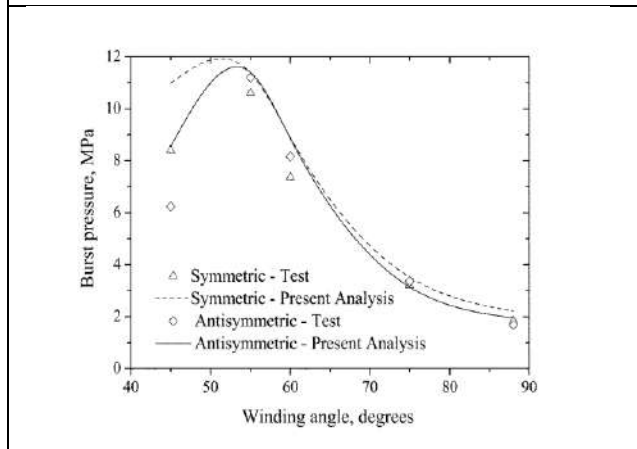


Fig. 7 Comparison of present analysis with test results [7] on E-glass/epoxy composite cylinders.

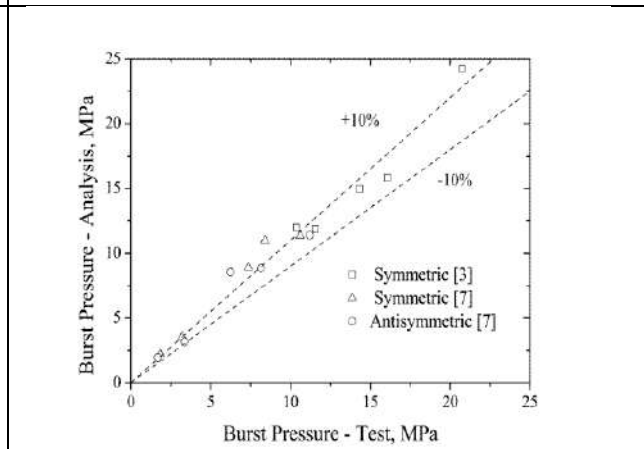


Fig. 8 Comparison of burst pressure analysis with test results





XRD, Hardness, SHG and Dielectric Studies of Potassium Chloride Doped L-Leucinium Oxalate Crystal

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ABSTRACT

Potassium chloride doped L-leucinium oxalate (PCLO) crystals have been grown by solution method. Colourless and transparent crystals of PCLO have been harvested after the period of about 30 days. For comparison purpose, undoped L-leucinium oxalate crystals were also grown. Solubility studies were carried out by gravimetric method. Induction period was measured for the samples at various super saturation values. XRD study indicates that the doped crystal has the triclinic structure like undoped crystal. Mechanical parameters such as hardness, work hardening coefficient, yield strength and stiffness constant of both undoped and potassium chloride doped L-leucinium oxalate were determined. Dielectric parameters like dielectric constant and dielectric loss of the samples have been measured at different frequencies. SHG studies were carried out for both the samples by Kurtz-Perry powder technique and the results are analyzed. LDT value of the sample was also measured.

Keywords: Single crystal; doping; NLO; SHG; XRD; Hardness; dielectrics; Yield strength; LDT





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INTRODUCTION

A crystal is a periodic array of the atoms, ions or molecules. An ideal crystal is constructed by the definite repetition of identical structural unit in space. In a single crystal, the periodicity normally extends throughout the material and it is free from inner grain boundaries [1, 2]. In this work, a single crystal viz. potassium chloride doped L-leucinium oxalate crystal has been grown and studied. It is reported that undoped L-leucinium oxalate crystal is a nonlinear optical (NLO) crystal and on this crystal when high intense light is incident, the re-radiation comes from dipoles whose amplitude does not faithfully reproduce the sinusoidal electric field that generates them. Therefore, the distorted reradiated wave contains different frequencies from that of the original wave [3, 4]. Anbuechezhiyan et al. reported studies of undoped L-leucinium oxalate grown from aqueous solution. The grown crystals were characterized with single crystal XRD and structure was confirmed. The chemical composition of the sample was determined by carbon, hydrogen and nitrogen analysis. The qualitative analysis on the crystal has been carried by using Fourier Transform Infrared spectral measurements. The presence of hydrogen and carbon in the grown crystal was confirmed by using proton and carbon nuclear magnetic resonance spectral analyses. Optical behavior of the crystal was studied using UV-visible spectroscopy. The thermal stability and decomposition of the crystal were studied by thermogravimetric analysis [5]. L-leucinium oxalate crystal is an organic NLO crystal and it is a complex of amino acid. Amino acid like L-leucine is a bifunctional organic molecule that contains both a carboxylic group as well as an amino group. In solid state amino acid contains protonated amino group and deprotonated carboxylic group. This dipolar exhibits peculiar physical and chemical properties. So the efforts have been made on the amino acid mixed crystal in order to make them suitable for device applications [6, 7]. Growth and characterization of some oxalate-type NLO crystals such as L-alaninium and glyciniun oxalate were reported in the literature [8, 9]. Costa Alexandre Saraiva et al. have prepared the crystal of L-leucine oxalate by dissolving L-leucine and oxalic acid in 1:1 molar ratio in deionized water. XRD analysis was carried out. The vibrational behaviors were investigated by Raman spectroscopy in the 298-478K temperature range and spectral range 30-3200 cm^{-1} . At high temperatures, no modification in the Raman spectra was observed, evidencing that the LLO crystal no presents structural phase transition up to melts of the material [10]. In this paper, various studies of potassium chloride doped L-leucinium oxalate (PCLO) crystal are reported and solution method was adapted to grow the crystal of PCLO

Experimental work

Synthesis, solubility and crystal growth

To synthesize L-leucinium oxalate sample, L-leucine and oxalic acid were taken in 1:1 molar ratio and they are dissolved well in double distilled water. The solution was heated and stirred well for about 2 hours and it is allowed for evaporation to obtain the synthesized sample of L-leucinium oxalate. To obtain the potassium chloride doped L-leucinium oxalate (PCLO), 1 mole% of potassium chloride was added into the aqueous solution of L-leucinium oxalate and by slow evaporation method, the crystals of PCLO were harvested after the period of about 30 days. The grown crystal of PCLO is presented in the figure 1. The solubility of undoped and potassium chloride doped L-leucinium oxalate crystals was carried out by gravimetric method [11]. A known quantity of solute was added into the solvent (water) at constant temperature till it was completely dissolved and saturation level was obtained. By taking the solution in a petri dish and warming it, the solubility was determined. Using this technique, the magnitude of the solubility of the samples was evaluated at various temperatures viz. 30°C, 35°C, 40°C, 45°C and 50°C. The temperature dependence of solubility of the samples is shown in figure 2. From the result, it is observed that the solubility increases with temperature for both the samples. It is also seen that solubility increases when L-leucinium oxalate crystal was doped with potassium chloride. These data can be used for preparing the saturated solution and for carrying out induction period measurements.

Induction period

The time taken between the achievement of super saturation and the appearance of crystal nucleus in a supersaturated solution is known as induction period. Different methods are used for the measurement of induction





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period. Conductivity and turbidity methods are more suitable for materials having low solubility whereas dilatometer and direct vision methods are suitable for materials having moderate solubility and in the present work; the direct vision observation method was used to measure the induction period. For the measurement of induction period, isothermal method [12] was used for the selected super saturation ratios viz. 1.2, 1.24, 1.28, 1.32 and 1.36 at room temperature (30°C). Using the solubility diagram, the samples of undoped and potassium chloride doped L-leucinium oxalate were used to prepare supersaturated aqueous solutions by keeping the super saturation ratio at 1.2 initially in a corning glass beaker, preheated slightly and it was stirred continuously for about 2 hours using a magnetic stirrer to ensure the homogeneous concentration. The nucleation cell was loaded into a constant temperature bath (controlled to an accuracy of 0.01°C) and illuminated using a powerful lamp to observe the formation of nucleus. The time interval in which the first speck or sparkling particle of nucleation occurred in the solution is noted and this is the induction period for formation of nuclei for the super saturation ratio 1.2. Similarly, induction period measurements were performed at the other super saturation ratio. The variation of induction period with super saturation ratio for samples is provided in the figure 3 and from the results, it is noticed that the induction period decreases with the super saturation ratio. The induction period is observed to be increasing when potassium chloride was added into L-leucinium oxalate.

RESULTS AND DISCUSSION

Single crystal XRD studies

In X-ray diffraction (XRD) technique, a monochromatic X-ray beam is incident at Bragg angle (θ) on the set of lattice planes with interplanar spacing (d) in a particular crystalline sample so that the Bragg's diffraction condition $2d \sin \theta = n\lambda$ for the particular lattice planes is satisfied. Here n is the order diffraction and λ is the wavelength of X-rays. There are two X-ray diffraction methods namely powder XRD and single crystal XRD methods. In this work, single crystal XRD method was adopted because the grown sample of PCLO is a single crystal. The unit cell constants for potassium chloride doped L-leucinium oxalate crystal were collected by using single crystal X-ray diffractometer (Bruker-Nonius MACH3/CAD4). It is observed that the grown crystal of PCLO of this work belongs to triclinic crystal system with the unit cell parameters $a = 5.653(2) \text{ \AA}$, $b = 9.785(3) \text{ \AA}$, $c = 9.883(2) \text{ \AA}$ and $\alpha = 88.23(1)^\circ$, $\beta = 98.42(4)^\circ$ and $\gamma = 101.74(2)^\circ$. The crystallographic data of undoped L-leucinium oxalate crystal have been already reported [5] and from the comparison of the data, it is confirmed that crystal structure is not changed when potassium chloride was added as the dopant into L-leucinium oxalate crystal.

Hardness, work hardening coefficient and stiffness constant

Mechanical properties like hardness, stiffness constant and yield strength of the samples have been found by carrying out microhardness studies. Hardness testing has been widely used to study the strength and deformation in materials. Hardness is defined as the ratio of the load applied to the surface area of the indentation. Hardness of the material depends on different parameters such as lattice energy, Debye temperature, heat of formation and interatomic spacing. Crystals, free from cracks, with flat and smooth surfaces were chosen for the static indentation tests. The crystal was mounted properly on the base of the microscope. Now, the selected faces were indented gently by loads varying from 20 to 60 g for a period of 10 s using Vickers diamond indenter attached to an incident ray research microscope. The length of the two diagonals of diamond indenter was measured by a calibrated micrometer attached to the eyepiece of the microscope after unloading and the average was found out. For a particular load, at least three well defined indentations were considered and the average value (d) was selected. The Vickers hardness (H_v) numbers at different loads were calculated using the following relation

$$H_v = 1.8544 P / d^2$$

where, 'P' is the applied load in kilogram and 'd' is the average diagonal length of the indentation marks in millimeter. The variation of hardness number with applied load for the samples is shown in the figure 4. The grown crystal exhibits the reverse indentation size effect (RISE), in which the hardness value increases with the increasing load upto 40 g and then it decreases [13-15]. When potassium chloride was added as the dopant into L-leucinium oxalate crystal, it seems that hardness increases and this leads to conclusion that bond strength increases when potassium





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chloride was used as the dopant. The plots of average value of diagonal indentation (d) versus the applied load (P) are presented in the figure 5 and using these values the Meyer's plots are drawn (Figs.6 (a) and (b)). Meyer's law given by

$$P = a d^n$$

where 'a' is the material constant, 'n' is the Meyer's index or work hardening coefficient [16]. This law is used to find the work hardening coefficient (n). The plots of $\log(P)$ against $\log(d)$ which gives a straight line and the slope of the line gives the value of n. The values of work hardening coefficient (n) for undoped and potassium chloride doped L-leucinium oxalate crystals are 1.664 and 1.758 respectively. Yield strength of the material can be found out using the following relation

$$\text{Yield strength } (\sigma_y) = (Hv/3)$$

where σ_y is the yield strength and Hv is the hardness of the material. Yield strength is the maximum stress that can be developed in a material without causing plastic deformation. The elastic stiffness constant (C11) for different loads was calculated using Wooster's empirical formula

$$C11 = Hv^{7/4}$$

It gives an idea about the measure of resistance of plastic to bending and tightness of bonding between neighboring atoms [17-18]. The plots of yield strength and stiffness constant with applied load for the samples are presented in the figures 7 and 8. The results indicate that behaviour of yield strength and stiffness constant of the samples is found to almost the same as the hardness of the samples. It is observed that yield strength and stiffness constant increase with increase of load upto 40 g and then these values decrease.

Dielectric constant and dielectric loss

In dielectric materials, the most commonly measured small signal electrical property is the dielectric constant. The dielectric constant in polar materials is rarely a constant, but varies with the applied field, stress, temperature and other parameters. When a dielectric is placed in an external electric field, electrons of the ions are displaced slightly with respect to the nuclei and thereby induced dipole moments result and it causes the electronic polarization. When atoms of different types form molecules, they will normally not share their electrons symmetrically and the electron clouds will be displaced eccentrically towards the stronger binding ions. Thus the ions acquire charges of opposite polarity and an external field acting on these net charges will tend to change the equilibrium positions of the ions themselves. By this displacement of charged ions or groups of ions with respect to each other, a second type of polarization viz. ionic polarization of the dielectric is created. The asymmetric charge distribution between the unlike partners of molecule gives rise, in addition, to permanent dipole moments which exists even in the absence of an external electric field. Such moments experience a torque in an applied field that tends to orient them in the direction of the field. Consequently, an orientational (dipolar) polarization can arise.

These three mechanisms of polarization are due to charges locally bound in atoms, molecules or in the structure of solids. Additionally to all these, there usually exist charge carriers that can migrate for some distance through the dielectric. When such carriers are impeded in their motion, space charges and macroscopic field distribution result. Such a distortion appears as an increase in the capacitance of the sample. Thus a fourth type of polarization called the space charge polarization comes into play. The total polarization is a sum of four polarizations if they act in a dielectric independently. The dielectric constant (ϵ_r) and loss factor ($\tan \delta$) were measured using an LCR meter for undoped and potassium chloride doped L-leucinium oxalate (PCLO) crystals. Fig.9 and 10 present the variations of dielectric constant and dielectric loss factor with frequency at room temperature. From the results, it is observed that both the dielectric parameters decrease as frequency decreases for samples. The high values of ϵ_r at low frequencies may be attributed to dominance of space charge polarization. It is observed that the crystals of this work have low dielectric constant and low dielectric loss at higher frequencies and hence suitable for electro-optic applications. In accordance with Miller's rule, the lower value of dielectric constant at higher frequencies is a suitable parameter for the enhancement of SHG coefficient. The results indicate that the dielectric constant and loss factor increase when L-leucinium oxalate crystal is doped with potassium chloride [19-22].



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Nonlinear optical organic materials will be the key elements for future photonic technologies. Photonic technologies are analogous to the field of electronics. Photonics technologies are based on the fact that photons are capable of processing information with the speed of light. In electronic devices, electrons are the key elements performing multifunction, whereas in photonic devices photons will perform the same functions of a much faster speed and in a cleaner and easier way. An important development in a non-centrosymmetric crystal when researchers reported the second harmonic generation (SHG) and it is called as the frequency doubling. Powder second harmonic generation test offers the possibility of assessing the nonlinearity of the materials. The second harmonic generation behavior of the powdered material was tested using the Kurtz and Perry method [23]. Calibrated polycrystalline samples were illuminated by nanosecond pulses at the fundamental wavelength $\lambda_{\omega}=1064$ nm, delivered by an Nd:YAG laser with a pulse width of 10 nanoseconds and a repetition rate of 10 Hz. In the case of phase matchable crystals, with the powder SHG efficiency being an increasing function of the particle size, a large calibration (150-200 μm) was chosen for the powder under test and the phase matchable material taken as a reference sample (KDP). The emission of green laser light from the samples confirms that these samples are second order NLO materials. SHG efficiency of the undoped L-leucinium oxalate crystal is found to be 0.65 times that of the standard KDP crystal. The SHG efficiency of potassium chloride doped L-leucinium oxalate (PCLO) crystal is observed to be 0.83 times that of KDP. Thus, potassium chloride doped L-leucinium oxalate crystal is the better candidate for NLO applications than the undoped L-leucinium oxalate crystal.

LDT measurement

Laser damage threshold (LDT) values of the samples have been measured using a Q-switched Nd: YAG laser with a pulse duration of 10 nano seconds. The grown crystals of undoped and potassium chloride doped L-leucinium oxalate crystals are polished and are subjected to LDT studies. LDT value is defined as the maximum power density required to create a damage on the surface of the crystal and it depends on the physical and chemical defects, specific heat, thermal conductivity and optical absorption etc. The LDT value of the crystal was calculated using the expression, power density (P) = $E/\tau\pi r^2$, where E is the energy (mJ), τ is the pulse width, r is the radius of the laser beam spot. The calculated values of LDT are 1.412 GW/cm² and 1.760 GW/cm² respectively for undoped and potassium chloride doped L-leucinium oxalate crystals. The LDT value of KDP crystal is 0.2 GW/cm² [24]. Thus, LDT values of the grown crystals are more than that of KDP crystal. Hence, the grown crystals are the better candidates for NLO and laser applications.

CONCLUSION

A comparative study has been carried out for both undoped and potassium chloride doped L-leucinium oxalate (PCLO) crystals and the samples have been grown in the form of single crystals by solution method with slow evaporation technique. Both the samples have positive temperature coefficient of solubility and solubility of PCLO crystal is observed to be more than that undoped L-leucinium oxalate crystal. Induction period of the samples have been measured and it decreases as the supersaturation ratio increases. Both the samples crystallize in triclinic structure. Hardness, yield strength and stiffness constant of PCLO crystal are found to be higher than those of undoped sample. Dielectric constant and dielectric loss of both the samples are observed to be decreasing as the frequency increases. The value of relative SHG efficiency of PCLO crystal is 0.83 times that of KDP sample. LDT value of potassium chloride doped L-leucinium oxalate crystal is observed to be more than that of undoped L-leucinium oxalate crystal.

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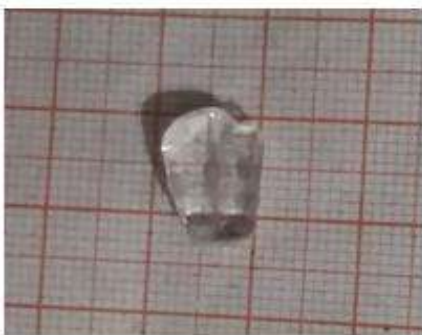


Fig.1. The grown crystal of PCLO

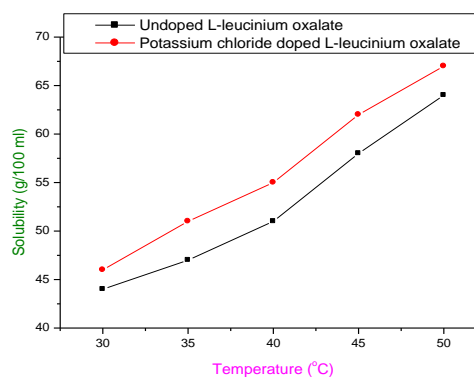


Fig.2: Solubility curves for undoped L-leucinium oxalate and potassiumchloride doped L-leucinium oxalate (PCLO) crystals





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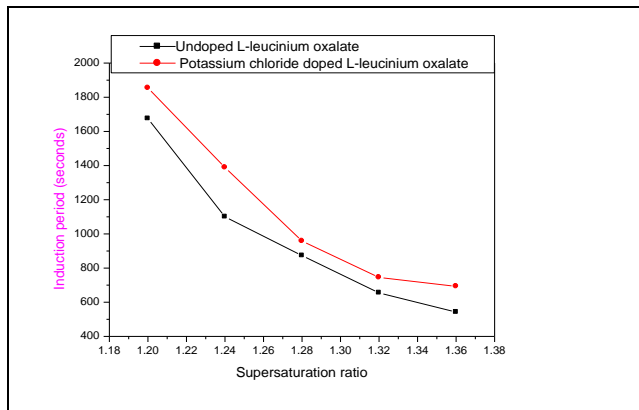


Fig.3: Variation of induction period with supersaturation ratio for unoped L-leucinium oxalate and potassium chloride doped L-leucinium oxalate (PCLO) samples

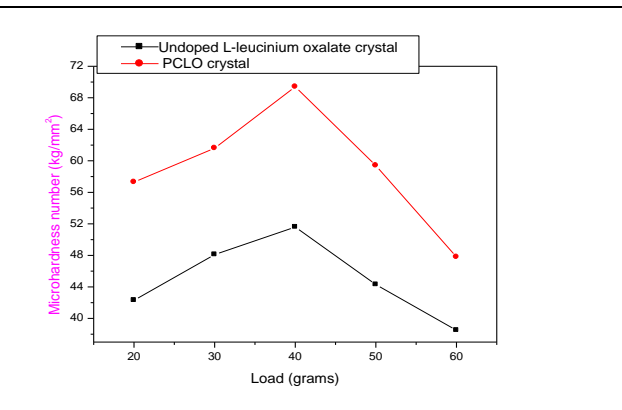


Fig.4. Variation of microhardness with load for undoped and potassium chloride doped L-leucinium oxalate crystals

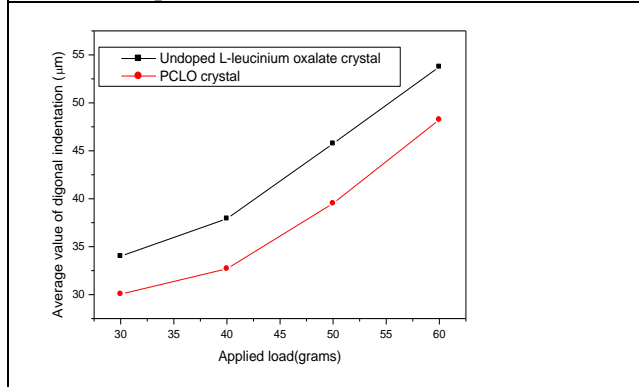


Fig.5. Plots of average value of diagonal indentation (d) versus the applied load (P) for both the samples

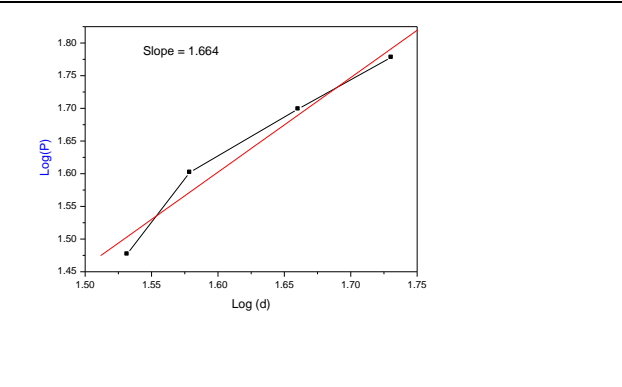


Fig.6 (a). Plot of log (P) versus log (d) for unoped L-leucinium oxalate crystal

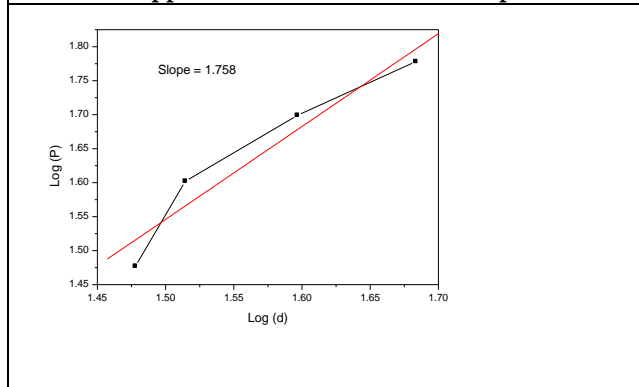


Fig.6 (b). Plot of log (P) versus log (d) for potassium chloride doped L-leucinium oxalate crystal

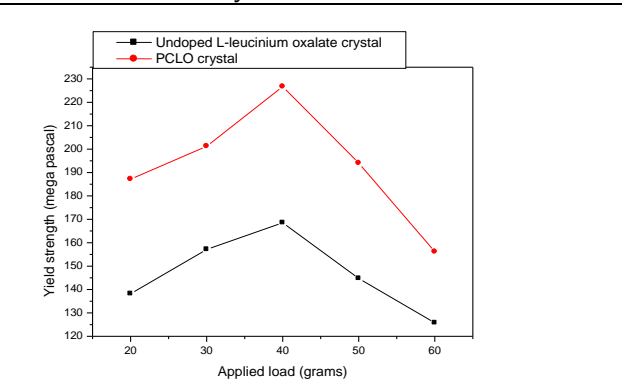


Fig.7. Variation of yield strength with load for undoped and potassium chloride doped L-leucinium oxalate crystals





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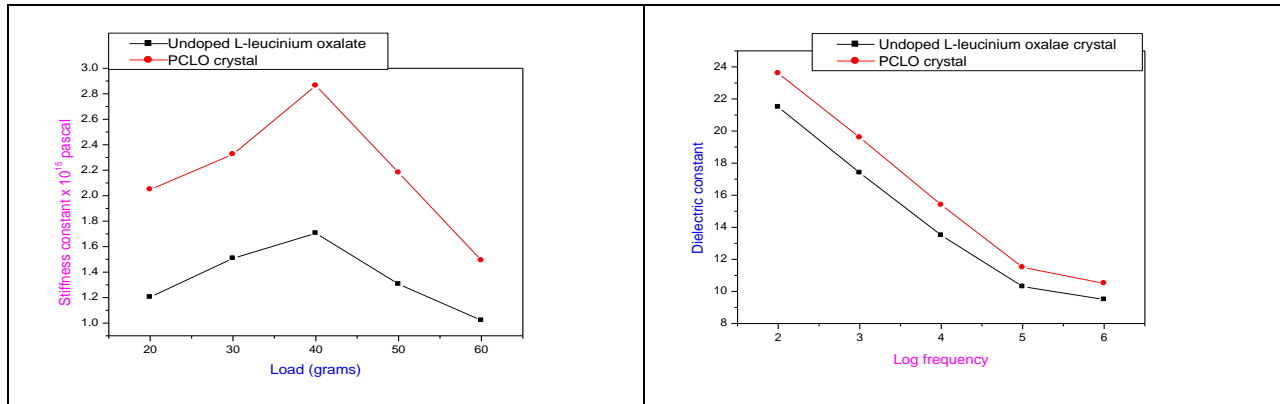


Fig.8. Variation of stiffness constant with load for undoped and potassium chloride doped L-leucinium oxalate crystals

Fig.9. Plots of dielectric constant versus frequency for both the samples

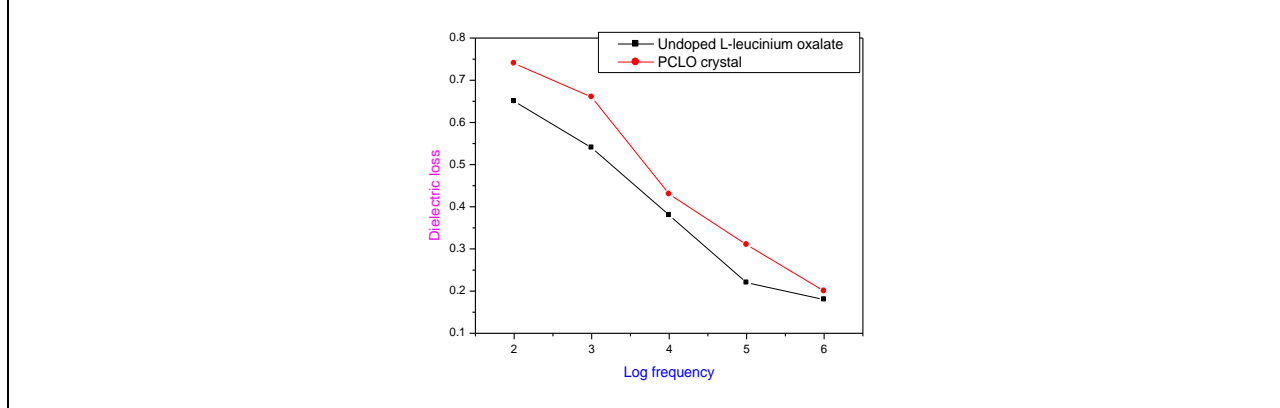


Fig.10. Plots of dielectric loss versus frequency for both the samples





A Study of Learning Style and Academic Performance of PG Students of Central University of Jammu

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ABSTRACT

The present study was an attempt to investigate the study of learning style and academic performance of PG students of Central University of Jammu. The data was collected randomly from the sample of 90 students, each 30 students from the department of Science, Social Science and Educational Studies. The self constructed opinionnaire tool employed for data collection of the study. Frequency and Mean used for data analysis of the study. The results revealed that there were significant differences in learning style of students with respect to their discipline and Visual learning style was the most prominent learning style on the basis of academic performance of students with respect to their discipline of the study.

Keywords: Learning style, Academic performance, Discipline, students.

INTRODUCTION

Every human being is rational animal because he/she has got the power of reasoning. This power of reasoning enables him/her to learn things quickly. Differences among people are reflected not only in how they think, communicate, and relate etc but also in the way each one learns. Learning may be properly defined as a relatively permanent change in behaviour(excluding the influence of growth , maturity or lesion).Every student learns in different way that best suit his/her learning needs and they use different styles for learning which enables them to be successful at their academic career. The notion of style refers to a person who preferred different way according to their abilities. This help to achieve the success in life. It is now confirmed that learning differences are caused by



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intelligence differences as well as other factors like personality traits, task difficulty, and learning styles. The traditional belief that learning differences are the result of intelligence differences and different cognitive abilities has changed. Everyone has a different preferred method of learning. It's a frequent misconception that learning styles have more to do with "how" than "what" children choose to learn, even though they play a significant role in determining students' attitudes and academic success. A person's tendency towards particular learning methodologies is referred to as their learning style. Kolb defined learning style is "the way we prefer to absorb and incorporate new information. Students have different styles of learning. Teachers identify different learning styles of their students and adjust his/her teaching method according to each student's needs.

Learning Style theory starts by Carl Jung (1927) who noted major differences in the way people perceived sensation versus intuition, the way they made decisions logical thinking versus imaginative feelings and how active or reflective they were while interacting extroversion versus introversion. Knowledge of one's learning styles can be used to increase self awareness about their strengths and weakness as learners. Every individual have their own learning style. Learning style encompasses motivation, on task persistence versus the need for multiple assignments simultaneously, the kind and amount of structure required and conformity versus mis conformity. Merrill (2000) argues that most of students are unaware of their learning styles. All the advantages claimed for metacognition can be gained by encouraging learner to become knowledgeable about their own learning styles and that of others (Coffield, 2004). Once students have brought this knowledge into their level of awareness, they are better suited to choose learning strategies that match their learning styles. This initiative student ownership of the educational process. One of the most significant issues in learning to learn is an individual's taking the responsibility for his/her own learning the individuals should know what their own learning styles are and what characteristics this style has and they should thereby behave according to this style. In this way, the individual can acquire the constantly changing and increasing amount of information without need for the assistance of others. When the learner takes the responsibility of his/her own learning, s/he attributes meaning to the process of learning.

TYPES OF LEARNING STYLE

Learning is an extremely important and personal experience for people of all ages. Years ago, there was an assumption that everyone learned new material the same way. But overtime, research discovered there are a number of different types of learning styles and different ways that humans retain and process information.

Visual learning style

These people prefer to use pictures, images, diagrams, colors, and mind maps. How to identify the learners who learn by visual learning style?

1. Sit in front.
2. Watch instructors' gestures constantly.
3. Watch videos.
4. Fast talker learner.
5. Use colored highlighters to color code texts and notes.
6. Use maps, charts, diagrams, PowerPoint and lists.
7. Watch audiovisuals.
8. Take photographs.
9. Use flashcards.
10. Use notebooks.
11. Watch instructor's mouth and face.
12. Use visual chains or mnemonics.
13. See parts of words.

Auditory learning style

People who prefer using sound (obviously), rhythms, music, recordings, clever rhymes, and so on. How to identify the learners who learn by auditory learning style?



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1. Like to talk and talk to self.
2. Lose concentration easily.
3. Prefer spoken directions into written direction.
4. Prefer lecture and discussion method.
5. Prefer verbal praise from teacher.
6. Record lecture for repeated listening.
7. Use rhymes to help memories.
8. Read loudly and listen carefully.
9. Listen recorded material while go to study.
10. With new processes, Talk about what to do, how to do it and why it's done that way.

Verbal learning style

The verbal learner is someone who prefers using words, both in speech and in writing to assist in their learning. They make the most of word based techniques, scripting, and reading content aloud. How to identify the learners who learn by Verbal learning style?

1. Use mnemonics.
2. Work in group.
3. Sharing more ideas to other both in written as well as verbal
4. Difficulty in chart, map reading.
5. Ability to quickly and accurately respond.
6. Careers in politics, writing and speaking.
7. Feel enjoy in writing and speaking.

Logical learning style

The people who prefer using logic, reasoning, and “systems” to explain or understand concepts. They aim to understand the reasons behind the learning, and have a good ability to understand the bigger picture. How to identify the learners who learn by logical learning style?

1. Analysis of cause & effect relationship.
2. Give logical, clearest explanations.
3. Provide information through bullet point, to do list.
4. Give students a chance to think strategically.
5. Strong visual analysis, problem solving skill.
6. Most of time spend in study of Maths & Science technology.
7. Find careers engineers scientists mathematicians and detectives.

Social learning style

These people are the ones who enjoy learning in groups or with other people, and aim to work with others as much as possible. How to identify the learners who learn by social learning style?

1. Share stories & compare own ideas with other.
2. Present opportunities for student to work & learn from groups of other.
3. Careers in teaching scales and counselling.
4. Develop small study group & peers to peer tutoring session.
5. They enjoy organizing events, people & groups.
6. Understand other people & resolving conflicts.
7. Difficult doing in work alone.
8. Their strength lies with communicating.
9. They enjoy activities like speech, drama debate.
10. They enjoy taking leadership roles & participating in group.
11. Prefer learning through interpersonal communication & interaction.
12. Learner love to interact with peers & friends.



**Sneh Devi and Kiran****Solitary learning style**

The solitary learner prefers to learn alone and through self-study. How to identify the learners who learn by solitary learning style?

1. More private, Introspective.
2. Motivated by internal force.
3. Spend more of time alone.
4. Find ways to allow these students to study quietly and free of distractions.
5. Work independently.
6. Careers in data analysis research, security.

Kinesthetic learning style

These are the “learn by doing” people that use their body to assist in their learning. Drawing diagrams, using physical objects or role playing are all Strategies of the Physical learner. How to identify the learner who learns by kinesthetic learning style?

1. Study in short block of time.
2. Walk or move while reviewing your notes.
3. Scientific in nature.
4. Doing.
5. Participating.
6. Experiences.
7. Field trips.
8. Models.
9. Movement.
10. Visit a location.
11. Work in group.
12. Make a game.
13. Role play in class.
14. Comfortable activities.
15. Hands on problem solving.
16. Multiple choices.
17. Long written tests.
18. Don't like long lectures.
19. Do creative work.

JUSTIFICATION OF THE STUDY

As the investigator start his writing with great thought of Franklin D.Roosevelt “we cannot always build the future for our youth, but we can build our youth for the future”, it indicates any study which may directly or indirectly concerned with the problems of individual and able to contribute something for the development of their future is worthy. It is believed that learning style plays an important role to permanent change in behaviour of individual and helps to achieve the success in life. Learning styles are not really concerned with “what” learners learn, but rather “how” they prefer to learn and it is important factor for students’ academic achievements and attitudes. While every individual is unique and learning styles differ from one individual to another. Problems of learning are becoming serious and increase day by day with increasing rate of competition. It brings challenges in every parts of life. Damavandi et al.(2011) in their study found that there was a statistically significant difference in the academic achievement of the Iranian students that correspond to the four learning styles i.e. VARK. Beyza(2012) in his study determined there was no effect of some personal characteristics such as age, gender of the secondary school students on their learning styles. Alade and Ogbo(2014) founded in their study that there was significant relationship between learning style preferences of students and their performance in both public and private schools and visual learning style was the prominent preference among students in both school. Karalliyadda (2017) investigated that there was no significant relationship between learning styles and academic performance and he also founded that students of



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agriculture more interested in kinesthetic learning style. There are many research studies conducted on learning style with relation to the gender, academic achievement, academic motivation and other dimension but very few studies conducted on students' learning style towards their academic performance of different discipline (Science, social sciences and Language) but few studies carried on seven different learning styles in Jammu and Kashmir. This study is helpful in bringing a positive change in behaviour of students, bring new innovations in the classroom and also helpful for teachers to improve the academic performance of the students according to their learning style. Hence the studies of students' learning style towards their academic performance of different discipline (Science, social sciences and language) gain its own importance.

RESEARCH QUESTIONS OF THE STUDY

1. Is there any relation between learning style and academic excellence?
2. Whether the nature of discipline compliments nature of learning style for Academic excellence?

STATEMENT OF THE PROBLEM

In the light of above discussion on different Learning style and other related dimensions, the investigator undertook the problem which is stated as under: A STUDY OF LEARNING STYLE AND ACADEMIC PERFORMANCE OF PG STUDENTS OF CENTRAL UNIVERSITY OF JAMMU

OPERATIONAL DEFINITION OF KEY TERMS USED

Student: In this study, Student refers to one who is enrolled or attends classes in the central university of Jammu.

Learning Style: Learning style refers to the way or pattern of student who learn from the style of auditory, visual, logical, kinesthetic, solitary, verbal and social.

Academic performance

Academic performance is the extent to which a student has achieved their short or long-term educational goals.

OBJECTIVES OF THE STUDY

1. To identify the differences in learning style of students with respect to their discipline of the study.
2. To find out the prominent learning style on the basis of academic performance of students with respect to their discipline of the study.
3. To suggest measures for enhancement of academic performance of the students belong to different discipline on the basis of finding of the research.

DELIMITATIONS OF THE STUDY

1. The present study has been delimited to Samba district only.
2. The present study has been delimited to Students of Central University of Jammu only.

RESEARCH METHOD

Descriptive exploratory research method was adopted for the present study.

POPULATION OF THE STUDY

In the present study, the population constituted of all the students who were in 3rd semester of their Post graduate degrees in Science, Social Sciences and Languages in Central University of Jammu.

SAMPLING**SAMPLING TECHNIQUES**

The investigator used random sampling for selection of the sample in the present study.



**Sneh Devi and Kiran****SAMPLING PROCEDURES**

Total three Departments, one each from the three Departments providing P.G. degree in Science subjects, three departments providing P.G. degree in Social Sciences subjects and two department providing P.G.degree in Languages were selected randomly through lottery method for data collection. The following table provides detailed description of the sample for the present study. Number of students constituting the final sample in the above table2 represents the students who were present in their classes when the investigator went for data collection in the respective Departments.

TOOL AND TECHNIQUES FOR DATA COLLECTION

For each and every type of research the investigator needs certain instruments. The instruments thus employed are called tools. The selection of suitable tools is of vital importance for successful research. Different tools are suitable for collecting various kinds of information for various purposes. Selection of tool for data collection depends upon the nature of the problem undertaken. For the present study, the tool was self constructed by the investigator on the advice and consultation of Supervisor.

DEVELOPMENT OF TOOL

The description of self constructed opinionnaire tool is as under-

Steps taken for the construction of Opinionnaire

The following steps were taken by the investigator during the construction of a opinionnaire:

1. Decide what information is required
2. Make a rough listing of the statements
3. Refine the statements phrasing
4. Develop the response format
5. Put the statements into an appropriate sequence
6. Finalise the layout of the opinionnaire
7. Pre-test and revise

Validation of Tool

After the tool was constructed, the investigator established the validity of the tool. For this, the draft of tool was circulated amongst the peers, scholars, subject experts and language experts for acquiring their suggestions. They suggested number of changes in the tool and on the basis of their suggestions some items were modified, some items are deleted and some new items were incorporated in the tool.

ADMINISTRATION OF THE TOOL

The investigator visited the selected departments personally for the collection of data, pertaining to her problem. The investigator approached the teachers and explained to them the nature and purpose of the investigation. They were kind enough to permit the investigator. The investigator also assured the students that their responses would be kept confidential and utilised only for research purpose, so they should try to be an honest and sincere in responding to each question. After giving the proper instruction and guidelines to every student. The investigator distributed the opinionnaire to the students and explained to each items. At the end when the students filled their responses in the opinionnaire then the investigator taken back the opinionnaire from the students. In this way, the investigator collected the data from the students required for her research work.

SCORING OF THE TOOL

The Opinionnaire of learning style consists of 21 statements which is based on seven different learning styles and each items followed by 5 possible answers. For statements the scoring is 5, 4, 3, 2, 1, for strongly agree, agree, neutral, disagree and strongly disagree respectively. It means that maximum scoring is awarded to expressing the usage of type of learning style.



**Sneh Devi and Kiran****DATA ANALYSIS TECHNIQUES**

The present investigation employed following techniques:

- Frequency
- Mean

Table 3 exhibited the learning style-wise categorization of academic performance scores of the thirty (30) PG students of Science discipline. As emerged from the analysis of the data obtained, logical learning style had been emerged to be the prominent learning style among the students of science discipline as out of thirty (30) students eight (8) students belonged to this style of learning. The mean value (381.1) of the academic performance scores for the logical learning style also closely approximate the overall mean (404) for science discipline. Thus, not only the number of the students who fell under the logical learning style was high, the students belonging to this learning style are also excelling academically as indicated by the mean score for this category. Besides logical learning style; visual and verbal learning style were also found to be close to logical learning style on grounds of number of students falling under these learning styles six in each stylistic category and the mean score of academic performance of the students under these two categories. The mean score for visual learning style is 395 which is even higher than the mean score of logical learning style and is closer to the overall mean score (404) of academic performance. The data obtained thus, clearly shows that the student who persuade science discipline mainly prominently belong to three kinds of learning styles i.e. logical learning style, visual learning style and verbal learning style. Other kinds of learning style i.e. kinnesthetic, auditory, solitary and social learning were found to be less prominent amongst the students pursuing Science subjects at PG level. The reason may be Science as subject/discipline demands students' indulgence in having hands on experiences through experimentation, use of demonstration, graph, chart and creative projects etc. for learning. Moreover, it's the nature of Science which seeks logic and reason to be the foundation of better learning. Science students have ability to solve the problem and find out the reason, keen observation analysis of cause and effects relationships.

Table 4 exhibited the learning style-wise categorization of academic performance scores of the thirty (30) PG students of Social Science discipline. As evident from the table, visual learning style had been emerged to be the prominent learning style among the students of Social Science discipline as out of thirty (30) students twelve (12) students belonged to this style of learning. The mean value (420) of the academic performance scores for the visual learning style also higher than the overall mean (409.13) for the Social Science discipline. Thus, not only the number of the students who fell under the visual learning style was high, the students belonging to this learning style are also excelling academically as indicated by the mean score for this category. The highest scorer of the discipline also fell in the category of visual learning style. Beside visual learning style; logical and social learning style were also found to be approximately close to visual learning style whereas the seven students falling under logical learning style and five students falling under social stylistic category. The mean score for logical learning style 402.8 and social learning style (395.6) which is even approximately nearest to the mean score of visual learning style and is closer to the overall mean score (409.13) of academic performance. Thus the data obtained clearly shows that the student who persuade Social Science discipline prominently belong to three kinds of learning styles i.e. visual learning style, logical learning style and social learning style. Other kinds of learning style i.e. solitary, verbal and auditory learning were found to be less prominent amongst the students pursuing Social Science subjects at PG level. In addition to this, no students were found to be adapted kinnesthetic style of learning. The reason may be Social Science as subject/discipline which helps to aware the human relationships with socio-cultural environment such as economical behaviour, common cultural behaviour, traditions, political behaviour and religious faith and also help to aware the students how to develop the society as well as the world. The students of Social sciences have ability to solve problem in the real world as creative thinking practice to see things around in various perspective in sequential way.

Table 5 revealed that the learning style-wise categorization of academic performance scores of the thirty (30) PG students of Languages as subject/discipline. On analyzing the data obtained from the students, visual learning style had been emerged to be the prominent learning style among the students of Languages as out of thirty (30) students; nine (9) students belonged to this style of learning. The mean value (306.1) of the academic performance scores for the visual learning style also closely approximate the overall mean (307.46) for discipline of Languages. Thus, not



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only the number of the students who fell under the visual learning style was high, the students belonging to this learning style are also excelling academically as indicated by the mean score for this category. From this table, Logical learning style also found to be close the visual learning style because eight students falling under this style and its mean score(304.7) of academic performance of the students is nearest to the mean score of visual learning style. While the mean score for verbal learning style (317) which is highest to the mean score of visual learning style and is uppermost to the overall mean score (307.46) of academic performance of students of Languages. In addition to this, no students were found to be adapted kinesthetic style of learning. Thus, the data obtained clearly illustrates that the student who persuade the discipline of Languages prominently belong to three kinds of learning styles i.e. visual learning style, logical learning style and verbal learning style. Even as the other kinds of learning style i.e. solitary, social and auditory learning were found to be less prominent amongst the students pursuing the discipline of languages at PG level. The reason may be language as subject/discipline emphasis on reading and writing, lectures, Keen observation, creative thinking (concept formation, creative hypothesis formulation, strengthened capacity to identify, understand and solve problem), good communication skills, grasp the beauty of nature and imaginative thinking, doing work in systematic way.

Table 6 demonstrated the learning style-wise categorization of academic performance scores of the ninety (90) PG students of Discipline of Science, Social Sciences and Languages. As emerged from the analysis of the data obtained, comparison of all seven learning styles of three discipline the overall mean value score of Social Sciences is 409.13 and overall mean value score of Science is 404 which is utmost from total mean value score 357.03. The calculated mean value score of language is 307.46 which is approximately least than total mean value score 357.03. The obtained data clearly shows that the students who persuade the discipline of Science and Languages prominently belong to three kinds of learning styles i.e. visual learning style, logical learning style and verbal learning style. Besides these disciplines, the students of Social Sciences discipline prefer to learn by visual learning style, logical learning style and social learning style. The number of students fallen under visual learning style (27), logical learning style (23), (15) students came under verbal learning style and social learning style prefer (9) students as compare to the other style of learning. As per the table, the least number of students were found to be adapted kinesthetic style of learning in overall the disciplines. This table shows that Visual learning style is the most prominent learning style across over all the disciplines. The findings of the study was in agreement with the study of Alade and Ogbo (2014) whereas the present study disagreement with Damavandi et al. (2011), Beyza (2012), Karalliyadda (2017) and Alkooheji and Hattami(2018).

MAIN FINDINGS OF THE STUDY

The main finding revealed that there is the difference in learning style of students with respect to their discipline of the study. The finding revealed that Visual learning style is the most prominent learning style on the basis of academic performance of students with respect to their discipline of the study.

EDUCATIONAL IMPLICATIONS OF THE STUDY

1. The finding of the study revealed that there is a significant difference in learning style of students with respect to their discipline of the study. The study reveals that students of all disciplines prefer to learn by different styles of learning. So, the teacher should engage students in inquiry by providing opportunities to experiment, analyze information critically, make assumptions and solve problems both individually and in groups.
2. The finding of the study revealed that visual learning style is the most prominent learning style. The teachers must address each learning style in their teaching to increase positive attitude of the students toward the teaching and learning process.
3. Teacher should give the task of assignment on the basis of different teaching learning styles like video-lecture, problem-solving, role playing, drama, skit, poetry.
4. Teachers must address to learning style of students for fostering the individual differences.
5. Being aware of their learning style, the students may contribute to their academic success by promoting self-awareness.





LIMITATIONS OF THE STUDY

1. In this study, only academic performance of post graduate students were used which make the results limited.
2. Background information of students' was not consulted during measuring their learning styles.
3. Teachers' teaching styles were not explored which is an important indicator of students' learning styles.
4. Only one subject from each disciplines were included as sample therefore, the results cannot be generalized to the students of other disciplines and area.
5. Descriptive exploratory research method were employed in this study, the results can be generalised by other research method.

CONCLUSION

On the above discussion, the investigator concluded that in modern society everyone wants to become the best and learns in different way that best suit his/her learning needs and they use different styles for learning which enables them to be successful at their academic career. Teachers may using multiple modes of teaching learning styles domain in enhancing the academic achievement. This may require moving their modes of teaching and learn to use a variety of styles, which will positively affect learning. By utilizing a variety of teaching approaches, teachers will reach more students because of the better match between teacher and learner styles.

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Table 1: Sampling Frame

Sr. No.	Discipline	Departments running in P.G programme	No. of students (3 rd semester)
1.	Science	Environmental Science	39
		Nano science	8
		Mathematics	
2.	Social Sciences	Educational studies	40
		National Security Studies	13
		Social Work	17
3.	Languages	English	32
		Hindi	20





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Table 2- Sample Description

Sr. No.	Discipline	Department selected for sampling	No. of students constituting final sample
1.	Science	Environmental Science	30
2.	Social Sciences	Educational Studies	30
3.	Languages	English	30
Total			90

Table 3: Learning Style wise categorization of Academic Performance Score of the Students of Science discipline

	Sr.NO.	Learning Styles						
		Auditory	Visual	Logical	Verbal	Social	Solitary	Kinnesthetic
Performance Scores	1	413	428	427	412	400	396	356
	2	378	409	412	385	340	384	-
	3	356	401	388	385	-	379	-
	4	355	398	383	360	-	-	-
	5	-	389	371	344	-	-	-
	6	-	345	369	343	-	-	-
	7	-	-	363	-	-	--	-
	8	-	-	336	-	-	-	-
Mean Scores		375.5	395	381.1	371.5	370	386.3	356
Overall Mean Score (N₁ = 30)		404						

Table 4: Learning Style wise categorization of Academic Performance Score of the Students of Social Science

	Sr. NO.	Learning Styles						
		Auditory	Visual	Logical	Verbal	Social	Solitary	Kinnesthetic
Performance Scores	1	408	449	432	423	433	413	-
	2	-	438	418	413	401	-	-
	3	-	434	407	411	387	-	-
	4	-	434	401	400	381	-	-
	5	-	428	399	-	376	-	--
	6	-	425	395	-	-	-	-
	7	-	418	368	-	-	-	-
	8	-	418	-	-	--	-	-
	9	-	413	-	-	-	-	-
	10	-	407	-	-	--	-	--
	11	-	394	-	-	-	-	-
	12	-	383	-	-	-	-	-
Mean Scores		408	420	402.8	411.7	395.6	413	-
Overall Mean Score (N₂ = 30)		409.13						





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Table 5 : Learning Style wise categorization of Academic Performance Score of the Students of Languages

	Sr.No.	Learning Styles						
		Auditory	Visual	Logical	Verbal	Social	Solitary	Kinnesthetic
Performance Scores	1	326	369	370	345	295	331	-
	2	309	311	324	332	285	313	-
	3	309	309	301	311	-	278	-
	4	-	304	300	310	-	-	-
	5	-	302	288	287	-	-	-
	6	-	295	288	-	-	-	-
	7	-	293	284	-	-	-	-
	8	-	287	283	--	-	-	-
	9	-	285	-	-	-	-	-
Mean scores		314.6	306.1	304.7	317	290	307.3	-

Table 6: Learning Style wise categorization of Academic Performance Score of the Students of Discipline of Science, Social Sciences and Languages

Discipline	Learning styles							Overall Mean score	Total mean score of 90 students
	Auditory	Visual	Logical	Verbal	Social	Solitary	Kinnesthetic		
Mean score of Science	375.5	395	381.1	371.5	370	386.3	356	404	357.03
Mean score of Social Sciences	408	420	402.8	411.7	395.6	413	-	409.13	
Mean score of Languages	314.6	306.1	304.7	317	290	307.3	-	307.46	
No. of students	8	27	23	15	9	7	1	-	

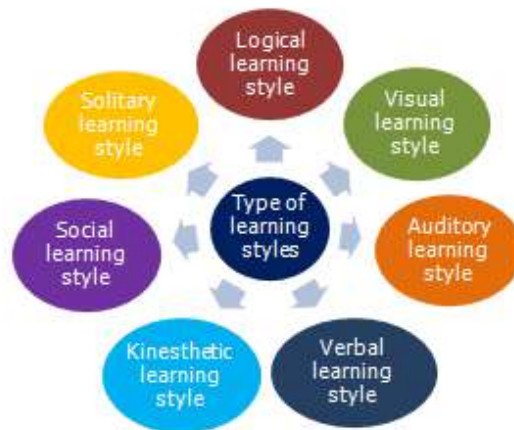


Figure 1: Type of learning Styles





Biochemical and Molecular Characterization of Ahu and Bao Rice Varieties of Majuli District

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ABSTRACT

The agricultural area of North East India contains a vast amount of rice varieties that have potential for providing mineral nutrients as well as carbohydrate. However, the exploration of these mineral infused varieties require attention as several natural varieties are neglected due to the preference of high yielding cultivars among commercial farmers. In this paper some pigmented varieties of rice were analyzed for their mineral nutrition and their genetic diversity is determined with ISSR. Varieties exhibit presence of Zinc and Iron in the analysis.

Keywords: Rice, minerals, Amylose, Zinc, Manganese, Iron, Copper, ISSR, *Oryza sp*

INTRODUCTION

Rice is a major staple food and a mainstay for the rural population and their food security. It is the second most cultivated cereal crop worldwide and is central to the lives of billions of people around the world [1]. Rice belongs to the family Poaceae and Asian rice cultivars are broadly classified into major subspecies *i.e.* *Oryza sativa japonica* and *Oryza sativa indica* [2]. In addition to these major varieties, the minor groups include Aus cultivars of India and Bangladesh, Ashinas varieties of Bangladesh and aromatic basmati varieties of India [3]. Rice varieties show extensive genotypic and phenotypic diversity, resulting in about 120,000 different accessions worldwide [4]. Considerable morphological, ecological and physiological variations exist within each varietal subpopulation owing to selection for adaptations to different agro-climatic conditions [4]. These accessions range from traditional rice landraces preserved by indigenous farmers to the commercially bred cultivars developed during the green





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revolution. Each landrace has particular characteristics; early maturity, adaptation to particular soil types, resistance or tolerance to biotic and abiotic stresses, and in the expected end usage of the grains. India is home to many such landraces and the ones from the states of North Eastern region of the country are especially diverse morphologically and genetically, and are worthy candidates for detailed examination [5]. India is the centre of origin of rice with a total of 88,681 different variety of rice. Studies have shown that, India comprises of 55,615 rice landraces of which 1,171 are wild races and 32,895 are other varieties [6]. Assam alone comprises about 6000 different landraces, which needs to be well characterized for their properties as well as to preserve intellectual property right. Rice is cultivated here on over 65 per cent area under agricultural crops in three different seasons viz., Aus (autumn rice), Aman (winter rice) and Boro (summer rice) [7]. Rice growing areas of north-eastern India were rich in traditional landraces of which many were reported to be tolerant to biotic stress against various pests (gall midge, stem borer, green leaf hopper) and diseases (blast, bacterial leaf blight, rice tungrovirus, bacterial leaf streak) [8] [9] [10] [11]. The pigmented rice cultivars analysed in the present study appear to be a good source of phytochemicals like anthocyanin, phenol, flavonoid and found to have antioxidant activity [12]. Rice is a extensively used material for research purpose however, in Assam detailed study of the rice varieties is a necessity as well as it is fascinating to gather knowledge from local people. It is an vast area for ethnobotany and genetic diversity analysis.

MATERIALS AND METHODS

Collection of seed

Rice varieties were collected from farmers' fields of Majuli district of Assam during 2020-2021. After collection, seeds were dried, kept in separate zip lock bags, and stored in desiccators. During the study, collected seeds of different rice varieties were photographed using a Nikon D7100 digital single lens reflex camera (DSLR) equipped with Tamron 90 mm f/2.8 macro (reproduction ratio of 1:1) lens. For documentation of the size, seeds were photographed along with an OMEGA cm scale. Eight quantitative characters were selected for the present study. The characters include quantitative measurement of seed with husk (termed as seed) and without husk (termed as grain). The traits considered are seed length, seed breadth, seed weight, grain length, grain breadth and grain weight. The length and breadth parameters were recorded using a digital side calliper (Model No: 15-077-958, make Fisher Scientific). The weight parameter was recorded using an electronic balance (Model RS 232, make KERNals, Germany). For each of the variable ten replications were made.

Quantification of Amylose, Zinc, Manganese, Iron and Copper content

Amylose content was determined by the method described by [13]. The mineral solution was prepared according to the method described by [14]. The results were expressed in mg/100g.

Statistical Analysis to identify core groups for seed characteristics

For each of the rice varieties, the variables were finally represented as mean \pm standard error (SE). To find the mean of the replicated data, following formula was used.

$$\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n}$$

SEM was estimated by the sample estimate of the population standard deviation (sample standard deviation) divided by the square root of the sample size (assuming statistical independence of the values in the sample).

$$SE_{\bar{x}} = \frac{s}{\sqrt{n}}$$





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To find the core clusters of collected rice varieties, using the same set of data, principal component analysis (PCA) and hierarchical clustering was constructed. All the calculations were made by using the statistical software package “Statistical Package for the Social Sciences (SPSS)” (IBM SPSS Statistics or simply SPSS).

EXPERIMENTAL FINDINGS AND DISCUSSIONS

During the study period, a total of 6 rice landraces were collected from the study area Majuli. The races were Ixjoy Ahu, Kola Ahu, Ronga Ahu, Kola amona Bao, Kekoa Bao and Kola Bao. The colour and texture characteristics of the collected rice varieties were recorded. It was found that the varieties have considerable variation for the characteristics under the study. It has been reported that coloured rice varieties are rich in total phenolics, flavonoid and antioxidant contents [15]. Therefore, this record will be of future research interest. The work on quantitative characters exhibit Ronga Ahu rice had the smallest seed length to breadth ratio (1.988 ± 0.06). On the other hand, Kola Ahu (2.839 ± 0.02) and Kekoa Bao (2.283 ± 0.29) have the highest seed length to breadth ratio. Characterization for amylase content revealed that Ixjoy Ahu has the highest Amylose content followed by Amona Bao (20.683 ± 1.49) and Kola Amona Bao (20.683 ± 1.49). Kola Ahu (13.549 ± 0.86) has the lowest amylase content. Characterization for zinc content showed that Kekoa Bao had the highest zinc content followed by Kola Ahu (1.720 ± 0.44) and Ronga Ahu (1.170 ± 0.06). For Manganese, Kola Ahu (1.160 ± 0.05) and Ronga Ahu (1.490 ± 0.06) showed the highest values whereas, the Kekoa Bao has the lowest Mn Content (0.560 ± 0.04).

Iron (Fe) is another micronutrient essential for human growth and development. Quantification for iron content revealed that, Ixjoy Ahu has the highest seed Fe content of 1.449 ± 0.05 (mg/100g). Quantitative characteristics for rice seed has a great importance in determining the total weight of rice *vis a vis* production/hectare of land. Therefore, identification of core groups of local rice varieties for seed length can have a great importance for considering these varieties as sources of genetic material for new improved varieties. During this study, for the quantitative character rice seed length, nine sub groups could be identified. To incorporate into breeding experiments, these genotypes can be of substantial importance. Cluster analysis (UPGMA) was generated by computing both polymorphic as well as monomorphic markers to construct the dendrogram. All the clusters could be grouped as one major cluster and one minor cluster. It was found that Kokua Bao and Amona Bao formed a minor cluster by forming a separate group. The major cluster comprised of Kola Amona Bao, Ronga Ahu, Ixjoy Ahu and Kola Ahu. In the major cluster, Ronga Ahu, Ixjoy Ahu and Kola Ahu emerged as sister groups from Kola Amona Bao.

CONCLUSION

From the biochemical results Zinc and Iron content of the rice varieties were confirmed. These varieties can serve as nutritious food for Zinc and Iron deficient people. These rice varieties will be of great importance as they can be used for fabrication of rice based food industry. Coloured rice varieties are also important source of antioxidants and several other micro and macronutrient supplements of human diet. The findings of this research work contributed towards documentation of coloured rice varieties of two different regions of Assam, which can be further utilized for studies related to nutritional supplementation for the people suffering from malnutrition.

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Table 1: Variation of quantitative characteristics of the rice seeds among the collected varieties

N o.	Coloured Varieties	Length (mm) ±SD	Breadth (mm) ±SD	L/B ratio± SD	Amylose (g) ±SD	Zn (mg/100g) ±SD	Mn (mg/100g) ±SD	Fe (mg/100g) ±SD	Cu (mg/100g) ±SD
1	Ixojoy Ahu	5.267±0.3 0	2.533±0.0 5	2.078± 0.07	25.673±3. 17	1.439±0.2 7	1.109±0.2 9	1.449±0.0 5	0.763±0.1 7
2	Kola Ahu	5.867±0.1 5	2.067±0.0 5	2.839± 0.02	13.549±0. 86	1.720±0.4 4	1.160±0.0 5	0.282±0.1 3	0.477±0.0 4
3	Ronga Ahu	4.833±0.1 5	2.433±0.1 1	1.988± 0.06	18.576±0. 59	1.170±0.0 6	1.490±0.0 6	0.824±0.1 4	0.678±0.1 0





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4	Amona	5.800±0.3	2.633±0.1	2.206±	20.683±1.	1.218±0.4	1.016±0.1	0.855±0.3	0.566±0.0
	Bao	0	5	0.14	49	6	3	4	9
5	Kekoa	5.933±0.7	2.600±0.1	2.283±	19.866±0.	1.858±0.1	0.560±0.0	0.299±0.0	0.431±0.1
	Bao	5	0	0.29	51	4	4	7	1
6	Kola	5.800±0.3	2.633±0.1	2.206±	20.683±1.	1.218±0.4	1.016±0.1	0.855±0.3	0.566±0.0
	Amona								
	Bao								

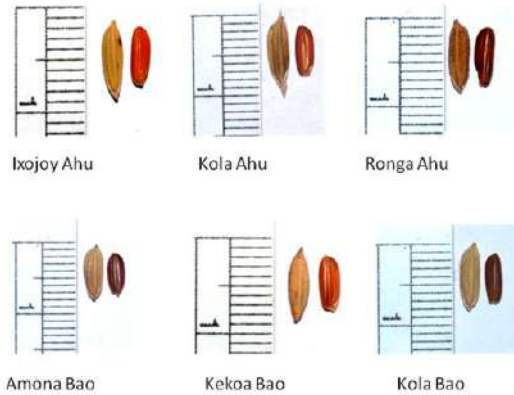


Figure 1: Satellite imagery of the location under study

Plate 1: Photographic documentation of the collected rice varieties of Assam

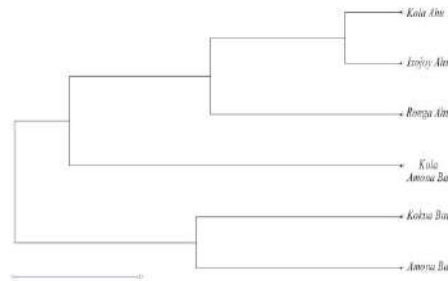


Figure 2: Genetic Distance based hierarchical cluster (UPGMA tree) showing the relationship between the collected genotypes of different varieties of rice.





Analysing Disaster Risk Reduction Approach And Opportunities for Enhanced Relations In The Indian Ocean - An Analytical Study of India's Soft Power Dynamics In The Region

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ABSTRACT

The paper presents a comprehensive analysis of India's approach to disaster risk reduction (DRR) in the Indian Ocean region, examining the associated opportunities for strengthening diplomatic ties. The study delves into the nuanced dimensions of India's soft power dynamics within the context of DRR initiatives. By scrutinizing India's engagement with disaster-prone areas in the Indian Ocean, the research explores how the nation's humanitarian efforts contribute to enhanced regional relations. The analysis encompasses India's involvement in international humanitarian organizations, its financial commitments, and the strategic allocation of resources for DRR. By shedding light on India's soft power influence in the context of disaster management, this study aims to provide valuable insights into the potential for strengthened diplomatic relationships in the Indian Ocean region.

Keywords: Indian Ocean, Disaster Risk Reduction, Soft Power, India, Regional Cooperation, Development, Disaster Management

INTRODUCTION

Historically, Western nations have traditionally taken the lead in disaster relief efforts. Nevertheless, the growing influence of countries in the Global South, such as India, has led to the development of dual strategies in disaster management. This involves enhancing domestic capabilities while also becoming an emerging donor that actively contributes to disaster relief efforts, particularly in the Indian Ocean Region. The Indian Ocean Region (IOR) is often referred to as the "World's Hazard Belt" due to its susceptibility to various disasters, whether natural or human-



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induced ("Disaster Risk Management – Indian Ocean Rim Association – IORA," n.d.) . Natural disasters in the form of Climatological events (such as cyclones and droughts), Geological and Tectonic occurrences (such as earthquakes and tsunamis), and Hydrological incidents (including floods and tidal surges) are frequent and recurring phenomena in this area. The Indian Ocean basin is indeed a hot spot for natural disasters, and the reasons behind it are a fascinating blend of geographical, geological, and climatic factors. The various reasons for the disasters in the region can be given as :

Tectonic Activity

Plate Convergence The Indian Ocean sits at the crossroads of three major tectonic plates – the African, Indian, and Antarctic plates. Their constant movement along convergent boundaries often triggers:

Earthquakes The subduction of the Indian plate beneath the Eurasian plate along the Sunda Megathrust generates frequent earthquakes, some strong enough to trigger tsunamis.

Volcanic Eruptions The collision of plates also fuels volcanic activity along island chains like Indonesia and the Maldives.

Warm Ocean Waters

Tropical Climate The Indian Ocean lies predominantly within the tropics, bathed by warm sunshine and receiving ample rainfall. This warm water acts as a breeding ground for powerful:

Tropical Cyclones The Coriolis force and high sea surface temperatures (SSTs) fuel intense cyclonic storms like hurricanes and typhoons, especially during the monsoon season.

Tsunamis Underwater earthquakes or landslides in the ocean floor can trigger tsunamis, sending devastating waves towards the coasts.

Monsoonal Influences

Seasonal Wind Reversals The Indian Ocean experiences dramatic seasonal wind reversals known as monsoons. These strong winds bring torrential rains, leading to:

Floods Low-lying coastal areas and river basins are particularly vulnerable to flash floods and inundation during the monsoon months.

Landslides In mountainous regions, heavy rainfall can trigger landslides, causing infrastructure damage and loss of life.

Climate Change

Rising Sea Levels Global warming is causing sea levels to rise, threatening coastal communities with:

Erosion Increased wave action and rising water levels erode coastlines, displacing communities and damaging infrastructure.

Salinization Intrusion of saltwater into freshwater sources and agricultural land can render them unusable.

Vulnerability of Coastal Communities

Dense Populations Many countries bordering the Indian Ocean are densely populated, with millions living in close proximity to the coast. This increases the risk of human casualties and economic losses during natural disasters.

Limited Resources Developing nations often lack the financial and technological resources to effectively prepare for and respond to natural disasters, exacerbating their impact. Understanding these scientific reasons is crucial for mitigating the impact of natural disasters in the Indian Ocean region. By investing in early warning systems, disaster preparedness programs, and sustainable coastal development, communities can become more resilient and adapt to the ever-changing environment. It's important to remember that while the Indian Ocean faces significant natural hazards, its people have also demonstrated remarkable resilience and adaptation in the face of adversity. By understanding the science behind these events and working together, we can build a safer and more sustainable future for the region (*Sunhak Peace Prize*, n.d.).





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Rank wise Countries with disaster risks in Indian Ocean

Rank	Country	Risk
1.	Philippines	46.86
2.	Indonesia	43.50
3.	India	41.52
6.	Myanmar	36.16
7.	Mozambique	34.61
9.	Bangladesh	27.29

Source- World Risk Report 2023

Disaster management in the Indian Ocean is a complex challenge, given the region's diversity and the interconnectedness of its risks. However, there are a number of important initiatives underway to improve disaster preparedness, response, and recovery in the region. According to the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP), approximately 50% of the natural disasters in the region are attributed to climatic and seismic factors (Limo, 2014). Rapid population growth, combined with the rise in sea levels and the escalating intensity of tropical cyclones, will result in increased levels of human vulnerability and regional insecurity. By 2030, the Indian Ocean rim is expected to have the highest population density globally, with approximately 340 million people residing in coastal hazard zones. Currently, the Bay of Bengal is responsible for over 80 percent of all cyclone-related fatalities, despite experiencing only 5 percent of the world's cyclones. Additionally, the heightened frequency and intensity of heat waves will have significant repercussions for human health. India being one of the responsible country in the region, over the past twenty years, India's approach to disaster management has undergone a significant transformation. Initially reactive and focused primarily on flood and drought relief, it has evolved into a proactive and holistic strategy. This comprehensive approach now encompasses prevention, mitigation, preparedness, capacity building, risk reduction, technological advancements, community involvement, and resilience against a broader spectrum of hazards. Holistic disaster management entails the integration of disaster risk reduction (DRR) into policies, institutions, infrastructure, and logistics.

This integration aims to develop effective tools for preemptive and efficient action. India has formulated DRR policies involving input from domain experts, various levels of government, and local communities. Furthermore, the country has enhanced its response capabilities through international collaborations and coordinated risk reduction efforts at both national and local levels. Recognizing the complexity of disaster management, India emphasizes the need for well-considered policies, a robust legal framework, specialized institutions, efficient administrative mechanisms, and proactive engagement from stakeholders. The effectiveness of these elements depends on their seamless integration. The policies, institutions, and logistics of disaster management are deemed as crucial as the actual rescue equipment. They play a vital role in disaster handling, reaching remote areas, and determining the tools for effective and efficient action. The involvement of disaster management practitioners in policy design and development is equally crucial, as their expertise ensures a deep understanding of the complexities involved and optimal coordination of policies, institutions, and logistics.

METHODOLOGY

The research employs Analytical research methodology which includes literature review strategy to gather and examine pertinent academic resources, reports, peer-reviewed papers, conference presentations, and other related credible publications. A blend of online databases and academic libraries has been employed to conduct an exhaustive examination of the existing landscape. The gathered information has been analysed through thematic analysis.





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Objectives

The study analyzes disaster risk reduction (DRR) approaches and opportunities for enhanced relations in the Indian Ocean, with a focus on India's soft power dynamics in the region, could be multifaceted and comprehensive. The objectives of the study are:

1. Evaluate the existing disaster risk reduction strategies implemented by India in the Indian Ocean region.
2. Examine the effectiveness of these strategies in mitigating and responding to disasters.
3. Explore how disaster management efforts can serve as a platform for building positive relationships with neighboring countries Identify potential opportunities for India to strengthen diplomatic ties and collaborations in disaster risk reduction within the Indian Ocean region.
4. Analyze India's participation in regional and multilateral forums focused on disaster risk reduction in the Indian Ocean.

India's Disaster Relief Initiatives in the Indian Ocean Region (IOR)

Due to its substantial size, central geographic location in the region, and borders with nearly every country in the vicinity, India holds a crucial position among its neighbors. This distinctive position, combined with its well-equipped armed forces, allows India to play a significant role in Humanitarian Aid and Disaster Relief Initiatives (Sharma, 2017). The emergence of the concept of India as a "first responder" underscores the country's readiness and capacity to take on the role of a leading power. Since 2001, India has been actively strengthening its capacity within the region, engaging with all stakeholders on an institutional level. India's approach to its neighbors has been characterized by health diplomacy and the provision of humanitarian aid during natural disasters. The country's increased financial resources and a growing sense of international and regional responsibilities have been driving forces behind these efforts. The Covid-19 pandemic took the region by surprise, posing immense challenges with lockdowns, insufficient medical infrastructure, and difficulties in ensuring social distancing. The Global Health Security (GHS) 2021 report reveals that countries across all income levels are inadequately prepared for future epidemic and pandemic threats, with South Asia performing particularly poorly. The pandemic has had a severe economic impact on the region. India's growing leadership in disaster management has strengthened its soft power and enabled opportunities to enhance relations with IOR countries. India has provided disaster relief to countries in the IOR bilaterally, including after the 2004 Indian Ocean tsunami, Cyclone Mora in Myanmar in 2017, and Cyclone Idai in Mozambique in 2019. India deployed naval ships carrying humanitarian aid and medical teams for relief operations after Cyclone Idai in Mozambique in 2019. It also sent additional ships with relief materials, medicines, food, and water. During Cyclone Diane in Madagascar in 2020, India dispatched naval ship INS Airavat carrying disaster relief stores. It also handed over relief materials and medicines to local authorities. India's relief efforts have focused on countries in its immediate neighborhood and the Indian Ocean region (Luiz de Freitas Vieira & Almeida C6, 1997)

Regional Cooperation on Disaster Management

India has provided support through multilateral channels like World Food Programme and has approved the United Nations (UN) as the principal coordinating body for disaster relief at the regional level. According to statistics from the World Risk Report 2023, India has actively engaged in regional disaster management exercises, including the South Asian Annual Disaster Management Exercise (SAADMEx) and the BIMSTEC Disaster Management Exercise. An action plan and criteria for humanitarian assistance and disaster relief in the region are also being developed by India, which holds the position of chair for Indian Ocean Rim Association (IORA) Working Group on Disaster Risk Management. Additionally, the nation is forming partnerships with the BIMSTEC Centre for Weather and Climate and IORA to improve its capabilities in disaster risk reduction. India has been a key contributor to global humanitarian efforts over the years through a number of organisations, including Caritas, the International Committee of the Red Cross (ICRC), the World Food Programme (WFP), and the Central Emergency Response Fund (CERF). With a US\$ 2.4 billion budget for direct overseas aid in the 2021–22 fiscal year, India has emerged as a prominent non-Western donor.



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Furthermore, India has extended a considerable direct credit line totaling thirty-six billion dollars to a number of other countries in support of development initiatives (Upadhyay, 2021). The South Asian Association for Regional Cooperation (SAARC) suggested in 2006 that SAARC Disaster Management Centre (SDMC), with its headquarters located in New Delhi, be established in the wake of the 2004 tsunami. A disaster management framework that is in line with the Hyogo Framework for Action 2005–2015 has been accepted by the SDMC, which has also developed a number of Road Maps that cover many disaster management topics. SAARC leaders are still unable to agree on the establishment of a fast response team specifically for disaster management in spite of their best efforts. India has been a key contributor to the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) countries. These countries frequently experience cyclones and tsunamis, necessitating cooperative approaches to risk mitigation and crisis management. India has been concentrating on "Environment and Disaster Management" in the region since 2015. This is in line with its foreign policy goal of improving connectivity with neighbouring states by working together on Humanitarian Assistance and Disaster Relief (HADR). Additional HADR-related collaborations within BIMSTEC have been made possible by India's maritime cooperation policy, Security and Growth for All in the Region (SAGAR).

All seven of the member states of BIMSTEC participated in the first Disaster Management Exercise (DMEx), which took place in October 2017. It included a Table Top Exercise (TTX), Field Training Exercises (FTXs) on earthquake and flood, and an After Action Review (AAR). In February 2020, there were simulated flood-related situations at the second BIMSTEC DMEx, which involved participants from five member nations. Along with holding a workshop on building disaster-warning systems, BIMSTEC also launched a Centre for Weather and Climate in 2018 (Upadhyay, 2021). India regularly participates in the Indian Ocean Rim Association (IORA), a founding member organisation whose objective includes disaster risk management. The association's mission is to strengthen institutions and capacities while encouraging collaboration and coordination amongst authorities, professionals, and stakeholders in the area. With the aim of giving member states a clear road map for forming an IORA-Working Group on Disaster Risk Management (WGDRM), the first IORA Expert Group Meeting on disaster risk management took place in 2021. In a similar vein, India organised the Indian Ocean Naval Symposium with a focus on regional collaboration in disaster relief and humanitarian assistance (HADR).

India's disaster management approach is implemented through a variety of mechanisms, including:***India's Vision of SAGAR and Focus on Capacity Building***

India's approach to disaster management in the IOR is guided by its vision of SAGAR - Security and Growth for All in the Region. It focuses on developing knowledge, building capacities, and enhancing cooperation to respond effectively to disasters in the region. India is encouraging partnerships between IOR countries and institutions to boost capabilities for disaster preparedness, mitigation and recovery. It aims to facilitate information exchange, training programs, system development, and sharing of best practices on disaster risk reduction. India's approach to the Indian Ocean aligns with the vision of SAGAR (Security and Growth for All in the Region). SAGAR encompasses diverse yet interconnected elements, including strengthening economic and security collaboration in coastal areas, building capabilities to protect both land and maritime territories, pursuing sustainable regional development, fostering the Blue Economy, and advocating for joint efforts to address non-traditional threats such as natural disasters, piracy, terrorism, and more. India's strategy for disaster management in the Indian Ocean is guided by the following principles:

1. **Proactive** India focuses on disaster risk reduction and preparedness, rather than just reacting to disasters after they occur. This includes identifying potential hazards, assessing vulnerabilities, and developing mitigation measures.
2. **Comprehensive** India's disaster management approach covers all phases of the disaster management cycle, including preparedness, response, recovery, and rehabilitation.
3. **Multi-sectoral** India recognizes that disaster management requires the involvement of all stakeholders, including government agencies, civil society organizations, and the private sector.





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4. **Regional** India cooperates with other countries in the Indian Ocean region to share information and best practices, and to coordinate disaster response efforts.

Strengthening India's Soft Power through Disaster Management initiatives in the Indian Ocean Region (IOR)

India's growing leadership in disaster management has strengthened its soft power and influence in the region. Its prompt response as a "first responder" has generated goodwill among Indian Ocean Region (IOR) countries. This has enabled India to emerge as a net security provider in the Indian Ocean region. It has also presented opportunities for India to forge stronger maritime security cooperation with regional countries. Overall, India's approach has allowed it to project itself as a responsible leader committed to the region's humanitarian and environmental security. India's initiatives in Humanitarian Assistance and Disaster Relief (HADR) demonstrate a determination to be a leading provider in the region. While HADR is typically a non-controversial aspect of the agenda, it serves as a tool for fostering stronger connections with neighbouring nations and reviving regional cooperation. Collaborative efforts, such as the PANEX-21 HADR exercises conducted by BIMSTEC, offer opportunities to address new challenges and refine existing relief and rescue operations. Given the increasing occurrence of large-scale disasters transcending national borders, there is a growing imperative for regional cooperation in Disaster Management. To address this need, it is crucial to establish a framework for the "One Region-One Response" policy. This approach not only encourages regional cooperation through the sharing of information, experiences, and best practices but also serves as a catalyst for the economic recovery of the entire region (Sharma, 2017). Besides, India's disaster management approach is implemented through a variety of other mechanisms, which includes:

1. *The Disaster Management Act, 2005*: This Act provides the legal framework for disaster management in India. It establishes the National Disaster Management Authority (NDMA) as the apex body for disaster management, and mandates the creation of State and District Disaster Management Authorities.
2. *The National Policy on Disaster Management, 2009*: This policy outlines India's overall approach to disaster management, with a focus on disaster risk reduction and preparedness.
3. *The Indian Ocean Rim Association (IORA)*: India is a founding member of IORA, which is a regional forum for cooperation on a range of issues, including disaster management.
4. India has also developed a number of specific disaster management initiatives for the Indian Ocean region, such as:
5. *The Indian Ocean Disaster Risk Reduction Network (IODRRN)*: This network provides a platform for disaster management experts in the Indian Ocean region to share information and best practices.
6. *The Indian Ocean Tsunami Warning System (IOTWS)*: This system provides early warnings of tsunamis to countries in the Indian Ocean region.
7. *The Indian Ocean Disaster Assistance Rapid Response Team (IDART)*: This team is deployed to provide rapid response and assistance to countries in the Indian Ocean region that are affected by disasters.
8. India's disaster management approach in the Indian Ocean has been praised by the international community. India is now recognized as a leading regional player in disaster management, and its expertise is sought by other countries in the region.

Here are some cases of India's disaster management interventions in the Indian Ocean region:

Case1 – Madagascar (2020)

Madagascar is the Indian Ocean's biggest and most populated island. It lies in the South Western Indian Ocean. Poverty, starvation, and malnourishment are just a few of the issues that Madagascar, a developing nation, deals with. Along with being susceptible to cyclones, floods, and droughts, the nation is also susceptible to other natural calamities. In January 2020, the island nation was hit by Cyclone Diane. In order to help the people of Madagascar who were impacted by the destruction caused by the cyclone, the Indian Naval Ship Airavat was redirected to Madagascar on January 26, 2020, as part of "Operation Vanilla". (Navy) The Indian Navy was the first international respondent to carry out Humanitarian Assistance and Disaster Relief (HADR) missions in the humanitarian catastrophe in Madagascar. (Defence, 2020) INS Shardul visited the Port of Antsiranana in March 2020 with 600 tonnes of rice in order to provide immediate help to the people of Madagascar affected by flooding. (Embassy of



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India, 2022) The INS Jalashwa transported 1000 metric tonnes of rice and 100,000 tablets of Hydroxychloroquine to the island nation in March 2021 to assist with the drought crisis in South Madagascar. In September 2022, humanitarian aid of 5000 metric tonnes of rice was provided by India to the storm and flood affected Madagascar. (Embassy of India, 2022)

Case 2 – Mauritius (2020)

Mauritius is an island nation in the Western Indian Ocean. Due to historical, demographic, and cultural factors, India and Mauritius have maintained close and long-standing ties. Of the 1.2 million people living on the island, individuals of Indian descent make up around 70%. (High Commission of India P. L., 2023) In July 2020, a Japanese owned ship named MV Wakashio ran aground at Pointe d'Esny on the coast of Mauritius after which the oil started leaking and caused led to the oil spill. (Khadka, 2020) The Indian government provided over 30 tonnes of technical equipment and material to Mauritius through Indian Air Force aircraft in response to the Mauritian government request for help in handling the environmental crisis. These supplies supported Mauritius's efforts to contain the oil spill and salvage it. The Indian Coast Guard (ICG) had also sent a Technical Response Team of 10 members to Mauritius in order to provide the required operational and technical support at the site. The team members were specialised in handling oil spill mitigation procedures (Ministry of External Affairs, 2020).

Case-3 Mozambique (2019)

Mozambique, an Indian Ocean coastal nation was struck by Cyclone 'Idai' in March 2019. Indian Naval ships INS Sujata and INS Shardul along with Indian Coast Guard Ship ICGS Sarathi reached Port Beira and provided necessary support to the local administration. They supply food, water, blankets, and other necessities for relief. (Navy, 2019) In addition to this, another ship INS Magar reached Mozambique with supplies for everyday needs, clothes, medications, dry goods, and ready-to-eat meals. 400 tonnes of rice and 500 kg of medicines relevant to the epidemic were also provided by the ship. (High Commission of India, 2019) Following a food scarcity brought on by natural disasters in 2017, Mozambique received \$10 million from India as humanitarian aid for food grains (Ministry of External Affairs, 2019).

Case 4 –Maldives (2014)

India and the Maldives are neighbours with a shared maritime border. Strategic, economic, and military collaboration between India and Maldives has been warm and close. India keeps helping to keep the island nation secure. India responded quickly to the Maldives' call for aid during the Male Water crisis, which broke out on December 4, 2014, as a result of a fire in the Male Water and Sewerage Company complex. Indian aircraft made several sorties to bring 375 tonnes of drinking water to the inhabitants of Male during which the first aircraft arrived in Male within 12 hours of the Maldives government's request. Additionally, two ships of Indian Navy, INS Deepak and INS Sukanya, arrived at Male and brought with them about 2000 metric tonnes of water. (Operation Neer : Indian assistance to Maldives during Male Water Crisis) India's disaster management approach in the Indian Ocean is a reflection of its commitment to being a good neighbor and a responsible global citizen. While it is evident that climate change poses a threat to the stability of the entire Indian Ocean region, scientists emphasize the need for further research to comprehensively understand the specific impacts of climate change on the region.

CONCLUSION

India has established itself as a capable first responder and net security provider in the Indian Ocean region through its bilateral and regional disaster relief efforts. Its SAGAR vision and focus on capacity building has strengthened its soft power. By leading disaster management initiatives, India has enhanced cooperation and relations with IOR countries, unlocking further opportunities for growth and security in the region. India's efforts in disaster relief have significantly expanded over the past two decades. This development can be attributed to India's emergence as an economic powerhouse, increased involvement in neighboring regions, and a strong commitment to being the





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primary responder to disasters in the area. Disaster response, generally considered uncontroversial, holds the potential to enhance diplomatic ties with neighbouring countries.

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Open and Closed Bisets in Topological Bispaces

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ABSTRACT

In this study, we define a semi open and semi closed bisets, pre-open and pre-closed bisets, obtain some of their properties. Next, we introduce the concepts of generalized closed sets in Topological bispaces, we discuss some of their properties and investigate the relations between the associated topology.

Keywords: semi-open and semi-closed bisets, pre-open and pre-closed bisets, G-star-S-closed bisets, Generalized pre-open biset [simply, GPOB].

INTRODUCTION

Let (X_B, τ) be a topological space and let $A \subseteq X$. Then the closure of A and the interior of A will be denoted by $cl(A)$ and $int(A)$ respectively. A subset A of a topological space (X_B, τ) is said to be semi-open [3] if there exists an open set U such that $U \subset A \subset cl(A)$. The complement of a semi-open set is called semi-closed [2]. On the other hand, the idea of semi-open set was introduced by Levine [3]. In 1970, Levine [3] first considered the concept of generalized closed (briefly, g-closed) sets. Generalized semi-open sets were defined. The concepts of pre-open set were given by Kelly [1] in his book *General topology*. $sCl(A) - sint(A)$ is called the semi-frontier of A [3] and is denoted by $sFr(A)$. $sInt(X - A)$ is said to be semi-exterior of A [3] and is denoted by $sExt(A)$. In this paper, we utilize the concepts of pre-open and





pre-closed bisets in topological bispace. Besides, we prove that some of its properties. Moreover, we define and study the notions of generalized closed biset, Generalized- star-s-closed bisets (briefly, G-star-s-closed bisets) Generalized pre-open Biset[Briefly, GPOB] GPOB-compact, strongly compact biset and investigate its basic property.

Preliminaries

As the preliminaries definitions, which is necessary to study [1],[5],[3],[6],[7].

Definition 2.1

Let A_B be a subbisets of a topological bispace X_B . Any point $a_B \in A_B$ is said to be interior of A_B , if a_B belong to an open bisets F_B contained in A_B .

That is, $a_B \in F_B \subset A_B$.

The set of interior points of A_B is denoted by $int(A_B)$ or A_B° , which is called the interior of A_B .

Definition 2.2

Let A_B be a subbisets of a topological bispace X_B . The closure of A_B is defined as the intersection A_B . the closure super bisets of A_B . the closure of A_B is denoted by $cl(A_B)$ or $\overline{A_B}$.

Definition 2.3

Let (X_B, τ) be a topological bispace and A_B be a subbisets of X_B and then A_B is said to be semi open bisets whenever $A_B \subseteq cl[int(A_B)]$ and semi closed whenever $cl[int(A_B)] \subseteq A_B$.

Definition 2.4

Let (X_B, τ) be a topological bispace and A_B be a subbisets of X_B , then if A_B is called pre-open biset if $A_B \subseteq cl[int(A_B)]$.

That is, a pre-open biset is a biset which is contained in interior of its closure.

The family of all pre-open biset in the topological bispace is denoted by $F[POB(X_B)]$.

Definition 2.5

A subbisets A_B of a bispace X_B is generalized preopen bisets (briefly, GPOB's) if $cl[A_B] \subseteq U_B$ whenever U_B is a pre-closed subbisets such that $A_B \subseteq U_B$. Complements of GPOB's are called generalized pre-closed bisets (briefly, GPCB's).

The collection of GPCB's in X_B are denoted by GPCBs (X_B, τ)

Definition 2.6

Let (X_B, τ) be topological bispace and $[A_B] \subseteq X_B$. Then A_B is called a pre-closed biset if $cl[int(A_B)] \subseteq A_B$.

That is, a pre-closed biset is a biset which is contains closure of its interior.

The family of all pre-closed biset in topological bispace is denoted by $F[PCB(X_B)]$.

Definition 2.7

If (X_B, τ) is a topological bispace. A subbisets of topological bispace is called Generalized closed biset [simply, GCB].

If $cl(A_B) \subseteq U_B$ whenever $A_B \subseteq U_B$ and U_B is open in X_B .

Definition 2.8

Let (X_B, τ) be a topological bispace and A_B be a subbisets of X_B and then A_B is defined as semi generalized closed bisets [simply, SGCB] whenever $scl[A_B] \subseteq U_B$ and U_B is semi-open in X_B .

Definition 2.9

Let (X_B, τ) be a topological bispace and A_B be a subbisets of X_B and then A_B is defined as

1. α –open biset whenever $A_B \subseteq int[cl[int(A_B)]]$ and α –open biset whenever $cl[int(cl(A_B))] \subseteq A_B$.
2. Semi pre-open biset whenever $A_B \subseteq int[cl[int(A_B)]]$ and semi – open closed biset whenever $int[cl(int(A_B))] \subseteq A_B$.
3. Weakly closed biset [briefly, w-closed biset] whenever $cl(A_B) \subseteq U_B$ and U_B is semi- open biset in X_B .
4. Weakly generalized closed biset [WG-closed biset] whenever $cl[int(A_B)] \subseteq U_B$ and U_B is open biset in X_B .
5. Regular open biset whenever $A_B = int[cl(A_B)]$ and Regular closed biset whenever $A_B = cl[int(A_B)]$
6. Regular α – open biset [simply, r α – open biset] whenever there is a regular open biset U_B such that $U_B \subseteq A_B \subseteq acl(U_B)$.
7. Regular semi open whenever there is a regular open biset U_B such that $U_B \subseteq A_B \subseteq cl(U_B)$.
8. Generalized α –closed biset [briefly, $G\alpha$ -closed biset] whenever $acl(A_B) \subseteq U_B$ and U_B is semi- open biset in X_B .
9. α –Generalized closed bisets [simply, αG -closed biset] whenever α – $cl(A_B) \subseteq U_B$ and U_B is open in X_B .





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10. Regular w- closed biset (simply, r w- closed biset) whenever $\alpha - cl(A_B) \subseteq U_B$ and U_B is regular semi open in X_B .

11. Strongly G – closed biset whenever $\alpha - cl(A_B) \subseteq U_B$ and U_B is G s- open biset.

The class of all G- star –s –closed bisets in a topological bispace (X_B, τ) is denoted by $G - star - s - CB(X_B, \tau)$.

The complements of the above mentioned closed sets are their respective open bisets.

Remarks 2.10

The set of real space \mathbb{R} with usual topology \mathbb{J} is always a pre-open biset.

That is $\mathbb{R} \in \mathbb{PO}$.

Definition 2.11

A subbiset A of a topological bispace (X, τ) is said to be dense biset in X if either belongs to A or else is arbitrary close to a member of A .

That is, A is dense in X if the smallest closed subbiset of X containing A is X itself.

3 Pre-open biset in topological bispace

In this section, (X, τ) is always denote topological bispace on which no separation axioms are assumed, unless otherwise mentioned. When A is a subbiset of (X_B, τ) then $cl(A_B)$ and $int(A_B)$ are denoted by closure and interior of A_B in topological bispace.

Proposition 3.1

The empty set \emptyset is always a pre- open biset in real space with the usual topological bispace

Proof

$$\text{Let } X_B = \emptyset \text{ and } cl(\emptyset) = \emptyset \text{ and } int[cl(\emptyset)] = int(\emptyset) = \emptyset$$

So that, $int[cl(\emptyset)] = \emptyset$ and $\emptyset \subseteq \emptyset$.

$$\text{Hence } X_B \subseteq int[cl(X_B)]$$

Therefore, the empty set \emptyset is always a pre- open bisets in (X_B, τ) .

Proposition 3.2

Every open biset is always a pre- open biset in the real space with the usual topological bispace.

Proof

$$\text{Let } X_B =]a, b[U1,2[$$

$$\text{Then } cl(]a, b[U1,2[) = [a, b] \cup [1,2]$$

$$int\{cl(]a, b[U1,2[)\} = int\{ [a, b] \cup [1,2]\}$$

$$=]a, b[U1,2[$$

$$int\{cl(]a, b[U1,2[)\} =]a, b[U1,2[$$

$$X_B \subseteq int\{cl(X_B)\}$$

Therefore, every open bi interval is always as pre-open biset in (X_B, τ) .

Hence Every open biset is always a pre- open biset in the real space with (X_B, τ) .

Proposition3.3

Every open biset is not a pre- open biset in the real space with the usual topological bispace.

Proof

$$\text{Let } X_B = [a, b] \cup [0,3]$$

$$\text{Then } cl([a, b] \cup [0,3]) = [a, b] \cup [0,3]$$

$$int\{cl([a, b] \cup [0,3])\} = int\{ [a, b] \cup [0,3]\}$$

$$=]a, b[U0,3[$$

$$int\{cl(]a, b[U0,3 [)\} \not\subseteq]a, b[U0,3[$$

$$X_B \not\subseteq int\{cl(X_B)\}$$

Therefore, every closed bi-interval is not a pre-open biset in the real space usual closed interval is always a closed set in real space.

Hence every, closed biset is not a pre- open biset in the real space with (X_B, τ) .

Remarks

Every half open bi interval is not a pre- open biset in the real space with (X_B, τ) .

Proposition3.4

The union of two pre- open biset in the topological bispace.

Proof

By the proposition 1, since every open intervals in the pre-open biset.





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Let $G_B = \{]a, b[U]1,2[\} \cup \{]b, c[U]2,3[\}$

We have $a < b < c$ & $1 < 2 < 3$

$= \{]a, c[U]1,3[- (\{b\}U\{2\})$

And $cl(G_B) = cl\{]a, c[U]1,3[- (\{b\}U\{2\}) \} = \{]a, c[U]1,3[\}$

and $int[cl(G_B)] = int \{]a, c[U]1,3[\} =]a, c[U]1,3[$

and $\{]a, c[U]1,3[- (\{b\}U\{2\}) \} \subseteq]a, c[U]1,3[$

hence $G_B \subseteq int [cl(G_B)]$

therefore, the union of two pre –open biset is also a pre- open biset in (X_B, τ) .

Proposition 3.5

The intersection of two pre-open biset is always pre-open biset in the topological bispac.

Proof

Same proof as above proposition (3.3).

Remarks

1. The intersection of arbitrary collection of pre-open biset is not a pre-open biset in the topological bispac.
2. The indiscrete bispac is always a pre-open biset in the topological bispac.
3. The discrete bispac is always a pre-open biset in the topological bispac.

4 G – star – s – closed biset in Topological bispac

Definition 4.1

A subbisets A_B of X_B is called a G – star – s- closed biset if $scl(A_B) \subseteq U_B$ whenever $A_B \subseteq U_B$ and U_B is G – open biset.

The class of all G – star – s- closed biset in (X_B, τ) is denoted by $G - star - s - CB(X_B, \tau)$.

The complement of G – star – s- closed biset is a G – star – s- open biset.

Theorem 4.2

Every closed biset X_B in G – star – s- closed biset in X_B but not conversely.

Proof Assume that A_B be a closed biset in X_B . Let U_B be a GS-open biset such that $A_B \subseteq U_B$. since, A_B is closed, that is, $cl(A_B) = A_B$, $cl(A_B) \subseteq U_B$.

But $scl(A_B) \subseteq cl(A_B) \subseteq U_B$.

Therefore, $scl(A_B) \subseteq U_B$.

Hence A_B is $G - star - s - CB(X_B, \tau)$.

The converse of the above theorem need not be true as seen from the following examples.

Example 4.3

Let $X_B = \{]a, b, c[\cup \{1,2,3\} \}$ with $\tau = \{ \emptyset, \{a\}, \{a, b, c\} \} \cup \{ \emptyset, \{1\}, \{1,2,3\} \}$

The bisets $\{b\}, \{c\}$ and $\{2\}, \{3\}$ are $G - star - s - CB$ but not closed biset.

Theorem 4.4

Union of two G – star – s- closed biset in G – star – s- closed biset.

Proof

Let A_B and F_B be G – star – s- closed biset in X_B .

Let U_B be GS-open biset in X_B , such that $A_B \cup F_B \subseteq U_B$.

$A_B \subseteq U_B$ and $F_B \subseteq U_B$.

Since A_B and F_B are G – star – s- closed biset such that $scl(A_B) \subseteq U_B$ $scl(F_B) \subseteq U_B$

Hence $scl(A_B \cup F_B) = scl(A_B) \cup scl(F_B) \subseteq U_B$

Therefore $A_B \cup F_B$ is $G - star - s - CB$.

Results 4.5

- I. Every G – star – s- closed biset is GS- closed but not conversely.
- II. Every G – star – s- closed biset in X_B is a SG- closed biset in X_B but not conversely.

Theorem 4.6

A subbisets A_B of X_B G – star – s- closed biset in X_B iff $scl(A_B) - A_B$ contains no empty $Gs - closed$ biset in X_B .

Proof

Suppose that G_B is non –empty GS- closed subbisets of $scl(A_B) - A_B$. Now $G_B \subseteq scl(A_B) - A_B$.

Then $G_B \subseteq scl(A_B) \cap \overline{A_B}$.





Therefore $G_B \subseteq scl(A_B)$ and

$$G_B \subseteq \overline{A_B}$$

Since $\overline{G_B}$ is a Gs-open biset, $scl(A_B) \subseteq \overline{G_B}$.

A_B is G-star-s- closed biset,

$$scl(A_B) \subseteq \overline{G_B}$$

That is, $G_B \subseteq scl(\overline{A_B})$

Since $\overline{G_B}$ is Gs-open biset and A_B is G-star-s- closed biset,

$$scl(A_B) \subseteq \overline{G_B}$$

$$G_B \subseteq scl(\overline{A_B})$$

$$G_B \subseteq scl(A_B) \cap [scl(A_B)] = \emptyset$$

$$G_B = \emptyset$$

Therefore, $scl(A_B) - A_B$ contains no non empty Gs-closed biset.

Conversely, let $scl(A_B) - A_B$ contains no non empty Gs-closed biset.

Let $A_B \subseteq U_B, U_B$ is Gs-open biset.

Suppose that $scl(A_B)$ is not contained in U_B . then $scl(A_B) \cap \overline{U_B}$ is a non- empty Gs – closed biset and contained in $scl(A_B) - A_B$ which is contradiction by our assumption.

Therefore, $scl(A_B) \subseteq U_B$ and A_B is G-star-s-closed biset.

Proposition 4.7

Let (X_B, τ) be a compact topological bispace. If A_B is G-star-s-closed subbisets of X_B , then A_B is compact.

Proof

Let $\{U'_B\}$ be an open biset cover of A_B . Since every open biset is Gs-open and A_B is G-star-s-closed biset, we get $scl(A_B) \subseteq \cup \{U'_B\}$

Since a closed subbisets of a compact bispace is compact, now $scl(A_B)$ is compact.

Therefore, there exists a finite sub open bicover say $\{U'_B \cup U'_B \cup \dots \cup U'_n\}$ of $\{U'_B\}$ for $scl(A_B)$.

So, $A_B \subseteq scl(A_B) \subseteq U'_B \cup U'_B \cup \dots \cup U'_n$.

Therefore A_B is compact.

Definition 4.8

A subbisets A_B of topological bispace X_B is called G-star-s-open biset. If $\overline{A_B}$ is G-star-s-closed. The class of all G-star-s-closed biset is denoted by G-star-s-OB(X_B, τ).

5 Generalized pre- open sets in (X_B, τ) .

In this section, Generalized pre-open bisets [briefly, GPOB], GPOB-compact notion is introduced and connections to other several well- known types of compactness are discussed.

Definition 5.1

A bispace (X_B, τ) is GPOB-compact if every GPOB- cover of X_B has finite sub cover, whenever a cover consisting of GPO- bisets.

Results 5.2

Every openbisets is GPO- biset.

If (X_B, τ) is GPOB- compact bispace, then it is compact.

Definition 5.3

A bispace is strongly irresolvable if and only if every pre-open biset is semi-open bisets.

Definition 5.4

Let (X_B, τ) be a bispace is said to be \mathbb{P} – closed biset[respectively, quasi \mathbb{H} – closed biset (simply, qHCB)] if every pre-open biset (respectively, open biset) cover of X_B has finite subfamily the pre closures (resp., closures) of whose member cover X .

A topological bispace (X_B, τ) is said to be strongly compact biset if every pre-open bicover of X_B has a finite sub cover.

Definition 5.5

A bispace (X_B, τ) is called s- closed biset if every semi-open biset cover has a finite subfamily the semi-closures of whose members cover X_B .

Result 5.6

A subbisets $A_B \subseteq X_B$ is open biset if and only if A_B is a GPOB and a pre -open biset.





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Theorem 5.7

If a bispace (X_B, τ) is GPOB – irresolvable and GPOB - compact, then it is \mathbb{P} – closed biset.

Proof

Let $A_B = \{A_B^\alpha; \alpha \in \Delta\}$ be a pre - open bicover of X_B since X_B is GPOB – irresolvable, A_B^α is a GPOB for all $\alpha \in \Delta$ and A_B is a GPOB- cover of X_B .

Since X_B is GPOB – compact, it has a finite subbcover.

Thus, $X_B \subseteq \cup_{i=1}^n A_B^{\alpha_i}$.

But, $\cup_{i=1}^n A_B^{\alpha_i} \subseteq \cup_{i=1}^n pcl(A_B^{\alpha_i})$. (resp., pcl- preclosed biset) and so X_B is \mathbb{P} – closed.

Since a GPOB need not to be preopen, a \mathbb{P} – closed bispace need not be GPOB – irresolvable or GPOB – compact.

6 Applications of semi – open Bisets

The union of all semi – open bisets of X_B contained in F_B is called the semi – interior of biset F_B and it is denoted by $sInt(F_B)$.

The intersection of all semi – closed bisets containing F_B is called the semi – closure of F_B and it is denoted by $sCl(F_B)$. $sCl(F_B) - sInt(F_B)$ is called the semi – frontier of F_B and is denoted by $sFr(F_B)$. $sInt(X_B - F_B)$ is said to be the semi – exterior of F_B and is denoted by $sExt(X_B - F_B)$

In this paper, these notions are further investigated. We also introduce and study the concepts of semi – isolated points and semi – scattered bispaces.

Theorem 6.1

For a bisets $F_B \subset X_B$, the following are equivalent

- a) F_B is dense in X_B .
- b) $sCl(F_B) = X_B$
- c) If G_B is any semi – closed sub biset of A_B and $F_B \subset G_B, G_B = X_B$.
- d) For each $a_B \in X_B$, every semi – open biset containing a_B has non- empty intersection with F_B .
- e) $sInt(X_B - F_B) = \emptyset$.

Proof (a) \Rightarrow (b)

Let U_B be an open biset with $U_B \subset G_B \subset cl(U_B)$

Since $U_B \subset X_B - F_B$ and F_B is dense, therefore $U_B = \emptyset$ and so $cl(U_B) = \emptyset$.

Hence $G_B = X_B$. It follows that the intersection of all semi – closed bisets containing F_B is X_B .

That is $sCl(F_B) = X_B$.

(b) \Rightarrow (a)

Let $sCl(F_B) = X_B$

Now, a subset F_B of a topological bispace X_B such that every points of X_B either belong to F_B or else is arbitrary close to a member of F_B

That is, $sCl(F_B) \subset Cl(F_B)$ for every $F_B \subset X_B$.

Therefore F_B is dense in A_B .

(b) \Rightarrow (c) and **(c) \Rightarrow (d)** are obvious . **(d) \Rightarrow (e)**.

If $sInt(X_B - F_B) \neq \emptyset$,

Then $sInt(X_B - F_B)$ is a non – empty semi – open biset. However, $(X_B - F_B) \cap F_B = \emptyset$ since $sInt(X_B - F_B) \subset X_B - F_B$, we have $sInt(X_B - F_B) \cap F_B = \emptyset$

This contradicts (d), and means $sInt(X_B - F_B) = \emptyset$.

(e) \Rightarrow (b) let $sInt(X_B - F_B) = \emptyset$ and since $sInt(X_B - F_B) = X_B - scl(F_B)$ therefore, $sCl(F_B) = X_B$.

Theorem 6.2

Let F_B be a subbisets of the bispace X_B then

- a) $sFr(sInt(X_B - F_B)) \subset sFr(F_B)$
- b) $sFr(scl(X_B - F_B)) \subset sFr(F_B)$
- c) $SExt(X_B) = \emptyset$
- d) $SExt(\emptyset) = X_B$
- e) $SExt(F_B) = SExt[X_B - SExt(F_B)]$
- f) $SInt(F_B) = F_B - sFr(F_B)$
- g) $SInt(F_B) \subset SExt[SExt(F_B)]$





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h) $X_B = S Int(F_B) \cup S Ext(F_B) \cup s F_r(F_B)$

Proof

Only the proof of (e) will be given here, we have,

$$\begin{aligned} & S Ext[X_B - S Ext(F_B)] \\ &= S Ext[X_B - S Int(X_B - F_B)] \\ &= S Int[X_B - (X_B - (X_B - S Int(X_B - F_B)))] \\ &= S Int[S Int(X_B - F_B)] \\ &= S Int(X_B - F_B) \\ &= S Ext(F_B) \end{aligned}$$

Theorem 6.3

If $F_B, G_B \subset X_B$ such that $s F_r(F_B) \cap s F_r(G_B) = \emptyset$ and $F_r(F_B) \cap s F_r(G_B) = \emptyset$. then $S Int(F_B) \cup S Int(G_B) = S Int(F_B \cup G_B)$.

Proof

Let $a_B \in S Int(F_B \cup G_B)$. Then there exists a semi open bisets U_B such that $a_B \in U_B \subset F_B \cup G_B$. If $a_B \in s F_r(F_B)$ then $a_B \notin F_r(G_B)$. So there exists an open biset V_B containing a_B with $V_B \subset G_B$ or $V_B \subset X_B - G_B$

Assume $V_B \subset G_B$ then

$$a_B \in U_B \cap V_B \subset G_B.$$

Since, $U_B \cap V_B$ is semi – open biset $a_B \in S Int(G_B)$.

On the other hands, if $V_B \subset X_B - G_B$, then $a_B \in U_B \cap V_B \subset F_B$ and so

$$a_B \in S Int(F_B).$$

if $a_B \notin S Int(G_B)$. In particular, suppose that $a_B \notin S Cl(F_B)$ for otherwise $a_B \in S Int(F_B)$. Then $a_B \in G_B \subset S Cl(G_B)$ since $a_B \in F_B \cap G_B$. We assume that $a_B \notin F_r(G_B)$ for otherwise $a_B \in S Int(G_B)$. Thus $a_B \notin F_r(F_B)$ and the argument new proceeds similarly in the case when $a_B \notin F_r(G_B)$.

Theorem 6.4

A biset $F_B \subset X_B$ is nowhere dense iff $Int(S cl(F_B)) = \emptyset$.

Proof

The proof is obvious

Since $Int(cl(F_B)) = Int(S cl(F_B))$ for every $F_B \subset X_B$.

Definition 6.5

Let F_B be a subbisets of a topological bispace X_B . then,

- a) A point $a_B \in F_B$ is said to be a semi- isolated point of F_B if there is a semi- open biset U_B such that $U_B \cap F_B = \{a_B\}$.
- b) A biset F_B is said to be semi – discrete if each point of F_B is semi- isolated.
- c) A bispace (X_B, τ) is said to be semi- scattered if every non – empty subset of X_B has a semi – isolated point.

It is obvious that every isolated point of $F_B \subset X_B$ is semi- isolated. But the converse is not true as can be seen from the following example

Example 6.6

Consider the usual topology on \mathbb{R} .

Let $F_B = [0,1] \cup [1,2]$, A subbisets $U_B = [1,2] \cup [2,3]$ of \mathbb{R} is semi – open biset and $U_B \cap F_B = \{1\} \cup \{2\}$, $1,2 \in F_B$ is a semi – isolated point of F_B but it is not isolated point of F_B .

Remarks 6.7

Let (X_B, τ) be a topological bispace and $F_B \subset X_B$. Then

- a) A semi- isolated point of X_B is merely an isolated point. For $\{a_B\}$ is semi – open bisets iff $\{a_B\}$ is open biset. The biset of all isolated (semi- isolated) points of a biset $F_B \subset X_B$ is denoted by $F_B^s(F_B^{ss})$.
- b) A bispace X_B is a semi – discrete subset of a biset of itself iff X_B is discrete. Every discrete biset is semi – discrete. But the converse need not be true as can be seen from the following example.

Example 6.8

The subset of biset $X_B = [0,1] \times \{0\} \cup [1,2] \times \{1\} \subset R^2$ is dense – in – itself but it is semi – discrete. For each $X_B = (r, 0) \cup (s, 1) \in F_B$. Let $U_B(X_B)$ be the open biset unit disk with non – negative center coordinates which is tangent to F_B at the point x_B .





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Thus $G_B = U_B \cap \{x_B\}$ is semi –open biset and $\{x_B\} = G_B \cap F_B$. This shows that each point $x_B \in F_B$ is a semi – isolated point of F_B .

This implies that F_B is semi – discrete in R^2 . However F_B is not discrete since its points are not isolated.

If F_B^s denotes the semi- derived biset of F_B , then we have the following theorem

Theorem 6.9

If F_B is a subset of biset of a bispace X_B , then

- a) $F_B^{s1} \cap F_B^{ss} = \emptyset$
- b) $scl(F_B) = F_B^{s1} \cap F_B^{ss}$
- c) $X_B = F_B^{s1} \cap F_B^{ss} \cup s Ext(F_B)$

Proof

(a) $a_B \in F_B^{ss} \Leftrightarrow$ there is a semi – open biset U_B containing a_B such that

$$U_B \cap F_B = \{a_B\}$$

$$\Leftrightarrow U_B \cap (F_B - \{a_B\}) = \emptyset$$

$$\Leftrightarrow a_B \notin F_B^{s1}.$$

(b) $a_B \in scl(F_B) \Leftrightarrow U_B \cap F_B = \emptyset$ for every semi – open biset U_B containing a_B

$$U_B \cap (F_B - \{a_B\}) \neq \emptyset \text{ if } a_B \notin F_B.$$

$$U_B \cap (F_B - \{a_B\}) = \emptyset \text{ if } a_B \in F_B.$$

$$\Leftrightarrow a_B \in F_B^{s1} \text{ or } a_B \in F_B^{ss}.$$

$$\Leftrightarrow a_B \in F_B^{s1} \cup F_B^{ss}$$

(c) obvious in view of parts (a)&(b)

Theorem 6.10

If $F_B \subset X_B$ is dense, then the following hold.

- a) The semi – isolated points of F_B are precisely the isolated points of F_B as a subspace.
- b) $F_B \subset F_B^{s1}$ iff $F_B^s = \emptyset$.

Proof

(a) If $\{a_B\} = G_B \cap F_B$ where G_B is semi open biset, then there is an open biset U_B such that $U_B \subset G_B \subset cl(U_B)$
 $U_B \cap F_B \neq \emptyset$ implies $U_B \neq \emptyset$ since F_B is dense in A_B . $G_B \neq \emptyset$ implies $U_B \neq \emptyset$.

Thus $U_B \cap F_B = \{a_B\}$ and a_B is an isolated points of the subspace F_B . converse is obvious.

(b) $F_B^s = F_B^{ss}$ because F_B is dense in A_B . Since $A_B = scl(F_B)$

$$= F_B^{s1} \cup F_B^{ss}$$

$$= F_B^{s1} \cup F_B^s$$

And $F_B^{s1} \cup F_B^{ss} = \emptyset$

$$F_B = F_B^s \cup (F_B \cap (F_B^{s1}))$$

Thus, $F_B \subset F_B^{s1}$ iff $F_B^s = \emptyset$.

CONCLUSION

The classes of pre-open and pre-closed bisets are defined using semi-open and semi-closed bisets in topological bispace. G-star-s-closed bisets, GPOB, GPOB-compact bisets are derived a new decomposition of closure and interior. This idea can be extended to various spaces.

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Employee Experience and the Digital Shift: A Deep Dive into India's IT Sector HR Transformation

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ABSTRACT

This study delves into the transformative effects of digitalization on human resource management within India's information technology (IT) sector, a pivotal industry for the country's economic growth. The present study concentrates on three major independent variables: administrative functions, employee engagement, and work-life equilibrium. Administrative functions encompass tasks such as managing employee records, updating information, and handling benefits. Employee engagement is characterized by the cultural, technological, and physical dimensions of the work environment, whereas work-life equilibrium pertains to personal relationships, mental and physical health, and overall contentment. Data was compiled from a pool of 114 participants working in the IT sector in Chennai, India. A thorough approach utilizing Structural Equation Modeling (SEM) was employed, using the Smart PLS software tool. This tool enabled evaluation of model fit, composite reliability of measures, and distinctness of constructs or discriminant validity. Testing hypotheses of study, Partial Least Squares (PLS) path modelling was utilized, delivering robust and reliable interpretations of collected data. Findings from investigation indicated positive association between employee engagement and process of digital transformation within realm of HR. However, study did not identify similar positive relationship for variables of administrative tasks and work-life equilibrium. This insinuates that while enhanced employee experience can drive HR digital transformation, traditional administrative tasks and work-life balance efforts may not exert similar influence. Insights bear significant implications for organizational decision-making, underscoring need for strategizing actions towards enhancing digital transformation in human resource processes.





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Keywords: Digital transformation, Human resource management, Employee experience, Work-family balance, India's IT sector

INTRODUCTION

The digital reshaping of human resources (HR) carries immense weight within the information technology (IT) sphere, particularly when viewed through lens of an employee's experience. As the drivers of innovative leaps and providers of digital services to various industries, IT companies are shaping a new business environment where digital technology plays an increasingly vital role. The success of an organization hinges significantly on its HR, which, by driving productivity and profitability, aids in realizing the organization's vision and mission. In this context, digital technology is significantly influencing areas such as the work-life balance of employees, the work environment, and HR administrative functions. This manuscript endeavours to explore the perceptions of employees regarding the digital metamorphosis of HR in the IT industry, with a specific focus on Chennai, India. This region is selected owing to its dense aggregation of IT service firms. The digital age's advent began earnestly around 2005, escalating from the early 1980s when less than 1% of stored information was in digital format, to an astounding 99% in 2014. The increase in data stored digitally has seen an explosive growth, rising from 2.5 exabytes in 1986 to five Zetta bytes in 2014 (Clement, 2020). Alongside this, internet usage linked with digital cloud storage reached 59% of the world population (4.54 billion users) in 2021, while hand phone subscribers linked to digital storing amounted to 62% of the world population (4.78 billion users). India's IT sector, a significant contributor to the country's GDP with a 7.7% share and total revenue of US\$160 billion in 2017 (Singh, 2017), primarily comprises business process outsourcing and IT services (Nirmal, 2017). Chennai, renowned as Asia's largest IT park and home to a majority of India's software companies (Parayil, 2016), is the country's second-largest exporter of business process outsourcing and IT services. The journey of HR digital transformation can be segmented into three phases: digitization, digitalization, and digital transformation. Initially, analog signals were converted to bits in a process known as scanning, which allowed information storage in different systems and mediums (Parviainen, Tihinen, Kääriäinen, & Teppola, 2017).

This marked the era of digitization. Gradually, digitization evolved into digitalization, regarded as the fourth industrial revolution, with profound influences on human activity domains, including manufacturing processes, communication patterns, transportation systems, and working styles. Lamberton and Stephen (2016) argue that the final phase, digital transformation, requires harnessing the power of technological innovation to build or adapt current business procedures, cultural norms, and customer anticipations in response to changing market and business needs. This transformation has gained attention across all business operations, leading to significant changes in business processes and developments (Nambisan S, Wright M, 2019). Verhoef et al. (2017) posited that digital transformation involves the incorporation of multiple digital tools such as social media platforms, cloud computing, mobile technology, and analytics into business activities, which in turn fosters innovation and stimulates dynamic interactions with consumers through social media channels. Historically, HR was viewed as an administrative function responsible for employee services. However, modern HR is now at the forefront of leading global organizations through digital transformation John Bersin, Tiffany Mcdowell, Amir Rahnema (2017), and Michael Stephan, David Brown (2017) highlighted that digital transformation is experiencing rapid and significant alterations, especially in relation to the digital workforce, digital workplace, and digital HR. Delving into employees' viewpoint on HR digital transformation in India's IT sector, this research aims to verify three hypotheses: 1) administrative tasks constructively impact HR digital transformation, 2) positive influence on HR digital transformation is exerted by employee experiences, and 3) a harmonious correlation subsists between work-family balance and HR digital transformation. The underlying structure of this investigation is shaped by past scholarly pursuits, involving diverse definitions, available data, and previous studies centered on digital transformation. This layout aims to underscore the employee perspective by presenting a detailed analysis and interpretation of the results. Conclusively, it derives an understanding and provides a direction for further inquiry in this field.





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Figure 1 visually presents our research model, integrating three standalone variables: administrative tasks (personnel records, detail updates, benefits data), employee experience (cultural, technological, physical environments), and work-family balance (personal relationships, physical and mental wellness, general satisfaction). Each of these variables feeds into HR digital transformation, identified as our dependent variable. Our research schematic demonstrates a direct link between independent elements and our dependent variable, thereby illustrating potential influences exerted by these individual factors. Overall, this exploration probes deeply into impacts that digital transformation might wield on HR within IT sector domains, chiefly from an employee's standpoint. It is a vital exploration of the modern workplace where HR is no longer a passive administrative function but a proactive driver of organizational change. Through this study, we hope to contribute valuable insights to the ongoing discourse on the digitalization of human resources within the rapidly evolving IT sector in India.

Review of Scholarly Literature and Formulation of Hypotheses

Scholarly literature on digital transformation in human resources provides a holistic understanding, amalgamating insights from multiple disciplines, thus facilitating informed decision-making for progressive regulatory changes in organizations (Tarafdar & Davison, 2018). Digitization, an initial stage of this transformation, entails documentation of the organization's internal and external activities without direct engagement in value creation. The subsequent stage, digitalization, involves leveraging digital technologies for optimizing business operations and cost savings (Pagani & Pardo, 2017). The full-fledged human resource digital transformation phase capitalizes on these digital technologies to hone core competencies and navigate challenges (Singh & Hess, 2017). Digital transformation enhances administrative task efficiency in human resources, playing a crucial strategic role in organizations (Silva & Lima, 2018). This metamorphosis complements conventional human resource management practices, facilitating a digital approach towards administrative tasks. It often poses challenges for organizations resistant to change. However, proficient information system management can guide human resource managers through digital transformation processes (Hausberg, Liere-Netheler, Packmohr, Pakura, & Vogelsang, 2019). For human capital evolution to transpire, a forward-thinking mindset is crucial for managers. Digital transformation in human resources provides a platform for skill development, easing work procedures and expanding employee capabilities (Betchoo, 2016). By amalgamating traditional administrative procedures with employee development aspects, digital transformation facilitates a streamlined approach to organizational human resource management. Fenech, Baguant, and Ivanov (2019) posit that technology can be leveraged to reduce administrative workload and enhance job design, leading to our first hypothesis:

H1: Administrative tasks within the Indian IT sector positively influence human resource digital transformation.

Digital transformation promotes streamlined work processes, enhanced work quality, and modern operational approaches within organizations. Integrating digital technologies like teleconferencing, robotic process automation, wearable tech, and computerized monitoring systems cultivates superior work environments and bolsters employee experiences (Cascio & Montealegre, 2016). Thus, a technological environment within an organization can significantly contribute to enhancing employee experiences. This influence and multidimensional support in the workplace lead to our second hypothesis:

H2: Employee experience positively impacts human resource digital transformation within the IT sector in India.

Balancing work and personal life is a significant concern for modern organizations, affecting personal relationships amongst employees and their families (Albalushi & Sankar, 2019). Implementing digital transformation can mitigate conflicts between professional commitments and personal responsibilities, promoting overall employee well-being. Digital transformation supports workload management, enhancing both physical and mental health (Vineetha Prakash, 2018). Further, flexible work schedules, aided by digital transformation, contribute to work-family balance and employee happiness (Sankar, 2018). Consequently, organizations need to implement digitally transformed human resource practices to ensure a balanced personal-professional life for their employees, leading to our third hypothesis:



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H3: Work-family balance within the IT sector in India is positively influenced by human resource digital transformation. Digital transformation within human resource management has begun to attract substantial attention in recent years. At first glance, the core of digital transformation within human resources entails harnessing digital technologies to minimize mundane administrative tasks, enabling HR professionals to devote more time to strategic initiatives (Kumar & Shankar, 2019). Yet, it extends beyond simple task automation to influence a broad array of HR functions - spanning talent acquisition, employee development, performance management, and succession planning, as noted by Parviainen, Tihinen, Kääriäinen, and Teppola in 2017. Human resource digital transformation also fosters a conducive environment for the effective delivery of employee services. By leveraging digital tools and solutions, HR professionals can now address the diverse needs and expectations of a multigenerational workforce, leading to increased employee satisfaction and engagement (Ghoshal S, 2015). This digital pivot can also help organizations build a resilient and adaptive workforce that can quickly respond to dynamic business needs. However, it's crucial to note that digital transformation is not an end, but a means to achieve strategic HR goals. It's a change process that necessitates a shift in mindset, culture, and operations (Scott, C.

R., & Lewis, 2017). In this context, HR leaders play a pivotal role in driving this change, right from envisioning the digital strategy to managing the transformation process. Looking ahead, understanding the impact of digital transformation on work-family balance becomes essential. With an ever-increasing emphasis on flexibility and work-life balance, digital technologies offer immense possibilities, including flexible work arrangements, telecommuting, and virtual collaboration. By enabling employees to balance their professional commitments and personal life effectively, digital transformation can significantly improve their overall well-being and productivity (Alaradi&Sankar, 2019). However, the transformative journey towards digital HR is fraught with challenges. These include resistance to change, data privacy concerns, and the risk of technology obsolescence. Overcoming these challenges requires a strategic approach, robust change management processes, and continuous learning and development initiatives. As we delve into this exploration, it is evident that a digital-first approach to HR can redefine the future of work and employee experience, making it a strategic priority for organizations today. Consequently, this research intends to illuminate the intricate link between digital transformation in human resources and its effects on administrative tasks, the employee experience, and work-family equilibrium in India's IT sector, offering a distinctive viewpoint on this burgeoning area of study. Moreover, the role of digital transformation in refining the administrative tasks in HR cannot be underestimated. With advancements in artificial intelligence, machine learning, and cloud computing, the HR domain has started embracing a more data-driven approach.

Administrative tasks such as maintaining personnel records, benefits management, and employee onboarding that once consumed significant time and resources can now be performed with precision and efficiency (Hausberg, Liere-Netheler, Packmohr, Pakura, & Vogelsang, 2019). By automating these routine activities, HR professionals can contribute more strategically towards achieving organizational goals. On a larger canvas, digital transformation significantly enhances the overall employee experience. Technologies such as teleconferencing, advanced analytics, AI-based personal assistants, and virtual reality are increasingly shaping the way employees interact with their organizations (Larkin, 2017). This enhances not only their work proficiency but also facilitates the development of a work culture that fosters innovation, engagement, and continuous learning. Beyond the organizational boundaries, the impact of digital transformation extends to how employees balance their work and family life. In an era where work-life balance is a crucial factor in talent attraction and retention, the role of technology in enabling flexible work schedules, remote working options, and efficient time management is pivotal (Sankar, 2018). The use of digital tools can provide employees the autonomy to manage their work schedules effectively, which in turn, improves their physical health, mental well-being, and overall happiness. Hence, this research seeks to methodically examine the beneficial impact of administrative tasks, worker experiences, and work-life harmony on digital transformation in HR, specifically within India's IT industry. The proposed conjectures for this investigation are as follows:

H1: Human resource digital transformation within the IT sector in India is positively influenced by efficient administrative tasks.





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H2: An enhanced employee experience exerts a positive influence on HR digital transformation in the Indian IT sector.

H3: An effective work-family balance contributes positively to the digital transformation of HR within India's IT sector. These hypotheses will guide the research to provide meaningful insights into how digital transformation is reshaping HR practices within the IT sector in India, fostering a new paradigm of work culture and employee engagement.

METHODOLOGY

Participants for this study were sourced from various IT companies in Chennai, encompassing different job roles, including middle-level managers, staff, and administrative personnel. This participant pool ensured varied responses and broad representation (Cooper, D. R., Schindler, P. S., & Sun, 2006). Online surveys and personal interviews facilitated nuanced understanding of employee perceptions on HR digital transformation. MCAR (Missing Completely at Random) test using SPSS software checked missing data randomness, yielding ($\chi^2=45.827$, $df=97$, $sig.=1.000$) and leading to null hypothesis rejection. An A-priori sample size calculator (Soper, 2020) determined appropriate sample size for Structural Equation Modeling (SEM), considering effect sizes (Cohen's d of 0.5), 95% statistical power level, and 0.05 probability level. This process recommended a sample size between 106 and 212 for all effect sizes. A sample size of 114 was thus chosen, exceeding minimum requirements. Detailed analysis followed data collection. PLS and ADANCO 1.1 software tested discriminant validity, and SPSS software assessed instrument reliability. Next, Smart PLS 3.3.2 software scrutinized measurement and structural models. This dual-stage analysis meticulously examined if administrative tasks, employee experiences, and work-family balance positively influenced HR digital transformation in IT sector of India.

RESULTS

Before analyzing measurement and structural models, an evaluation of model fit took place. This crucial step reports on model fit, utilizing inferential statistics or fit indices. Above table presents model fit measures such as standardized root mean square residual (SRMR), evaluated using ADANCO software (Dijkstra & Henseler, 2015). Additional model fit indicators like unweighted least squares discrepancy (dULS) and geodesic discrepancy (dG) were determined through bootstrap method (Hair, Hollingsworth, Randolph, & Chong, 2017). A cautious perspective recommends an SRMR value under 0.1 as an indicator of good fit; a calculated outcome of 0.097 confirms model fit for this instance. For dG and dULS values, outcomes under 95th percentile of bootstrap quantile typically align with traditional views. Given calculated dG and dULS values of 1.49 and 0.52 respectively, it becomes clear that our model fulfils these fit requirements, reinforcing model fit. Table 2, located below, presents calculated values for composite reliability, Cronbach's alpha, and average variance extracted (AVE=convergent validity), crucial for assessing measurement model. Assessment of measurement model involved considering factors such as Cronbach's alpha, composite reliability, AVE (convergent validity), outer loadings, and discriminant validity. As illustrated in table above, values computed for composite reliability surpassed critical cut-off point of 0.7 (Henseler, Hubona, & Ray, 2016), thus establishing their validity. Additionally, overall value for reliability statistics computed through SPSS hit 0.870, demonstrating satisfactory internal consistency. Values of average variance extracted (AVE), indicative of convergent validity, went beyond necessary cut-off of 0.50, further endorsing suitability and validity of model. Discriminant validity underwent an assessment via PLS approach, as depicted in Table 3. Employment of Fornell-Larcker criterion, a common measure to evaluate degree of shared variance among latent variables of model, was witnessed. Monotrait-Hetero method correlations, when under 0.9, are regarded as acceptable (Dijkstra & Henseler, 2015). As observed in Table 3, all calculated values fall below the threshold for Monotrait-Heteromethod correlations, indicating the acceptance of discriminant validity. These findings support the notion that the utilized measurement scales are both reliable and valid.





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Structural Equation Modeling (SEM)

Figure 2 shows derived equation's R2 value as 0.969, signifying statistical significance at 1% probability level. It suggests that administrative tasks, employee experience, and work-family balance explain 96.9% variation in human resource digital transformation. Following Table 4 details an in-depth examination of structural relationships using PLS Algorithm. It also includes an assessment for presence of multi collinearity using Variance Inflation Factors (VIF) and tolerance parameters. Results make it evident that variables do not showcase multicollinearity. Hair Jr, Black, Babin, & Anderson (2010) propose a VIF value exceeding 4.0 or below 0.2 signals issues of multicollinearity. In this model, however, VIF values span from 1.353 (Overall Happiness) to 2.020 (Technological Environment), fitting comfortably within an acceptable range and affirming lack of multicollinearity. Table 5, found below, delivers comprehensive results from hypothesis testing using a bootstrapping technique. Bootstrapping, with 5000 re sampling procedures within Smart PLS, facilitates establishment of significance level of paths among variables.

Discoveries imply that administrative tasks fail to exert a positive influence on human resource digital transformation ($\beta=-0.011$, $t\text{-value}=0.841$, $p>0.05$), leading to rejection of Hypothesis 1 (H1). This observation coincides with challenges encountered by numerous HR departments as they navigate transition from traditional administrative responsibilities (McGrath, 2019). Contrastingly, data endorses Hypothesis 2 (H2), illustrating that employee experience positively impacts human resource digital transformation ($\beta=0.957$, $t\text{-value}=32.504$, $p<0.05$). Technological support in forms of teleconferencing, robotics, wearable computing devices, and automated monitoring systems can enhance work environments and uplift employee experiences, thereby bolstering digital transformation in HR (Cascio & Montealegre, 2016). Lastly, Hypothesis 3 (H3) lacks support, denoting that work-family balance fails to significantly influence human resource digital transformation ($\beta=0.028$, $t\text{-value}=0.870$, $p>0.05$). This outcome may emanate from increasingly indistinct boundaries between personal and professional life in today's work settings, causing work-family balance strategies to vary across generations (Simer, 2019). Hence, HR digital transformation may not intrinsically promote work-family balance.

CONCLUSION

This investigation embarked on an assessment of influence from administrative tasks, employee experience, and work-family balance on human resource digital transformation within IT organizations located in Chennai. A Structural Equation Model was deployed for an all-encompassing data analysis. Insights yielded from our findings carry significant weight in understanding human resource digital transformation, illuminating focal areas for organizations. Results implied that amongst three independent variables studied, only employee experience had a notable influence on human resource digital transformation. This stresses vital importance of employees' experiences in shaping successful digital transformation execution within human resource framework. Technological support such as teleconferencing, automated monitoring systems, and other advancements turn out key to enhancing employee experience, thus positively swaying digital transformation. In contrast, no substantial influence of administrative tasks and work-family balance on HR digital transformation was discerned from this study. This implies that the traditional role of HR in handling administrative tasks doesn't necessarily translate into effective digital transformation. Similarly, the work-family balance parameter, despite its importance in employee well-being, showed no notable contribution to digital transformation in HR practices. These results suggest that organizations must prioritize enhancing employee experience through strategic digital implementations to achieve successful digital transformation in human resource practices. While administrative tasks and work-family balance remain critical areas of HR, these elements alone may not drive the digital transformation process. The IT organizations in Chennai, and possibly beyond, can benefit from these insights to improve their HR digital transformation strategies. In the future, research might explore other variables that potentially impact human resource digital transformation. Furthermore, this study can be expanded to other geographical locations or industries for more comprehensive insights. Digital transformation in HR is an ongoing journey, and understanding its dynamics will remain crucial as organizations continue to navigate the digital age.





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Scope for Further Research

Insights gleaned from this study pave way for numerous avenues warranting further research. Analysis in this investigation concentrated on IT organizations in Chennai. Nevertheless, expanding such research to incorporate a wider demographic, inclusive of varied geographical regions and industries, might yield generalized and more holistic insights. While this investigation emphasized administrative tasks, employee experience, and work-family balance as predictors of HR digital transformation, upcoming research could delve into other potential variables. This could encompass an exploration of roles played by organizational culture, leadership support, digital literacy level among employees, and technology infrastructure investments in successful HR digital transformation. Notably, a significant role was detected in digital transformation played by employee experience, demanding deeper exploration in this area. Future studies might focus on particular aspects of employee experience that strongly impact digital transformation. For instance, studying influences of flexible working options, digital training and development programs, or digital communication tools on HR digital transformation could prove insightful. Additional research might also concentrate on barriers to HR digital transformation, such as employee resistance to change, digital skills deficiency, or insufficient resources. Comprehending these obstacles will aid organizations in strategizing to overcome them. Finally, a longitudinal study tracking HR digital transformation over time would offer significant utility. Such a study could provide insights into long-term effects of digital transformation on HR practices, employee productivity, and overarching organizational performance. These represent merely a fraction of areas where future research could extend findings of this study, enhancing our understanding of intricate interplay between HR practices and digital transformation.

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Table 1: Goodness of Model Fit

Fit Criteria	Value
SRMR	0.097
dULS	0.52
dG	1.49

Table 2: Composite Reliability

Criterion	Administrative Tasks	Employee Experience	Work-family Balance	Human Resource Digital Transformation
Cronbach's Alpha (α)	0.745	0.805	0.755	0.790
Composite Reliability (CR)	0.775	0.885	0.860	0.860
Average Variance Extracted (AVE)	0.555	0.720	0.670	0.550

Table 3: Discriminant Validity

Criterion	Administrative Tasks (AT)	Employee Experience (EE)	Human Resource Digital Transformation (HRDT)	Work-family Balance (WFB)
AT	0.745			
EE	0.120	0.850		
HRDT	0.130	0.890	0.745	
WFB	0.145	0.830	0.820	0.825

Table 4:

Variable Relationships	Beta	SE	P-Values	VIF
Benefit Information ? Administrative Tasks	0.903	0.327	0.035	1.429
Personal Records ? Administrative Tasks	0.411	0.480	0.732	1.434
Updating Details ? Administrative Tasks	0.816	0.295	0.066	1.608
Cultural Environment ? Employee Experience	0.813	0.010	0.000	1.693
Physical Environment ? Employee Experience	0.835	0.011	0.000	1.641
Technological Environment ? Employee Experience	0.889	0.012	0.000	2.020
Personal Relationship ? Work-family Balance	0.856	0.015	0.000	1.660
Personal, Mental Health ? Work-family Balance	0.888	0.010	0.000	1.934
Overall Happiness ? Work-family Balance	0.693	0.014	0.000	1.353

Table 5 Hypothesis Testing

Hypotheses	Beta	t-Statistics	P-Values	Outcome
Administrative Tasks → HRDT	-0.012	0.840	0.402	Not Supported
Employee Experience → HRDT	0.958	32.500	0.000	Supported
Work-family Balance → HRDT	0.029	0.880	0.386	Not Supported





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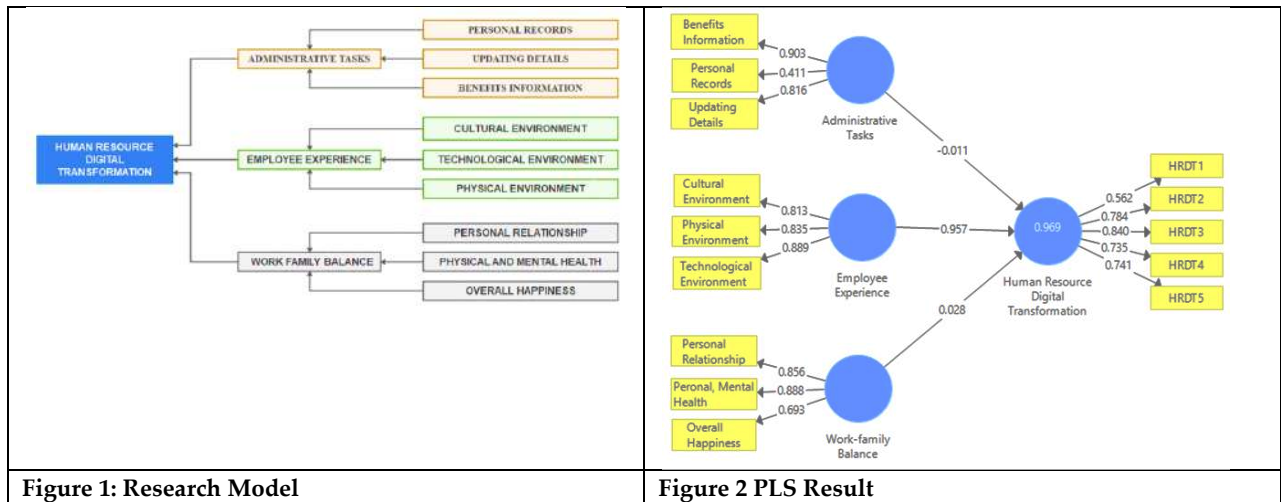


Figure 1: Research Model

Figure 2 PLS Result





Psycho-Sociological Impact of Learning from Home during Covid'19 Pandemic Outbreak on the Education of Primary School Children with Special Reference to Rural Areas

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ABSTRACT

The Covid'19 stuns the world and stagger the world economy. Irrespective of the sectors and departments, it affected the all the sectors and departments in the world. In which, one of the most affected department is education department. In the state of Tamil Nadu, last one year the schools are closed and students learning through channels and online mode through internet. In specific, the primary schools are not yet opened though higher classes are gradually come to normal. This study aimed to find out the impact of COVID'19 pandemic Lockdown on the education of the Primary school Children; studying 1st Standard to 5th Standard. Practically it was difficult for practicing these kids to attend the class through digital mode without facing their teacher in person. Moreover parents are also felt difficult to create a class room atmosphere at home and to bring the kids in to study table. By considering the future of these kids, a study was needed to understand the reality of reach of the digital mode classes and to know the present knowledge level of these kids after lockdown. The students studying primary classes in Trichy district alone taken for consideration and the samples are chosen from 14 rural educational blocks in Trichy district. The results may or may not applicable for the whole state of



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Tamil Nadu. It is found that the primary school students are not showing interest in online classes and their mental age has been diluted. Bring back them to the normal is too difficult but it is must. Most of the children are attending the Digital classes (TV channel or online classes) by the compulsion of their parents and with the expectation of getting mobile phone for playing games and watching favorite channels. In this research, it is suggested to permit the kids have school atmosphere maximum of two/three days in a week initially by strictly following precautionary measures and to compel the kids to follow the virtual classes daily. Through this research, it is concluded that the COVID'19 pandemic lockdown severally affected the education of the primary school children and needed some remedy to overcome this pathetic situation otherwise various welfare measures implemented by the Government of Tamil Nadu become waste and meaningless.

Keywords: Covid 19 Pandemic, Lockdown, Virtual (Digital) Classes, Primary School Children, Knowledge level, Education in Rural areas

INTRODUCTION

The COVID-19 may be most pronounced word in the year 2020. It affects different people in different ways during the year 2020. One among them is Education department. Covid'19 has disrupted the education, especially primary education, till today it is not being fully recovered. In Tamil Nadu, all the primary school students are missing their school life nearly 12 months since 16th March 2020. This is due to (Schools are being closed since 16th March 2020 to till date [1]. The Tamil Nadu Government has taken public health measures to the control the spread of COVID-19 pandemic and has meant the extended closure of schools. Even the Tamil Nadu government has taken efforts for the continuity in learning and well-being of these children and has implemented virtual learning strategies; it is found that an aggravate education gaps existing in the regions due to pandemic. The major objectives of this research is to finding out the impact of Covid'19 pandemic lockdown on the education of primary school students, say 1st standard to 5th standard studying in schools located in Trichy District. Totally 35,605 schools are available in Tamil Nadu in which 25,81,843 lakhs students are studying LKG to 5th Standard in Government, Government aided and Private schools [2]. The Indian Government has taken more initiatives to achieve universalization of primary education through many schemes [3] to the children in the age group of 5-10 years and ensures the availability of quality of primary education. According to Dr. Pravat Kumar Jena (July 2020) [4], this lockdown deteriorates the continuity in education of the student suffered a loss of nearly 3 months and created difficulty in resuming school again. Generally in India, Initially the educators and learners are not experienced and trained with use of technology in education and this is due to lack of practice and drive towards using technology in the field of education, this created high challenges during pandemic situation [5].

EDUCATION SYSTEM IN THE STATE TAMILNADU

The education structure of Tamil Nadu is based on the national level pattern of 12 years of schooling, i.e., 10+2, which includes eight years of elementary education. During these eight years of elementary education, first five year called primary education (1st Std. to 5th Std.) for the age group of 5 – 10 years and rest of three years will be a middle school education (6th Std. to 8th Std.) to the age group of 11- 13 years, followed by two years of secondary education (9th & 10th Std.) and two years of higher secondary education (11th & 12th Std.), in addition to two years of pre-primary education as LKG & UKG. The entry age in grade 1, i.e. 1st standard is 5+ years age and pre-primary classes from the age group of 3-4 years [6]. The primary education in Tamil Nadu is the period of formal education usually encompasses 1 to 5 and the students acquire basic skills in areas such as reading, writing and arithmetic during this period [7].



**Mohanraj et al.,****STUDENT ENROLLMENT AND STUDY AREA**

This research has been conducted in the primary schools located in Trichy district and offering only Nursery and Primary education. The Trichy district education zone has been divided into 16 blocks [8][9], in which, 14 blocks, such as Andanallur, Manikandam, Thiruverambur, Manapparai, Marungapuri, Vaiyampatty, Lalgudi, Manachanallur, Pullampady, Musiri, Thottiam, Thathaiyangar Pet, Thuraiyur, Uppiliyapuram in Trichy district are considered as rural and 2 blocks (Trichy town & Trichy west) are considered as urban. The study group are studying and residing in rural blocks. Totally 1032 Schools are offering only Nursery and Primary education from these 16 blocks. In which, totally 93,735 are studying the Grade between 1st standard to 5th standard. Out of which, 46,016 boys and 47,719 girls are studying primary education with Net enrollment ratio of 99.83% [10]

STATEMENT OF THE PROBLEM

Post COVID'19 pandemic lockdown gives rise to a number of issues and negative impact on educational knowledge of the children. The students are forced to attend classes through online mode, whether they are willing or not. Though the Government took many initiatives and sets guidelines on conducting online classes, especially for the welfare of the school children, the result is not appreciable. The Schools are squeezing them to maintain its image. In this context, the present study has made an attempt to study the impact of COVID'19 pandemic and remedy for the School children, especially Primary school going students (I Std. to V Std.). This is because, it is the first generation have not gone to school for the last one year and experienced the concept of Online Classes. In this study, the impact of COVID'19 on the primary school children has been analyzed.

RESEARCH OBJECTIVES

The research objectives are to find out the major impact on the education of Primary school students due to COVID'19 pandemic lockdown, Psychological effect on online/TV classes (Virtual), impact on their knowledge level relating to mental age, real output of conducting classes through online, students' response towards online classes and real outcome of the same.

RESEARCH METHODOLOGY**Research Design**

Descriptive research design has been used in this research and required data has been collected from different sources. The primary data collected through interview method and secondary data collected through websites and Government published data.

Sources of data and collection procedure

The researcher has used both primary and secondary data. The Primary data are collected fresh from 383 primary school student respondents. As the respondents were being the children, Interview schedule has been adapted with standardized questions for collecting the data. The required secondary data have been collected from books, journals, Press media, websites and Government published data.

Sampling Size and technique

Total number of Primary school students studying in Trichy district is 93,735 from 1032 schools by considered the schools offering primary and pre-primary education. In which, 46,016 numbers of students are boys and 47,719 are girls are studying 1st to 5th standard. In Trichy districts, the Nursery and Primary schools are comes under 16 rural blocks [10]. Out these 16 blocks, 383 samples from 14 rural blocks are taken for conducting survey. Here, the researcher has used cluster sampling technique and the sample size of 383 is calculated through online with 95% confidence level and 5% of margin of error [11].





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Analytical Tools

The collected data were analyzed by using proper statistical tools for the requirement of the objectives of the study.

DATA ANALYSIS AND INTERPRETATION

Democratic factors

The following are the democratic factors of sample of 383 students from primary schools. Based on the survey conducted on 383 samples of primary school students studying 1st std. to 5th std., the percentage of boy and girl respondents are 48% and 52% respectively, which shows the girl dominance on primary school students in this study area. In the whole sample, 14% of respondents studying 1st standard, 18%, 20%, 21% and 27% are studying 2nd, 3rd, 4th and 5th standard respectively. Regarding employment of parents, 68% of the student's parents (both Father and mother) are employed and 32% of the respondents' parents either father or mother is employed. 25% respondents are studying in Government schools, 21% and 54% of the respondents are studying in Government aided and Private primary schools respectively. From the above table, it is observed that gender wise standard of study 14%, 18%, 20%, 21% & 27% of the students are studying 1st, 2nd, 3rd, 4th and 5th standard respectively. Regarding gender wise standard of the study, 44% each, 60%, 49% & 42% of the boys students and 56% each, 40%, 51% and 58% of the girls students are studying 1st, 2nd, 3rd, 4th and 5th standard respectively. The Table No. inferred that out of 383 respondents, 74% of them are aware of COVID'19 pandemic and reason for the closure of schools for the last one year and 26% of the respondents are not aware of it. From the above table, it is clear that 64% of the Children are not willing to go to school and the rest of 36% Children are willing to go to school irrespective of the standard of study.

It is also found that the percentage of unwilling students from 1st, 2nd and 3rd standard is more comparatively 4th and 5th standard of students. From the above table, it is clear that out of 138 students willing to go to school, 37% of the students are willing to go to school due to unwillingness for attending online- classes, 22% of them are due to meet and play with friends, 18% of the kids are feel boring at home, 13% of them are due to interested on studies and 10% of them are pressure from their parents. From the above Table No. it is clear that out of 383 respondents, 64% of students are having the knowledge of their standard of study and able to recalling their subjects and 36% of the children irrespective of the standard; forget about their standard of study and not able to recall their subjects. The higher grade students are far better than the lower grade students in this regard. 83% of the kids opined that they are attending virtual classes for getting mobile phone/ TV to play games or to watch favorite channels and least number (06%) of kids are attending the classes due to gain subject knowledge. It is inferred that out of 383 respondents, 84% of them opined that they are not using or referring text books every day and just 16% of the respondents using the same. During this COVID'19 pandemic closure of school period, 55% of the primary school children opined that they are spending majority of their time with digital media followed by playing with friends (31%). 09% for Painting/ Craft work/ Drawing/Home play and 05% for Study related works. Out of 176 students of both Government and Govt. aided schools (Govt. 96+ Govt. Aided 80), 86% of them are unable to get Mid-day meals from the schools due to COVID'19 lockdown and 14% of them are getting mid-day meals through Govt. efforts, like door delivery, etc. It impacts on loss of nutrition to the students, who were depending Mid-day meals.

Hypothesis Testing (ANOVA)

Perception of respondents on the basis of gender about interest on attending virtual class, Concentration on virtual class, Response to Home work, Remembrance of subject and Clarity on topics relevant to subject.

1. H1: There is a significant relationship exist between Gender of the respondents' with interest on attending virtual class.
2. H1: There is a significant relationship exist between Gender of the respondents' with Concentration on virtual class.
3. H1: There is a significant relationship exist between Gender of the respondents' with Response to Home work.
4. H1: There is a significant relationship exist between Gender of the respondents' with Remembrance of subject.





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5. H1: There is a significant relationship exist between respondents' Clarity on topics relevant to subject. (H0 denotes, there is no significant relationship exists between all the five opinions).

From the above table, it is clear that all significant value (0.036, 0.338, 0.184, 0.159, 0.152) is greater than 0.05 (at 5% level of significant). Hence, The Alternate hypothesis (H1) of all criteria is rejected. It means, there is no significant relationship exists between gender of the respondents and factors of virtual classes. It is clear that 57%, 70%, 74% and 78% of the students are disagreed about interest on virtual classes, concentration on virtual classes, response to home work, remembrance of subject and clarity on relevance of topic to subject respectively. From the above analysis, the kids are not clear about the topics from which subject it is being taught (82%). From the above table, it is inferred that the High Standard Deviation denotes that the data are wide spread; it means that the primary school students are given variety of opinions and the low standard deviation denotes the given opinion has close relationship and common.

RESEARCH FINDINGS

It is found that almost 74% of the Primary schools students (Sample) are aware of the COVID'19 pandemic, purpose of lock down and reason for the closure of schools for the last one year. 64% of the students are not willing to go to school and 36% of them are willing to go to school. Out of which, 37% of the students are willing to go to school due to unwillingness for attending online- classes. While asking about willingness to go to school, it was observed that psychologically the students are felt tensed about reopening of schools; especially 1st to 3rd standard students felt tensed more comparing with higher classes. 64% of the students have the knowledge of their standard of study and 36% of the kids almost forgot about their standard of study. In which, students are studying 3rd and below are poor knowledge in this regard and unable to recall their subjects. According to Suraksha Subedi (2020), in his research, 75.9% of the respondents (75.9%) were nervous due to unable to understand full course content taught in the online classes [12]. Parents of primary school children feel that it is better to let the children repeat same grade in the next academic [13]. 83% of the kids opined that they are attending virtual classes for getting mobile phone/ TV to play games or to watch favorite channels. Majority (85%) of the Students are not using the text book and even not opening the book after the virtual classes are over. During this COVID'19 pandemic closure, 55% of the primary school children opined that they are spending majority of their time with digital media followed by playing with friends (31%). 86% of them are unable to get Mid-day meals from the schools due to COVID'19 lockdown and 14% of them are getting mid-day meals through Govt. efforts, like door delivery, etc. There is no significant relationship exist between gender of the respondents and factors like Interested on virtual class, Concentration on digital class, Response to Home work, Remembrance of subject, Clarity on relevance of topics to subject. The students are mostly given negative response about interest on virtual classes (57%), 70%, 74%, 78% and 82%), concentration on virtual classes (70%), response to home work (74%), remembrance of subject (78%) and clarity on relevance of topic to subject and respectively. The standard deviation denotes that the opinion given by the kids are not uniform and they are given variety of opinions.

RECOMMENDATIONS

A strong educational policy is to be thought of throughout India like in wartime terms, especially to overcome this COVID'19 pandemic situation faced by educational sector. The COVID-19 affected primary education in India and teaches a lesson to us to construct versatility to face this dangers situation and advised us that change is unavoidable [14]. The sudden shift to virtual learning without any having proper designed curriculum on virtual classes, make our students a risk of passive learners and they may losing interest on attention [15]. To overcome these, the researcher has given some recommendations. First of all, it is recommended that if the Government decided to reopen the primary schools, if everything comes to normal, it is better to permit to conduct the classes initially weekly 3 days only, otherwise psychologically it affects the kids and they may dislike to go to school in future, here the parent's role is vital to bring back their wards in normalities. As found that majority of the parents are employed and virtual classes are conducted during day time, it did not reach the wards properly. So, it is recommended to





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conduct the classes at evening time or recorded one. It is also suggested that in the virtual classes not only talking about subjects and also providing stories and fun games. Majority of the online platforms are following the same methodology (delivering only subjects), it should be unique to the level of the primary school students and may be designed to create interest among the kids by attending the virtual classes. Due to this lockdown, the students studying in Government and Govt. aided schools were not able to get free mid-day meals, this severely affected the nutrition level of such students [5], In this regard, the Tamil Nadu government has taken the effort of providing mid-day meals at their door steps in some particular areas, but it has to be extended all the areas, because, we should compromise the hungry and health of kids.

CONCLUSION

It is concluded that the COVID'19 pandemic lockdown severely affected the knowledge level of primary school children, especially the children studying between 1st standard and 3rd standard. It will a collective effort by Government, Teachers, Parents and the society to bring these children in to normality, but it will take few years. This study portrays the negative impact of COVID'19 Pandemic lockdown on the education of primary school children. It is advisable that there should be gradual feeding of subjects towards the mind of kids, definitely we need patient, because they are kids, they are experiencing a new situation what we were not faced in our childhood.

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Table No.1: Respondents’ profile from 383 samples

Particulars	Basis	Frequency	Percentage
Gender	Boys	184	48%
	Girls	199	52%
Standard of Study	1 st	54	14%
	2 nd	68	18%
	3 rd	75	20%
	4 th	82	21%
	5 th	104	27%
Occupation of Parents (Both Father & Mother)	Employed Both	260	68%
	Not Employed Both	123	32%
Gender wise Standard of study	1 st	24 Boys/ 30 Girls	44% & 56%
	2 nd	30 Boys/ 38 Girls	44% & 56%
	3 rd	45 Boys/ 30 Girls	60% & 40%
	4 th	40 Boys/ 42 Girls	49% & 51%
	5 th	45 Boys/ 59 Girls	42% & 58%
Category of School	Govt. Schools	96 (B-36/ G-44)	25%
	Govt. Aided	80 (B-52/ G-44)	21%
	Private	207 (B-96/ G-111)	54%

Source: Primary Data (B –Boys, G- Girls)

Table No.2: Students’ awareness about COVID’19 pandemic & Reason for Closure of School

Particulars	Opinion	Frequency	Percentage	N
Awareness about COVID’19 pandemic and reason for Closure of school	Yes	282	74%	383
	No	101	26%	

Source: Primary Data

Table No.3: Standard wise students’ opinion on willingness to go to school

Standard of Study	Opinion				N
	Yes		No		
1 st Standard	06	11%	48	89%	54
2 nd Standard	15	22%	53	78%	68
3 rd Standard	21	28%	54	72%	75
4 th Standard	36	44%	46	56%	82
5 th Standard	60	58%	44	42%	104





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Total & Percentage	138	36%	245	64%	383
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Source: Primary Data

Table No.4: Reason for willingness to go to school

Particulars	Frequency	Percentage	N
Unwilling to attend On-line classes	51	37%	138
To Meet and play with friends	30	22%	
Interest of Studies	18	13%	
Feel boring at home	25	18%	
Pressure from their parents	14	10%	

Source: Primary Data

Table No.5: Opinion of the respondents’ knowledge on their standard of study and ability to recalling the subjects

Particulars	Opinion				N
	Yes		No		
1 st Standard	15	28%	39	72%	54
2 nd Standard	32	47%	36	53%	68
3 rd Standard	45	60%	30	40%	75
4 th Standard	56	68%	26	32%	82
5 th Standard	96	92%	08	08%	104
Total/ Percentage	244	64%	139	36%	383

Source: Primary Data

Table No.6: Reason for attending virtual classes

Particulars	Frequency	Percentage	N
To get mobile/ TV to play games or to watch favorite channels	318	83%	383
To gain subject knowledge	022	06%	
Fear on class teacher/ parents	043	11%	

Source: Primary Data

Table No.7: Opinion on referring the text books by the students

Particulars	Opinion	Frequency	Percentage	N
Opinion on using or referring the text book	Yes	063	16%	383
	No	320	84%	

Source: Primary Data

Table No.8: Opinion on everyday spending majority of the time during this COVID’19 pandemic closure of school

Particulars	Frequency	Percentage	N
Study related works.	019	05%	383
Playing with friends	118	31%	
Painting/ Craft work/ Drawing/Home play	036	09%	
Spending time with digital media	210	55%	





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Table No.9: Opinion on unable to get Mid-day meals due to COVID'19 lockdown & Loss of nutrition by the Govt. & Aided schools students

Particulars	Opinion	Frequency	Percentage	N
Unable to get Mid-day meals due to lockdown	Yes	151	86%	176
	No	025	14%	

Table No.:10 – Relationship between Democratic factors and other criteria (ANOVA)

Gender	N	Mean	Std. Deviation	Sum of Squares	df	Mean Square	F	Sig.
Male	184	41.9255	10.26546	362.552	2	362.522	3.525	.067
Female	199	40.6623	10.37028					
Total	383	41.4801	10.31486					

Table No.:10 (a) - Relationship between Democratic factors and other criteria (ANOVA)

Factors	Gender	N	Mean	Std. Deviation	Sum of Squares	Df	Mean Square	F	Sig.
Interested on Virtual class	Boys	184	5.9122	1.82139	16.807	2	16.809	4.832	.036
	Girls	199	5.5246	1.98094					
	Total	383	5.8172	1.88256					
Concentration on Virtual class	Boys	184	6.5437	2.03942	3.853	2	3.755	0.875	.338
	Girls	199	6.2050	2.09903					
	Total	383	6.3670	2.06046					
Response to Home work	Boys	184	11.3876	3.67949	24.368	2	24.378	1.687	.184
	Girls	199	10.9615	3.73011					
	Total	383	11.1751	3.69881					
Remembrance of subjects	Boys	184	18.3876	5.49538	64.987	2	65.963	2.201	.159
	Girls	199	17.8324	5.79232					
	Total	383	18.1827	5.60469					
Clarity on relevance of topics to subject	Boys	184	18.4812	5.49538	53.838	2	54.937	2.305	.152
	Girls	199	17.8337	5.79232					
	Total	383	18.2021	5.60469					

Table No.11: Opinion of the students on virtual classes

Study Elements	Agreed	No opinion	Disagreed	N
Interested on Virtual classes	61	104	218	383
	16%	27%	57%	
Concentration on Virtual classes	75	38	270	383
	20%	10%	70%	
Response to Home work	52	46	285	383
	14%	12%	74%	
Remembrance of subjects	51	32	300	383
	13%	08%	78%	
Clarity on relevance of topics to subject	43	28	312	383
	11%	07%	82%	





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Table No.12: Standard and mean deviation on opinion of respondents

Study Elements	N	Minimum	Maximum	Mean	Std. Deviation
Interested on Virtual class	383	3	8	5.75	.91
Concentration on Virtual class	383	2	8	5.70	.76
Response to Home work	383	3	8	5.67	.81
Remembrance of subjects	383	2	8	5.34	1.02
Clarity on relevance of topics to subject	383	3.66	8	5.68	.726

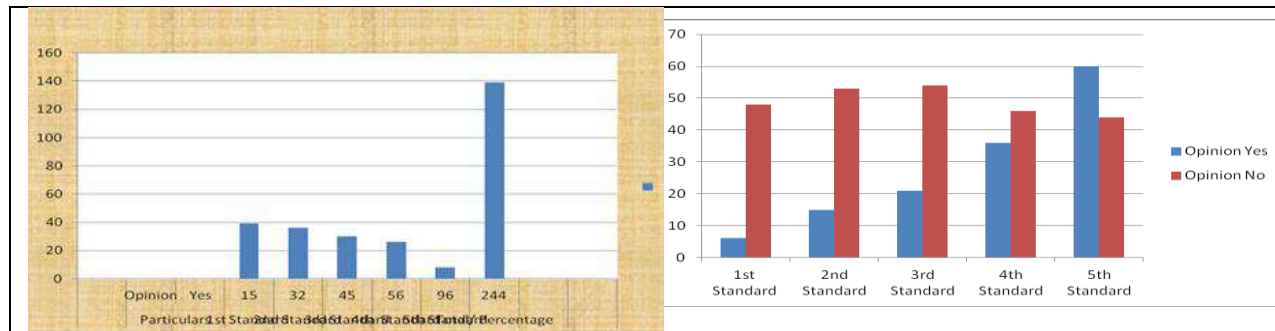


Fig.1 showing respondents’ demographic profile like gender, standard of study and occupation of parents

Fig. 2 Standard wise students’ opinion on willingness to go to school

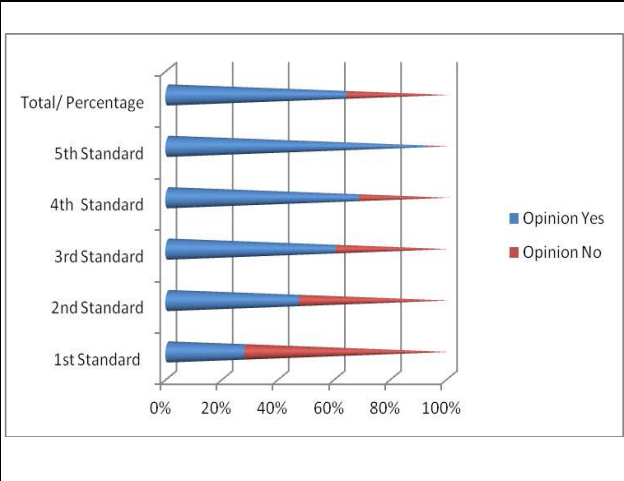
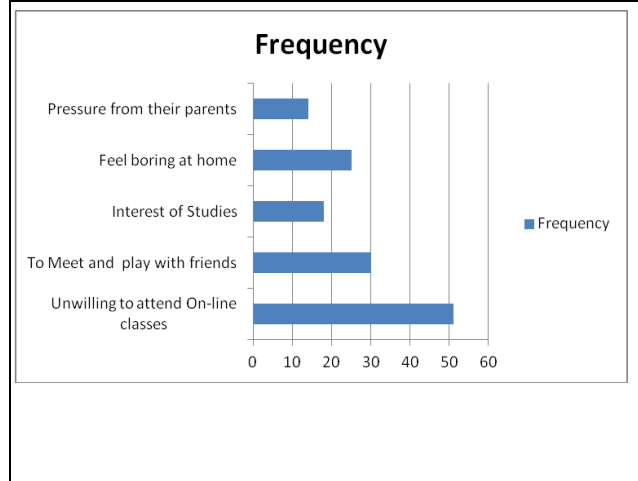


Fig. 3 Reason for willingness to go to school

Fig. 4 Opinion of the respondents’ knowledge on their standard of study and ability to recalling the subjects





Navigating Sustainability - A Study on ESG Integration on Firm Performance of Indian Companies

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ABSTRACT

In the past, investors prioritized quantitative and objective characteristics while choosing investments. Growth, financial positions, profit, dividend pay-out, financial ratios, and peer comparison are standard parameters. This method was best for solo analysis. Investors and organizations have realized they are part of a broader ecosystem. They recognize that a mutually beneficial relationship with the environment and society is essential for long-term existence. Governance is a foundation and directs the environmental and social pillars of sustainability. Today, firms must have a larger goal than just profit. The triple bottom line is more emphasized as it embraces economic, social, and environmental sustainability. This study examines how environmental, social, and governance (ESG) practices affect the financial performance of the top 50 Indian corporations listed by the National Stock Exchange (NSE) for 2021–2022. The data used for this research was taken from CRISIL ESG Scores 2022. Corporate value and profitability are regularly used to evaluate corporate performance. Tobin's Q values companies, while ROA measures their profitability. The findings derived from Tobin's Q analysis suggest a positive impact of ESG Practices. It has been established that individual ENV, SOC, GOV, and the aggregate ESG score positively affect corporate value. The return on assets (ROA) analysis also showed that environmental, social, and governance (ESG) components and the composite ESG score affect business profitability. This study also considered the individual pillar-wise ESG scores and the aggregate ESG score to assess business performance, unlike previous research that only considered one dimension or an overall ESG score. In addition, this research used firm value (Tobin's Q) and firm profitability (ROA) to analyze how environmental, social, and governance (ESG) variables affect Indian companies.



**Niveditha and Nirmala****Keywords:** ESG practices, firm performance, Indian Companies, Tobin Q, ROA, Firm value.

INTRODUCTION

Sustainability and corporate responsibility-related issues are sometimes called "Environmental, Social, and Governance (ESG)" issues. The impacts on ecosystems and communities are at the heart of these discussions. In light of the climate disaster and the increased significance of diversity, inclusiveness, and equality, companies, regulators, investors, and other stakeholders are increasingly focusing on these concerns. Responsible investing is gaining traction, and one technique for doing so is incorporating environmental, social, and governance (ESG) considerations into investment practices and choices. Individuals with socially solid preferences, as identified by Riedl and Smeets (2017), are more likely to invest their money into socially responsible funds than into more traditional ones, despite the latter's potential for higher returns. By proactively assessing possible problems, ESG risk management helps businesses achieve long-term growth that won't derail the economy. Organizations are given more time to adapt and develop solutions to reduce associated costs if they are made aware of potential dangers sooner rather than later. In evaluating the overall risk and possible return of an investment, investors place a premium on how well a company manages risk related to environmental, social, and governance (ESG) aspects. Yoon et al. (2018) report a worldwide pattern of firms voluntarily engaging in ESG practices, which may indicate the existence of financial incentives for doing so. Companies have shown a growing propensity to disclose ESG (environmental, social, and governance) information. Lokuwaduge and Heenetigala (2017) show that the credibility of its ESG practices greatly impacts a company's commitment to ESG disclosure.

Companies may maintain and improve their reputation in the face of stakeholders' scrutiny and social media's impact by using ESG disclosure as a strategic instrument for impression management (Brammer & Pavelin, 2008). Globally, ESG investments are proliferating. According to research by Bloomberg Intelligence, environmental, Social, and Governance (ESG) assets are expected to grow to more than \$53 trillion by 2025. Over a third of the estimated \$140.5 trillion in Total Assets Under Management (AuM) is predicted to come from this sum. Increased investor demand, changing regulatory requirements, and the emergence of numerous ESG funds all contribute to the recent surge in asset allocations prioritizing environmental, social, and governance (ESG) aspects. Similarly, the meteoric rise of ESG funds in India over the past four years reflects the observable pattern. From \$283.5 million (INR 2,268 crore) in March 2019 to \$1.5 billion (INR 12,447 crore) in March 2022, the AUM of these funds has increased significantly. Thomson Reuters Asset, Bloomberg, MSCI, S&P Global, Refinitiv, CRISIL, MOODY'S, Dow Jones Sustainability Index, etc, are some of the rating agencies that track and rate the environmental, social, and governance (ESG) performance of thousands of companies every year and makes information accessible to the shareholders, investors, regulators, and other interested parties. Despite having existed for quite some time, systematic ESG reporting and analysis is a relatively recent discipline in India. The Sustainable Stock Exchange Initiative (SSE) of the United Nations works with stock exchanges to foster the sustainability agenda. According to SSE (2022), 66 of the 120 member stock exchanges have published criteria for environmental, social, and governance (ESG) reporting by corporates.

ESG Reporting in India

The Indian government's Ministry of Corporate Affairs (MCA) issued its Voluntary Guidelines on Corporate Social Responsibility in 2009, marking the beginning of ESG reporting in the country. Business Responsibility Reporting (BRR), Corporate Social Responsibility (CSR), Integrated Reporting (IR), National Guidelines for Responsible Business Conduct (NGRBC), and, most recently, the Business Responsibility and Sustainability Report (BRSR) have all been added to the reporting framework since then. Environmental, Social, and Governance (ESG) reporting has been required since 2012, according to rules established by the Securities and Exchange Board of India (SEBI). According to this rule, the 100 largest publicly traded companies by market value must file a Business Responsibility Report. It was later decided to broaden the initiative's focus to include the 500 largest publicly traded companies



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worldwide as of 2015, based on their market capitalizations. On May 10th, 2021, the Securities and Exchange Board of India (SEBI) launched a new reporting framework called the Business Responsibility and Sustainability Report (BRSR). Top 1000 listed companies in market capitalization are made mandatory to report on the material environmental, social, and governance (ESG) risks and opportunities related to their operations by the BRSR (Business Responsibility and Sustainability Reporting) framework for 2022-23. Furthermore, these companies need to give an overview of their plans for responding to and adjusting to these risks while keeping the monetary costs in mind. The measure was implemented to ensure openness and accountability for all parties involved.

REVIEW OF LITERATURE

Independent and dependent variables are discussed, and hypotheses are developed from the reviewed literature.

ESG Practices and Firm Performance

There is a contemporary trend of stakeholders evaluating businesses based on short-term profits and considerations like sustainability and long-term value creation. Organizational value can be significantly impacted in both the short and long term by addressing ESG factors. Their importance has expanded as organizations increasingly focus on generating fair and inclusive value over the long run. Environmental, social, and governance (ESG) factors have been shown to affect company success (Friede et al., 2015; Zumente & Bistrova, 2021). There is evidence that environmental, social, and governance (ESG) factors considerably impact corporate profits (Efimova, 2018). Several international studies show a link between a company's Environmental, Social, and Governance (ESG) ranking and its financial success. Xie et al.'s (2019) research analyses how various environmental, social, and governance (ESG) activities relate to the bottom lines of numerous multinational corporations. According to the results, many ESG projects have a beneficial effect on bottom-line results. More stringent disclosure laws are associated with larger organizations hiring more qualified managers, boosting financial performance (Hamelin & Weisbach, 2012). Swami et al. (2016) state that ESG screening has not significantly impacted the financial performance or risk profile of businesses. Duque-Grisales and Aguilera-Caracuel (2021) state that ESG (environmental, social, and governance) concerns can significantly affect the bottom line and the value of a company. Environmental, social, and governance measures taken by corporations have been shown to positively affect innovation performance in a study by Freiberg et al. (2019), as emphasized by Zhang et al. (2020). Environmental, social, and governance (ESG) aspects are investigated in the financial performance of 4887 companies between 2014 and 2018 in the study by Bhaskaran et al. (2020). As independent variables, the authors use measures of company value (as determined by Tobin's Q) and operational performance indicators (ROE and ROA, respectively).

ESG and Firm Value.

In four nations—China, Denmark, Malaysia, and South Africa—the study by Ioannou and Serafeim (2012) examined the effects of regulatory requirements on the disclosure of environmental, social, and governance (ESG) information. The study's findings suggested a positive association between sustainability disclosure regulations and the valuations of participating firms. Several studies have shown a positive and statistically significant association between the combined score of environmental, social, and governance (ESG) variables and company value. Aydomuş et al. (2022) found a positive and statistically significant correlation between individual social and governance ratings and company value. Still, they found no such correlation between the environment score and value. During the decade between 2007 and 2016, Buallay (2019) studied 342 financial institutions in the top 20 nations that made the most progress toward attaining sustainable development goals. The study aimed to determine how environmental, social, and governance (ESG) issues affect market performance. The study's results to the value creation idea by showing a link between ESG considerations and financial returns. However, it can be claimed that ESG issues hurt financial and operational performance, consistent with the cost-of-capital reduction theory. Naeem et al.'s (2022) research analyzes how the performance of ESG (environmental, social, and governance) affects bottom lines. Tobin's Q is used as a proxy for market capitalization, and the authors show a positive and statistically significant association between ESG ratings and market capitalization. As a result of this discussion, the following conjecture can be made:



**Niveditha and Nirmala****ESG and Firm Profitability**

There is a statistically significant link between a company's profitability and its ESG total score. Each part of the ESG score—environment, social, and governance—correlates similarly. Since the pandemic has had such a profound effect on economies and societies worldwide, it is not surprising that investors and businesses have recently shown increased interest in ESG ratings, which incorporate not only accounting practices but also governance and social impact measures. Daz et al. (2021) conducted research that hints at the "hidden" hazards faced by corporations that ignore their social responsibilities and engage in inefficient governance practices. While Talento et al.'s (2019) research found that individual ESG scores had no bearing on performance, it did find that out-of-the-ordinary ESG results had a favorable correlation with industry norms. Evidence shows that a company's size is a meaningful contextual factor, frequently indicating the presence or absence of discretionary resources. To remain competitive in today's market, businesses must fulfill their stakeholders' social, environmental, and governance obligations. The number of ESG funds, their average AUM, and their inflows have all increased dramatically in recent years. Based on the risk-adjusted performance metrics analysis results, it is clear that many of the funds have outperformed the market portfolio in 2021 and during the given time frame (Sarkar, 2022). The effect of environmental, social, and governance (ESG) performance on financial success is the subject of research by Naeem et al. (2021). The authors show a positive and statistically significant relationship between ESG ratings and profitability as assessed by return on assets (ROA) for individual and aggregated scores. Therefore, the following hypothesis has been developed as a result of the preceding discussion: It is expected that increased firm value and profitability may result from enhanced ESG ratings based on the complete analysis of existing data, which considers the increased attention from investors and the public perception of the organization. The following theories will be tested in this investigation:

Hypothesis 1. ESG scores have a positive and significant impact on firm value

Hypothesis 2. ESG scores have a positive and significant impact on firm profitability

Numerous scholarly investigations and empirical analyses conducted in finance indicate a favorable correlation between Environmental, Social, and Governance (ESG) factors and the value and profitability of firms. Nevertheless, prior studies have shown many unfavorable and inconclusive findings. This study aims to contribute to the ongoing debate by utilizing a substantial, up-to-date, and extensive dataset.

DATA AND METHODOLOGY

This section provides an overview of the sample data, followed by a detailed description of the variables, a presentation of descriptive statistics, and an explanation of the methodology employed in the study. Two-panel data models are employed for each dependent variable, resulting in four models for each independent variable.

Sample Data

The current study has used the ESG Scores of the top 50 companies in terms of Market Capitalization as per the NSE Website for 2021-22. These 50 companies belong to 9 sectors measured by CRISIL.

Dependent Variables

This research uses market-based and accounting-based measures of a company's success (Gentry & Shen, 2010). As a result, company performance has been measured through two surrogates: market capitalization and profitability. Based on the work of Jang, Lee, and Choi (2013), Mishra and Suar (2010), and Simpson and Kohers (2002), this study expands on their findings. Tobin's Q is often used as a proxy for firm value in market-based business performance assessments in developing economies. According to Kim, Chung, and Park (2013), Tobin's Q is a financial indicator that "measures the extent to which a company's market value exceeds the value of its tangible assets." Consequently, businesses with higher Tobin's Q ratios are more valuable than those with lower ratios. The formula below is used to carry out the calculation. Tobin's Q is the ratio of a company's market value to its book value. Since its introduction, return on assets (ROA) has become a standard indicator of financial performance in accounting-based evaluations (Gryphon & Mahon, 1997). Investors may use it as a proxy for overall company success (Scott, 2003); therefore, it is essential to keep that in mind. The following equation is applied to calculate return on assets (ROA): The ratio of a





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company's net income to the average of its total assets is known as its return on assets (ROA), a financial indicator used to assess its profitability.

Independent variables

The study includes four independent variables: the environment score, the social score, and the governance score, for a total of the ESG combined score. All of the ESG scores used in this analysis are from Crisil ESG Scores 2022. CRISIL's Environmental, Social, and Governance (ESG) scores are used to aid financial institutions and corporations in evaluating and monitoring the ESG risks inherent in their stock and debt holdings. The evaluation is based on data made public by the firms, such as information from their websites, exchange filings, annual reports, investor presentations, sustainability reports, and CDP filings. It also includes relevant ESG information readily available from credible sources, such as that disclosed by trade associations, government agencies, and other organizations. The rating is based on a combination of quantitative data and qualitative disclosures.

Descriptive Statistics

NSE Top 50 companies are taken. Tobin's Q and Return on Assets (ROA) are the dependent variables, and ESG_CS, Environment, Society, and Government (ESG_CS, ENV, SOC, and GOV) are the independent variables. The descriptive data are shown in Table 1. Return on assets (ROA) is 10.04 percent, whereas Tobin's Q averages 2.35 percent. The stock may be overpriced if Tobin's Q is more than one. A sizeable fraction of the businesses in our sample are overpriced. A higher return on assets (ROA) indicates increased profitability for a business. A return on assets (ROA) of 5 percent or more is generally considered successful. According to the data, most businesses are pretty effective at turning their resources into cash flow, with a mean return on assets (ROA) of 10.04 percent. The average ESG (environmental, social, and governance) scores are as follows: 62.14 for the combined score, 54.82 for the environment, 58.26 for social, and 70.90 for Governance. Governance and social indicators are higher than environmental ones. It is also important to note that all variables have standard deviations inside the norm.

Methodology

Tobin's Q and return on investment (ROI) models are used to analyze the data and draw conclusions for this study. Numerous studies, such as those by Giannopoulos et al. (2022) and Naeem et al. (2022), have included Tobin's Q and ROA as dependent variables. Since the independent variables (ESG_CS, ENV, SOC, and GOV) are correlated, multiple models consider them separately. To estimate the results, we ran a total of eight models.

$$TQ_{it} = \beta_0 + \beta_1 ESG_{CSit} + \epsilon_{it}$$

$$TQ_{it} = \beta_0 + \beta_1 ENV_{it} + \epsilon_{it}$$

$$TQ_{it} = \beta_0 + \beta_1 SOC_{it} + \epsilon_{it}$$

$$TQ_{it} = \beta_0 + \beta_1 GOV_{it} + \epsilon_{it}$$

$$ROA_{it} = \beta_0 + \beta_1 ESG_{CSit} + \epsilon_{it}$$

$$ROA_{it} = \beta_0 + \beta_1 ENV_{it} + \epsilon_{it}$$

$$ROA_{it} = \beta_0 + \beta_1 SOC_{it} + \epsilon_{it}$$

$$ROA_{it} = \beta_0 + \beta_1 GOV_{it} + \epsilon_{it}$$

where TQ_{it} and ROA_{it} are dependent variables, ESG_{CSit} , ENV_{it} , SOC_{it} , GOV_{it} are independent variables, ϵ_{it} is the error term for firm i in period t .

Impact of ESG measures on ROA:

Pearson correlation coefficients were used to study the link between ROA and ESG measures, including sustainability performance and social responsibility. The ROA was considered dependent, whereas the ESG indicators were treated as independent factors. A multiple regression analysis was carried out to dig even deeper into this connection. The data was tabulated and presented below.: One way to measure the closeness of a relationship between two variables is with a coefficient of correlation. Table 2 shows a positive and statistically significant relationship when analyzing the relationship between the return on assets (ROA) and the independent variables that make up environmental, social, and governance (ESG). Return on assets (ROA) has a moderately



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positive link with social aspects (0.424) and a moderately positive correlation with governance elements (0.580), according to the correlation value. The association between ROA and integrated ESG measures indicates a substantial positive correlation, with a correlation coefficient of 0.732. Concerning Table 3, ANOVA results indicate that the regression model is statistically significant in predicting ROA as $p < 0.05$ ($p=0.000$) Table 4 displays the unstandardized coefficients from the multiple regression model, which explains how ESG measures affect ROA for different types of businesses. The coefficient reveals the correlation between the dependent and independent variables, each measured on their own scales. We normalized the coefficients to measure how much each independent variable affected the dependent variable. This research found that the Environment variable was the most influential ($r = 0.512$). The Governance Factor came in second with a rating of 0.344, and the Social Factor came in third with a value of 0.213. The Return on Assets (ROA) is significantly influenced by incorporating Environmental, Social, and Governance (ESG) indicators, with an r -squared value of 0.493. The statistical analysis shows that all independent variables significantly affect return on assets (ROA) because their p -values are less than 0.05 ($p < 0.05$).

The regression equation for ROA

$$\text{ROA} = 35.684 + 0.434(E) + 0.215(S) + 0.318(G)$$

From Table 5, we may infer that the simple correlation coefficient (R) value is 0.807, indicating a high degree of connection. In addition, the R^2 value is 0.620, which indicates that the independent factors explain 62% of the variation in the dependent variable, which is companies' return on assets (ROA).

Impact of ESG measures on Tobin Q

The correlation between Tobin Q and ESG measures was analyzed using Pearson correlation coefficients. The researchers used a multivariate regression analysis, with ESG readings as the independent variables and Tobin Q as the dependent one. Standardized values for all constructs were first calculated so that regression analysis could be performed. The data is presented in the tables below. The correlation coefficient can measure the degree of association between two variables. Table 6 shows a positive and statistically significant relationship between Tobin Q and all of the ESG parts, the independent variables. Tobin Q has a moderately good association with social and governance characteristics ($r = 0.589$) and a substantial positive correlation with environmental elements ($r = 0.766$). Tobin Q and combined ESG readings correlate positively ($r = 0.700$). Concerning Table 7, ANOVA results indicate that the regression model is statistically significant in predicting Tobin Q as $p < 0.05$ ($p=0.000$) Table 8 displays the multiple regression coefficient, which explains how ESG indicators affect the unstandardized Tobin Q of businesses. The coefficient reveals the correlation between the dependent and independent variables when measured on separate scales. The significance of the relationship between the independent and dependent variables was calculated using the standardized coefficients. The environment component was shown to have the most significant influence in this research, with a value of 0.643. The governance factor ranked last with a rating of 0.210, and the social factor ranked third at 0.321. The value of 0.282 in connection to TobinQ is discovered to be significantly impacted by the incorporation of environmental, social, and governance (ESG) indicators. All of the independent factors greatly affect the return on assets (ROA), as shown by the fact that all of the corresponding values are statistically less than 0.05 ($p < 0.05$).

The regression equation for Tobin Q:

$$\text{Tobin Q} = 11.107 + 0.641(E) + 0.318(S) + 0.244(G)$$

From Model Summary Table 9, we can infer that the simple correlation R -value is 0.855, signifying a high degree of correlation R^2 value being 0.707, which indicates that the Independent Variables explain 70.7% of the variability of the dependent variable Tobin Q in Companies.





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CONCLUSION

This research examines how Environmental, Social, and Governance (ESG) performance affects corporate valuation and financial performance. Data from 50 firms was used in the study. Multiple regression and correlation analyses were used to analyze the data. The results showed a strong correlation between the firm's ROA, Tobin's Q ratio, and ESG scores. The environment had the highest correlation compared to social and governance variables. Environmentally conscious investment decisions by corporations result in the following. By producing biodegradable products, they achieve zero carbon emissions, use renewable energy sources like solar panels, reduce electricity use, reuse byproducts, practice effective waste management, green supply chain management, and other sustainable practices. These investments help businesses implement innovative environmental technology and processes to reduce costs, mitigate risk, and explore new markets. Thus, the company's profitability and value rise. The combined ESG score (ESG_CS) and profitability have a strong and statistically significant positive correlation. Profitability has a strong positive correlation with environmental (ENV), social (SOC), and governance (GOV) factors, which is consistent with stakeholder theory and prior research. Shareholders, investors, creditors, and governments expect corporations to perform well in ESG areas. When companies meet or exceed these expectations, they may receive market rewards. The positive correlation between ESG factors, CSR, business value, and profitability shows this. Our study shows that business managers should invest more in ESG activities. Our findings also emphasize the need for policymakers to pass and enforce ESG laws. Future research should examine the relationship between categories like resource use, emission, innovation, workforce, human rights, community, CSR strategy, compliance, transparency, etc, which form the three pillars of sustainability with the individual scores and combined ESG scores and also its impact on ESG performance, business value, and profitability.

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Table 1 Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
TobinQ	.03	9.16	2.35	2.66
ROA	-13.45	49.91	10.04	10.27
E	33.00	81.00	54.82	11.59
S	39.00	70.00	58.26	5.86
G	50.00	81.00	70.90	7.01
ESG	47.00	76.00	62.14	6.90





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Table 2: Correlation between ROA and ESG measures

	ROA	E	S	G	ESG
ROA	1				
E	.745**	1			
S	.424**	.583**	1		
G	.580*	.598**	.578**	1	
ESG	.732**	.776**	.633**	.632**	1

** . Correlation is significant at the 0.01 level (2-tailed).

Table 3: ANOVA table for ROA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2962.428	4	740.607	20.974	.000
	Residual	1588.952	45	35.310		
	Total	4551.380	49			

Table 4: Multiple regression coefficients for ROA

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	35.684	9.786		3.647	.001
	E	.434	.156	.512	2.776	.008
	S	.215	.138	.213	2.106	.026
	G	.318	.110	.344	-2.877	.006
	ESG	.698	.278	.493	2.512	.016

Table 5: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.807	.651	.620	5.94223

Table 6: Correlation between Tobin Q and ESG measures

	Tobin Q	E	S	G	ESG
Tobin Q	1				
E	.766**	1			
S	.589**	.637**	1		
G	.554**	.587**	.626**	1	
ESG	.700**	.718**	.687**	.637**	1

** . Correlation is significant at the 0.01 level (2-tailed).

Table 7: ANOVA table for Tobin Q

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	35.826	4	8.956	30.593	.000
	Residual	13.174	45	.293		
	Total	49.000	49			





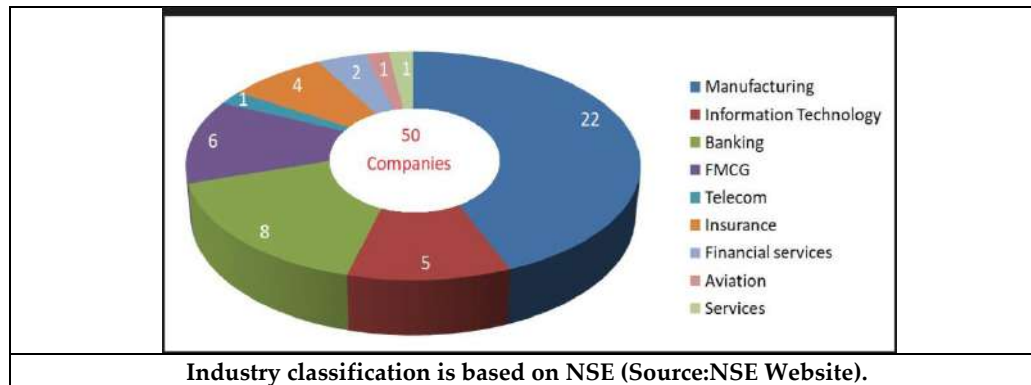
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Table 8: Multiple regression coefficients for Tobin Q

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
	B	Std. Error	Beta			
1	(Constant)	11.107	1.884		5.895	.000
	E	.641	.125	.643	5.121	.000
	S	.318	.104	.321	3.199	.002
	G	.244	.098	.210	2.101	.044
	ESG	.292	.136	.282	2.075	.032

Table 9: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.855	.731	.707	.54107547





Digital Transformation in Strategic Marketing: Trends, Challenges, and Implications for Firms

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ABSTRACT

The computerized time has introduced in a insurgency within the field of key promoting, with businesses adjusting to computerized change at an uncommon pace. This writing study paper investigates the energetic scene of computerized change inside the domain of key showcasing, shedding light on later patterns, challenges, and the significant implications for firms. Drawing on the hypothetical establishments and models within the field, we set the arrange for an in-depth investigation of computerized promoting patterns. We exhibit the foremost later and significant methodologies embraced by businesses and display compelling case ponders outlining fruitful computerized showcasing changes, utilizing computerized innovations and leveraging enormous information to pick up bits of knowledge into buyer behavior. In differentiate, the paper moreover dives into the challenges and boundaries confronted by businesses when executing advanced showcasing methodologies. This segment highlights the basic significance of information in personalizing promoting endeavors whereas tending to protection and security concerns. The developing significance of Omni channel showcasing is additionally explored, enumerating how companies coordinated their online and offline endeavors to form consistent client encounters. All through the paper, we underline the suggestions of advanced marketing transformation for firms, from enhancing business execution to reshaping the parts of showcasing experts. This comprehensive study paper solidifies important experiences for businesses, analysts, and experts looking for to get it and tackle the potential of advanced change in key promoting.



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Keywords: Digital transformation, strategic marketing, digital marketing, trends, challenges, data analytics, consumer insights, Omni channel marketing.

INTRODUCTION

Background and Context of Digital Transformation in Marketing

The digital age has catalysed transformative shifts in promoting, rethinking how businesses interface with their clients. Nowadays, customers are engaged with data and lock in with brands through computerized touch points, driving to a worldview move in promoting honed. As Kaplan and Haenlein (2010) famous, social media and computerized advances have enabled clients, permitting them to effectively take part in promoting discussions. In this setting, businesses must grasp computerized change to remain competitive.

Significance and Relevance of the Review

The noteworthiness of this writing survey lies within the have to be comprehend the suggestions of computerized change in promoting. Digitalization isn't simply an choice; it's a principal prerequisite for firms to stay pertinent and beneficial. The American Promoting Affiliation (AMA) emphasizes the criticality of keeping pace with the energetic promoting scene, expressing that "Showcasing is the movement, set of educate, and forms for making, communicating, conveying, and trading offerings that have esteem for clients, clients, accomplices, and society at huge" (AMA, 2020). As such, understanding the advancing setting and importance of computerized change is crucial for businesses.

Research Objectives

1. Look at later patterns in advanced promoting procedures.
2. Explore the challenges and obstructions firms confront in executing computerized showcasing changes.
3. Analyze the part of information analytics in forming advanced promoting methodologies and the utilization of buyer experiences.
4. Assess the noteworthiness of Omni channel showcasing in conveying consistent client encounters

Structure of the Paper

This paper is organized to supply a comprehensive investigation of advanced change in promoting. Taking after this presentation, the ensuing areas will dive into the different viewpoints of advanced change and its suggestions. These incorporate a survey of later patterns in advanced promoting, outlined through case ponders, and the affect of developing innovations. The paper will conclude with bits of knowledge into future inquire about headings, advertising a all encompassing see of computerized change in vital promoting.

Transformation in Marketing: Conceptual Framework

Definition and Scope of Digital Transformation

Computerized change may be a multifaceted concept that includes the integration of computerized innovations into different viewpoints of an organization's operations to drive significant changes in how it conveys esteem to its partners. Chaffey and Smith (2017) portray computerized change as "the utilize of innovation to profoundly make strides execution or reach of undertakings." This definition highlights the significant affect innovation has in reshaping the way organizations function and associated with their groups of onlookers. Within the setting of vital promoting, advanced change amplifies to the vital appropriation of advanced devices and channels to upgrade showcasing endeavors. Kotler et al. (2017) assert this, expressing, "Advanced change in promoting alludes to the basic changes in showcasing procedures, forms, and organizational structures to use computerized innovations for client engagement and esteem creation." This shows that advanced change isn't simply a innovative overhaul but a crucial move in promoting techniques to superior interface with digital-savvy shoppers.



**Guruprasad et al.,****Relationship between Digital Transformation and Strategic Marketing**

Computerized change and vital promoting share a advantageous relationship. Whereas advanced change gives the innovative framework, key showcasing guides the utilization of these devices for accomplishing organizational objectives. For case, the American Promoting Affiliation (AMA) characterizes showcasing as "the movement, set of educate, and forms for making, communicating, conveying, and trading offerings that have esteem for clients, clients, accomplices, and society at expansive." In a carefully changed scene, these exercises are increased, and the scope of offerings extended through digital channels (AMA, 2020).

Theoretical Foundations and Models Relevant to Digital Marketing Transformation

Hypothetical establishments for advanced showcasing change draw from different areas, counting showcasing, innovation administration, and organizational hypothesis. One unmistakable system is the Innovation Acknowledgment Demonstrate (TAM) by Davis (1989), which clarifies client acknowledgment of innovation, a vital perspective of computerized change. Essentially, the Resource-Based See (RBV) of the firm (Barney, 1991) is important because it investigates how firms can use their interesting assets, counting advanced capabilities, for competitive advantage. Additionally, the McKinsey 7S Demonstrate (Waterman et al., 1980) offers a all encompassing viewpoint on how different variables, counting innovation, connected to shape an organization's advanced change travel. These hypothetical establishments and models serve as focal points through which analysts and professionals can get it, analyze, and actualize advanced promoting change methodologies successfully.

Trends in Digital Marketing**Review of Recent Trends in Digital Marketing Strategies**

The discipline of digital marketing is dynamic and always changing to keep up with the rapidly expanding digital environment. Recent developments in digital marketing techniques cover a variety of techniques intended to increase client interaction and spur company expansion. For instance, content marketing has become increasingly popular, as noted by Pulizzi and Barrett (2015). In order to draw in and keep a target audience while building authority and trust, it includes producing good content. Personalization has also emerged as a key component of digital marketing. Schmitt (2016) underlines the need of adjusting marketing initiatives to meet the specific demands and preferences of each consumer. Marketing professionals can now design highly tailored campaigns thanks to advanced analytics and AI-driven insights, which increase consumer experiences and conversion rates.

Case Studies Illustrating Successful Digital Marketing Transformations

We look at case studies to get a practical knowledge of how digital marketing trends are affecting businesses. According to Shah and Dhawan (2018), HubSpot is a prime example of efficient inbound marketing, showing how content-driven methods, SEO, and email marketing can effectively draw in and nurture prospects. According to Agrawal et al. (2015), Airbnb's user-generated content strategy serves as an example of how utilizing user-generated content may dramatically improve a brand's online presence and consumer trust.

Impact of Emerging Technologies (e.g., AI, IoT, Blockchain) on Marketing Strategies

The integration of developing innovations is forming long-standing time of promoting. Developing innovations, such as Counterfeit Insights (AI), the Web of Things (IoT), and blockchain, are revolutionizing showcasing methodologies. McCarthy and Perreault (2018) emphasize the part of AI in prescient analytics, chatbots, and proposal motors, which improve client intelligent and decision-making. IoT is changing the way items and administrations are showcased. As highlighted by Correia and Putnik (2017), IoT empowers information collection and analysis in genuine time, permitting businesses to offer personalized encounters and make strides item plan. Within the setting of blockchain, the work of Tapscott and Tapscott (2016) diagrams its potential to form straightforwardness and believe in promoting by decreasing extortion and guaranteeing the keenness of supply chains. These patterns and advances collectively outline the energetic nature of computerized showcasing and the require for businesses to adjust to stay competitive in a quickly advancing computerized scene.



**Guruprasad et al.,****Challenges and Barriers****Identification of Challenges in Implementing Digital Marketing Transformations**

There are difficulties in putting digital marketing changes into practice. Adopting digital strategies and technology presents a variety of challenges for organizations. One significant problem, as emphasized by Smith and Zook (2011), is managing the growing complexity of digital marketing platforms and technologies. Technology and digital channels must constantly adapt and develop due to their dynamic nature.

Organizational and Cultural Obstacles

There are difficulties in implementing digital marketing changes. Adopting digital technology and initiatives presents organizations with a variety of challenges. Managing the growing complexity of digital marketing platforms and technologies is a significant problem, as Smith and Zook (2011) point out. Because technology and digital channels are dynamic, learning and adaptation must be ongoing

Regulatory and Ethical Considerations

The environment of digital marketing's rules and morals is complex and constantly changing. Many academics focus on legal and ethical issues. For instance, Werbach and Hunter (2012) explore the effects of data security, advertising transparency, and online privacy. Marketing professionals must uphold strict ethical standards in order to comply with rules like the General Data Protection Regulation (GDPR) in the European Union, which presents considerable hurdles. It's essential to comprehend these obstacles and issues in order to create efficient digital marketing transformation strategies. To fully take use of the potential of digital technology, businesses must overcome several challenges.

Data Analytics and Consumer Insights**Role of Data Analytics in Shaping Marketing Strategies**

Modern marketing tactics are now shaped in large part by data analytics. To make wise decisions, businesses increasingly rely on data-driven insights. According to Davenport and Harris (2007), data analytics gives firms a competitive edge by helping them to recognize patterns, improve marketing initiatives, and improve consumer experiences. Marketers may make more strategic, data-driven decisions by using data analysis to better understand consumer behavior, preferences, and the success of various marketing activities.

Utilizing Big Data for Consumer Insights and Personalized Marketing

Big data, which is distinguished by its volume, speed, and diversity, has a huge amount of promise for improving customer insights. The authors of a study by Chen and Chiang (2019) stress the significance of using big data to develop customised marketing efforts. Businesses may customize their marketing messages and offers to specific customers by analyzing large datasets, which improves the customer experience and engagement. Increased customer satisfaction and conversion rates are a result of personalization.

Privacy and Security Concerns in Data-Driven Marketing

Concerns about security and privacy are growing alongside the development of data-driven marketing. The acquisition and use of customer data present ethical and legal issues, as discussed by Newman and Forrester (2018). Data security and customer privacy protection are of utmost importance. The need to handle privacy issues is highlighted by the General Data Protection Regulation (GDPR) and other data protection legislation. To sustain customer trust, businesses must be ethical and open in their data operations. Utilizing the potential of data for consumer insights and targeted marketing while preserving trust requires an understanding of the diverse function of data analytics in marketing while resolving privacy and security issues.

Omni channel Marketing**Review of Omni channel Marketing Strategies and Their Adoption**

A complete strategy for consumer involvement across several channels, omni channel marketing ensures a unified and smooth experience. Verhoef et al. (2015) wrote a paper in which the authors stressed the significance of Omni



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channel strategies, defining them as "the systematic and consistent use of channel and customer knowledge to design and deliver customer experiences." The goal of omnichannel marketing strategies is to meet customers where they are by providing a seamless experience that respects and takes into account their channel choices.

Customer Journey Mapping in the Digital Age

Customer journey mapping has become crucial as a result of the customer journey's transformation in the digital era. Lemon and Verhoef (2016) underline the need of charting the customer experience in an Omni channel and multichannel setting in their essay. Businesses can create personalised experiences at each stage by using mapping to identify the touch points and interactions customers have with the brand across channels. It makes sure the consumer journey is very relevant and frictionless.

Integrating Online and Offline Marketing Efforts

An important component of Omni channel marketing is combining online and offline marketing activities. The authors of a case study by Belch and Belch (2019) describe how Nordstrom, a major retailer, successfully combines its online and physical marketing initiatives. The research demonstrates how Nordstrom unifies its online and in-store processes to deliver a uniform brand experience. For organizations trying to connect clients across several platforms and maintain a consistent brand presence, such integration is essential. Businesses looking to engage customers effectively in the digital era need to understand and implement Omni channel marketing strategies, include customer journey mapping, and integrate online and offline marketing activities.

Implications for Firms

Impact on Business Performance and Competitiveness

The adoption of digital marketing changes has a significant effect on the competitiveness and performance of businesses. In their study, Kannan et al. (2016) draw attention to the link between effective digital marketing techniques and increased business success. Businesses that successfully use digital technology to interact with consumers frequently see a boost in revenue, improved customer satisfaction, and a competitive advantage in the marketplace. Additionally, a 2019 research by Sinha and Batra highlights the value of digital marketing in boosting a company's brand equity, which in turn has a favorable impact on business performance.

The Changing Role of Marketing Departments and Professionals

The job of marketing departments and experts has been re imagined in the digital age. In a 2015 paper titled "The Evolution of Marketing Roles," Kotler and Keller emphasize the necessity for modern marketing professionals to be knowledgeable in digital technology, data analytics, and customer experience management. They are essential in developing and putting into practice digital marketing strategy. The role of the marketing department has changed from a conventional promotion-oriented strategy to a more data-driven, customer-centric, and tech-savvy one, as described by De Pelsmacker et al. (2018).

Strategies for Adapting to the Digital Marketing Landscape

For businesses to succeed, they must adjust to the changing world of digital marketing. Smith and Taylor (2020) provide solutions for businesses to successfully handle digital change. Adopting an agile marketing strategy, investing in digital skills and training, and staying current with developing technology are a few of these. In order to achieve a smooth integration of technology in marketing initiatives, businesses must also coordinate their marketing and IT teams, according to Fischer et al. (2017). Businesses that want to flourish in the digital era must comprehend the effects of digital marketing revolutions on their organizations and adapt to the new environment and roles.

Case Studies

In-Depth Analysis of Select Case Studies in Digital Marketing Transformation

Case studies offer insightful information on actual experiences with the shift of digital marketing. In-depth analyses can be performed by researchers to comprehend the approaches, difficulties, and results. For instance, Jain and Yadav's (2020) case study on Coca-Cola's digital transformation provides a thorough analysis of how a major brand



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handled changes in the digital landscape. The influence of the methods used, such as content marketing and social media interaction, on brand success is thoroughly examined in their study.

Lessons Learned from Successful and Unsuccessful Implementations

Case studies give insights from failure deployments in addition to highlighting achievements. The case study by Mayzlin (2019) on the failure of McDonald's "Create Your Taste" campaign offers insightful information in the context of lessons gained. The study looks at operational issues and a lack of customer research as potential causes of its under performance. These case studies are excellent tools for businesses planning to start their digital marketing transformation journeys for deriving useful insights and lessons..

Future Directions and Research Gaps

Emerging Areas and Trends in Digital Marketing Research

New niches and trends are always developing because of the dynamic nature of digital marketing. The study conducted by Karjaluo et al. (2015), for instance, highlights the rising importance of mobile marketing in the digital era. They talk about how new ways for client involvement have been made possible by mobile devices and applications, which have completely changed the marketing environment. A further promising new field is the emergence of social commerce, which Mangold and Faulds (2009) investigated. Researchers now have new chances to study customer behavior and marketing tactics because to the combination of social media and e-commerce.

Unexplored Research Questions and Gaps in the Literature

Despite the abundance of research on digital marketing, there are still unanswered research topics and gaps in the body of knowledge. The study by Li, Li, and Kambele (2019) reveals a gap in our knowledge of consumer behavior in the setting of cutting-edge technology like chatbots and voice assistants. The way customers connect with brands is changing as a result of these technologies, yet there is little study in this field. Serapio and MacKenzie (2018) noted that worries regarding the ethical ramifications of data-driven marketing are underrepresented. Future research projects might benefit greatly from filling these gaps in the literature.

Recommendations for Future Research in this Domain

Recommendations are crucial in order to direct future research. For example, it is crucial that scholars investigate the ethical aspects of digital marketing. Research should examine the moral dilemmas brought on by data collecting, customization, and privacy concerns, as Donthu and Kumar (2021) recommend. Furthermore, it is crucial to analyze how new technologies, like blockchain and artificial intelligence, may affect marketing strategies. According to Jin et al. (2020), researchers should take into account the global viewpoint of digital marketing since various nations and cultures may provide distinct chances and difficulties. Maintaining the relevance and alignment of digital marketing research with the changing landscape depends critically on understanding these future trends and research gaps.

CONCLUSION

Summarize Key Findings and Insights from the Literature Survey

The literature review has offered insightful information on the changing, dynamic world of digital marketing. The main conclusions of this study illustrate the numerous effects of digital marketing on companies and customers. Businesses that adopt digital transformation frequently report improved company performance, increased consumer engagement, and competitive advantages (Kannan et al., 2016; Sinha & Batra, 2019). Additionally, the relevance of multichannel marketing (Lemon & Verhoef, 2016) and the role of data analytics in defining marketing strategies and personalisation have been emphasized (Chen & Chiang, 2019). These results highlight how transformational digital marketing can be in transforming consumer experiences and corporate results.





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Highlight the Significance of Digital Marketing Transformation

It is impossible to overestimate the importance of the digital marketing transition. It has become crucial for businesses to change in order to survive and grow in the digital age. According to Kotler and Keller (2015), in order to stay relevant, current marketing professionals need to be knowledgeable in digital technology and data analytics. For firms trying to keep a competitive advantage, a thorough integration of digital channels, consumer information, and future technology is essential. Effective social media tactics and agile marketing techniques are crucial for success in the digital marketing environment, according to Smith and Taylor's research (2020).

Conclude with Implications for Firms and the Field of Strategic Marketing

The consequences for businesses are obvious. They have to negotiate the difficulties and chances posed by changes in digital marketing. It is essential to adjust to the shifting environment and responsibilities, coordinate marketing and IT departments, and uphold ethical data practices (Fischer et al., 2017; Donthu & Kumar, 2021). Additionally, both practitioners and academics must be aware of unanswered research issues and knowledge gaps in order to advance future understanding (Li, Li, & Kambele, 2019; Jin et al., 2020). In conclusion, digital marketing transformation is at the center of the area of strategic marketing's ongoing evolution. The study offered here offers a thorough review of the prospects and difficulties in this area, providing insightful information for both businesses and scholars.

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Real Time Expectancy Analyzing of Perspectives Placement Related Activities of the Management Students of Kolkata

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ABSTRACT

The present scenario of management institutes compelling the students as well as their parent to think as company's placement agent due to the lucrative placement promises made by the maximum institutes (Patil2012), but practically, the situation is somewhat different. These institutes are making a lot of commitment regarding the placement activities at the time of admission to the students and based on these commitments, the students expects to get placement but how far these expectations are being fulfilled during the tenure of the course is a matter of concern. Sometime, it is seen that many institutes could not be delivered the expectations of the students, which affect the employability of the students and quality of management graduates pass out from these institutes. The author has tried to discuss in this study some of the expectations of the management students relating to the placement activities and status of fulfillment of those expectations using the tenure of course in the city of Kolkata.

Keywords: Placement activities, expectations, Management Student, Kolkata.

INTRODUCTION

In the present competitive era the management degree is very essential to get a targeted good job and the kind of skills that a student should possess to gain desired placement are essential for placement activities (Mantz& York 2005), reason thereof, the students are running after the management institute for enhancing the employability for fulfilling the dream of hefty compensation package, but at the same time, the institutes are also exploiting the sentiment of the students to get them admitted in their institute. The situation of lacking employability among the management students shows a deteriorating trend of demand for management programme particularly for the



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middle and low ranking institutes and reason thereof, these institutes are slacking the admission criteria for their survival and hence management graduates fall short to increase the employability (Havaladar2012). These institutes are also not in position to fulfil the commitment made to the students at the time of admission in placement areas which affect the employability of the students and quality of management graduates pass out from these institutes (Kwek et al., 2010). In this study, we have tried to find out the status of commitment made and fulfilled by different types of institutes in the city of Kolkata.

LITERATURE REVIEW

A majority of management institutes having the faculty members with no academic as well as industry experience, even not having permanent faculty members and not arranging the faculty development programme (FDP) which affect enhancing the employability skills among the students (Robinson, 2009). Faculty retention is major problem for the institutes due to lack of work environment and payment of less remuneration, ultimately students facing the consequences (Helms (2005). The Academic Institutions should take initiation for Industry -Academia Interface to extend support to conduct various seminar and workshop about present situation of demand in Industry, working condition and hand on training for students to increases the chances of employment (Shetty, et.al 2010). Learning management skills and techniques during internships with hands-on practical work is important for the development of knowledge and success of management graduates at workplace(Tas, 1988; Weligamage & Munasingha, 2006). Students should aware the kind of skills they should possess for desired placement and enhance their employability skills (Mentz& York 2005), but there is some mismatch between student's expectation to learn skills helpful for employment and delivery of such skills during the tenure of their study (Janeen, 2011, Farooq 2011). A survey conducted with 200 respondents from six B-Schools in Pune (Agrawal, 2011) found that students enter with expectation to gain knowledge, good placement, good faculty and access to industry exposure but their expectations are modified which creates a gap between expectation and delivery. These all situation explained above motivates the researchers to conduct the study to find out the real time situation of placement activities among management graduates in the institutes situated in the city of Kolkata (WB).

OBJECTIVES OF THE STUDY

The objective of the study is to analyse the placement related expectation and actual achievement of the MBA students admitted in Maulana Abdul Kamal Azad University of Technology (MAKAUT) formerly West Bengal University of Technology (WBUT) affiliated colleges of Kolkata. The objectives segregated in to the following categories based on following expectations:

1. Objective-1: To find the status of expectation among the students regarding arrangement of pre placement training by industry experts.
2. Objective-2: To find the status of expectations for soft skill training by professionals from industry
3. Objective-3 To find the status of providing value added courses by the institutes to support placement activities
4. Objective-4: To study the expectation of the students regarding project work in reputed industry.
5. Objective-5: Introduction of updated latest course curriculum as per industry requirement.

HYPOTHESIS

Considering the above objective, the following hypothesis has been framed:

Null Hypothesis H₀ The expectations of placement related activities for students have been delivered by the institutes to the Satisfaction level during the tenure of their course. The above hypothesis has further divided in to 5 operative hypotheses mentioned in data analysis section.





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FRAMING OF QUESTIONERS

The survey questioners extracted from the references of the articles of various scholars as under:

1. Pre placement training programme, hands on training in industries and Soft skill training from industry people (Robinson, 2009; Helms, 2005; Mantz & York, 2005; Foster & Carboni, 2009; Ajzen, 1991; Singh & Singh, 2008; Robles, 2012; Pritchard, 2013; Goswami, 2013; Williams, 2015; Bringula, Balcoba & Basa, 2016).
2. Project work in the companies for hands on practical experience (Tas, 1988; Walo, 2000),
3. Updated course curriculum Down (2003), Ishwar (2006) and Shetty, et.al (2010).

RESEARCH DESIGN AND METHODOLOGY

Population

The population comprises the students studying in the final year of MBA conducted by the institutes affiliated under Maulana Abdul Kalam Azad University of technology (MAKAUT), West Bengal. The following table enlighten the college wise intake of MBA for the year 2020 – 22. Though, the actual number of student admitted is 519, but as per the university record the total number of the students remains in the final semester as on 1st January, 2022 (4th semester – January-June, 2022) was 443, which is considered as population for this study.

Sample

The sample size drawn by using the “Slovin’s formula”:

$$n = \frac{N}{1 + N \times e^2}$$

Where, n=Number of samples, N= Total population, e=Error tolerance

$$n = 443 / [1 + 443 * (.05)^2] = 210$$

The sample size as per above formula is 210, and 85 questionnaires were distributed in January 2022 due to pandemic situation and remaining questionnaires send though mail to the available students.

Data Collection

The questioners contained dichotomous type questions with possible answer with “Yes” or “No”.

The questioners contain two parts

1. First part contains expected placement activities of students from institute at the time of admission
2. The second part relates status of fulfilment the expectations during the tenure of the course.

Testing of Questionnaire

Sample of 50 questioners taken for reliability and validity testing, result is as under:

Reliability Test

Cornbach’s Alfa considered to measure the reliability of the questions and the value of Cronbach Alpha is more than 0.7 in each case (Table – III)

Validity Test

The questionnaire is valid if the Pearson correlation value is more than the value of r from table for n-2 (n is the number of respondent) at .05% of significance. The Pearson Correlation computed for the entire questioner is more than the value of “r” i.e. 0.279 for .05 level of Significance and df=48 (n-2=50-2), hence we could consider that questionnaires structured for the study is valid.

ANALYSIS TOOLS

Z-test is a statistical tool used to determine whether two population means are different when the variances are known and the sample is large (more than 30). The mean of the student’s expectation and fulfilment are calculated by using SPSS 20.



**Monu Singh and Dhakshayini****Mathematically z test formula is represented as:**

$$Z \text{ Test} = (\bar{x} - \mu) / (\sigma / \sqrt{n})$$

Here,

\bar{x} = Mean of Sample, μ = Mean of Population, σ = Standard Deviation of Population and n = Number of Observation

The Z value calculated by the above formula with the help of Excel

DATA ANALYSIS AND INTERPRETATION**Operative Hypothesis-1**

Null Hypothesis (H01): The expectations of the students regarding arrangement of pre- placement training programme from industry people have been arranged by the institutes.

Results of test

Table V shows z-value is 2.1267 and corresponding p-value is 0.033, which is less than the level of significance at 0.05. Hence, we fail to accept the null hypothesis and alternate hypothesis is accepted. Alternate Hypothesis (H11): The expectations of the students regarding arrangement of pre- placement training programme from industry people have not been arranged by the institutes.

Operative Hypothesis-2

Null Hypothesis (H02): The expectations of the student regarding arrangement of soft skill training by the professionals from industry have been arranged by the institutes.

Results of test

Table-V, we can observe that the z-value is 1.8145 and corresponding p-value is 0.0695, which is more than significant level at 0.05. Hence, we fail to reject null hypothesis and alternate hypothesis is rejected.

Operative Hypothesis-3

Null Hypothesis (H03): The expectations of the students regarding add on courses to support the placement activities have been arranged by the institutes.

Results of test

Table-V shows the z-value is 1.4757 and corresponding p-value is 0.14, which is more than the level of significance at 0.05. Hence, we fail to reject null hypothesis and alternate hypothesis is rejected.

Operative Hypothesis-4

Null Hypothesis (H04): The expectations of the students regarding arrangement of project work in reputed industries have been fulfilled by the institutes

Results of test

From Table-V we observe that z-value is 3.3993 and corresponding p-value is .006, which is less than the level of significance at 0.05. Hence, we fail to accept null hypothesis and alternate hypothesis is accepted.

Alternate Hypothesis (H14)

The expectations of the students regarding arrangement of project work in a reputed industry have not been fulfilled by the institutes

Operative Hypothesis-5**Null Hypothesis (H05)**

The expectations of the students regarding updated and latest course curriculum as per industry requirements has incorporated in syllabus by the institutes.

Results of test

Table-V shows z-value is 2.1008 and corresponding p-value is 0.0356, which is less than the level of significance at 0.05. Hence, we fail to accept null hypothesis and alternate hypothesis is accepted.



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Alternate Hypothesis (H15): The expectations of the students regarding updated and latest course curriculum as per industry requirements has not been incorporated in the syllabus by the institutes.

FINDINGS

Table V shows the mean score of expectation and fulfilment of expectations by the institutes and based on this analysis we can conclude the following objective wise findings:

Objective-1

Table-V shows the mean square of expectation of pre placement training from industry people is 0.86, which is more than mean square of fulfilment of expectation 0.64. This shows that the institutes have not fulfilled the expectations of the students.

Objective-2

Table-V shows the mean square of expectation fulfilled for frequent soft skill training by professionals from industry is 0.69, which is more than the mean square of expectation by the student is 0.69. This shows that institutes have fulfilled the expectations of the students.

Objective-3

The mean squares of expectation of students for add on courses is 0.78, which is less than the mean square of fulfilment of expectation is 0.86. This shows the institutes have fulfilled the expectations of the students.

Objective-4

Table-V shows that mean square of expectation of arrangement for project work in a reputed industry is 0.90, which is more than the mean square of fulfilment of expectation is 0.70. This shows that the institutes have not fulfilled the expectations of the students.

Objective-5

Table-V shows that mean square of expectation for updated and latest course curriculum as per industry requirement is 0.72, which is more than the mean square of fulfilment of this expectation is 0.58. This shows that institutes have not fulfilled the expectations of the students.

CONCLUSION

The study reveals that some of the area which are very important considering the need of the industries like arrangement for Pre placement training, latest course curriculum as per the industry requirement, project work in reputed industries but unfortunately these areas are not been given attention by the institutes. The study also shows that the institutes under the MAKAUT should be given more importance to the expectations of the students for successful placement of the students.

LIMITATIONS

1. This study is confined to the management institutes controlled by private body and the fees charging is more than the government controlled institutes, hence it is but natural that the expectations of the students will be high compare to these institutes.
2. Due to the closing of the educational institute in the pandemic situation, the response received from the students though e-mail not cover the adequate sample, which may affect the finding of the study.

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Table – I

S. No	Name of the Institutes	INTAKE
1	Institute of Engineering & Management	180
2	Netaji Subash Engineering College	30
3	JIS Engineering College	60
4	Bhartiya Bidya Bhaban	120
5	Techno India	120
6	Army Institute of Management	120
7	Institute of Business Management & Research	30
8	Meghnath Saha Institute of Technology	60
9	Future Institute of Engineering & Management	60
10	Calcutta Institute of Management & Technology	60
11	Brainware Group of Institutions	60
12	Swami Vivekananda Institute of Technology	60
13	Regent Education & Research, Foundation	60
14	Budge Budge Institute of Technology	60
15	NSHM Knowledge Campus	120
16	Pailan College of Management & Technology	30
17	Heritage Business School	180
18	IMS Business School	60
	TOTAL	1470

Table – II

Mode of distribution the questioners	No of questioners distributed	No. of Respondent received	No. of the set of questioners rejected	No. of the set of questioners considered for study
Physically distributed to the students	85	66	14	52
Distributed through E-Mail	140	59	13	46
Sample size for study				98

Table – III

S. No	Attributes	No of Item	Cornbach's Alpha
1	Questioners for expectation of the students	5	.737
2	Questioners for fulfilment of the student's expectation	5	.721

Table-IV

Questionnaire for Student's expectation	Pearson Correlation Computed (r)
Pre placement training from industry people	0.861
soft skill training by professionals from industry	0.894
add on courses by the institutes to support the placement activities	0.743
Project work in a reputed industry	0.674
Updated and latest course curriculum as per industry requirements	0.743





Monu Singh and Dhakshayini

Questioner for fulfilment of expectations	
The institute has arranged pre-placement training programme from industry people	0.910
Soft skill training by experts has been introduced as inbound course curriculum.	0.910
The institute have arranged short term add on courses in the specialized area.	0.776
Student has been allotted good industries for their project work which help them to create access for placement opportunity in the similar type of industry.	0.675
he institutes has updated course curriculum commensurate with the industry requirements	0.723

Table – V Z and P value for Placement Expectation of students

S. No	Description of Expectations	Mean	Z - Value	P - Value	Result of test
1	Expectation of arrangement for pre placement training from industry people	.86	2.1267	0.033	Fail to accept the null hypothesis (<i>Expectation not fulfilled</i>)
	Expectation of arrangement for pre placement training from industry people full filled.	.64			
2	Expectation of arrangement for frequent soft skill training by professionals from industry	.61	1.8145	0.0695	Fail to reject the null hypothesis (<i>Expectation fulfilled</i>)
	Expectation of arrangement of frequent soft skill training by professionals from industry full filled	.69			
3	Expectation of add on courses to support the placement activities	.78	1.4757	0.14	Fail to reject the null hypothesis (<i>Expectation fulfilled</i>)
	Expectation of add on courses to support the placement activities full filled	.86			
4	Expectation of Project work in a reputed industry	.90	3.3893	0.006	Fail to accept the null hypothesis (<i>Expectation not fulfilled</i>)
	Expectation of project work in a reputed industry full filled	.70			
5	Expectation of updated and latest course curriculum as per industry requirement	.72	2.1008	0.0356	Fail to accept the null hypothesis (<i>Expectation not fulfilled</i>)
	Expectation of updated and latest course curriculum as per	.58			
	industry requirements full filled				

Source: Researcher's Analysis





A Study on Impact of Climate Change on Indian Business Economy

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ABSTRACT

Business is mostly dependent on the nature around us. Earth, being our home is habitual to all the economic and non economic activities of human beings. Our mother earth is continuously facing climate related crisis like inadequate rainfall mainly monsoons, severe heat & temperature, floods, draught and rise in the sea levels, the overall impact on economic environment is severe. As the Climate change is severely impacting the sustainability of life, livelihood and the ecosystem, the economists across the world are honing their emphasis on mitigating such risks. India is already among the top few growing economies which are vulnerable to the risk of climate change activities. We are already suffering the adverse impact of climate change in many parts of our country. This paper aims to explore the multifaceted effects of climate change on various sectors of the Indian economy, with a particular focus on its impact on markets. Climate change poses significant challenges to the Indian market dynamics, affecting agriculture, water resources, infrastructure, and overall economic stability. However, it also creates opportunities for research and innovation, sustainable practices, and the emergence of new markets. This presentation delves into both the negative and positive aspects, providing insights into the adaptation strategies required for a resilient and sustainable future.

Keywords: climate change, business economy, sustainability, impact, economic stability.

INTRODUCTION

Human Carbon footprint is a biggest concern as dependence on natural resources mainly fossil fuels have increased. This human interaction is of biggest reason for climate change. As a biggest global concern, climate change is impacting not only environment, but almost all other important aspects like business, politics, society etc. The impact of change in climate is one among the very complex and controversial problem of the current century as it has





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harmful effects on most of our business economies. It has a major impact on the economy in the short and long run. It is advisable to all business economies to recognize and adopt methods to survive with existing and unpredictable future impacts of climate change so that they can make the most of the current opportunities. This adaptation by the current business sector is not a formalized and generalized process. A few proactive futuristic companies have started to inculcate and include points related to protection of environment and climate in their policies were as most business managements have taken few more steps than complying with minimum expected standards and regulations prescribed by their government.

Objectives

1. To strengthen the knowledge on development of effective policies and regulations to mitigate the impact
2. To study the economic consequences of climate change in Indian business.
3. To study the long term implications of climate change in Indian business

METHODOLOGY

This paper is completely prepared based on secondary data available in website

REVIEW OF LITERATURE

1. Anita Fuchs, Eric Strobl and Preeya Mohan in their paper 'Climate change awareness and mitigation practices in small and medium-sized enterprises' (February 2023 Business and Society Review 128(425):1-23) , throw light on how inculcate awareness on impact of climate change and to mitigation the action based on the factors which are either motivating or limiting the pro-environmental behaviour on the business environment.
2. Mr.Pratap Chandra Mandal in his research paper 'The New Marketing Realities and the Major Marketing Forces, Journal of Business Ecosystems'(March 2023 Journal of Business Ecosystems 4(1):1-14), writes that the main objective of their study is to analyze the different elements and aspects of social and physical environment and their influence on the business environment.
3. Manish Kumar Goyal and Shivam Singh, in their research 'Enhancing climate resilience in businesses: The role of artificial intelligence' (Journal of Cleaner Production, 2023 – Elsevier) , focus on how the extreme change in weather condition mainly due to climate change in the last few decades has caused massive threat to all the sectors on economy all over the world.

Notable impacts of climate change on Indian business as per the survey

Climate change can have significant impacts on businesses, both directly and indirectly. Let's delve into each category:

Direct Impacts

1. **Physical Damage:** Businesses may face direct physical damage to their assets, infrastructure, or operations due to severe weather and environmental changes like floods, hurricanes, wildfires and storms. This can cause property destruction, equipment damage, and disruption of operations.
2. **Forced Closures:** Extreme weather events or environmental hazards may force businesses to temporarily or permanently shut down their operations, leading to financial losses and potential long-term impacts on viability.
3. **Increased Operational Costs:** Businesses may face increased costs for repairs, insurance premiums, and infrastructure upgrades to adapt to changing climate conditions or comply with new regulations aimed at mitigating climate risks.





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Indirect Impacts

1. **Supply Chain Disruptions:** Climate-related events can disrupt the availability or delivery of essential goods and services, impacting production schedules, inventory levels, and overall business operations. For example, droughts may lead to shortages of raw materials or agricultural products, while extreme weather events can disrupt transportation networks.
2. **Market Demand Changes:** Changing consumer preferences and behaviors in response to climate change can influence market demand of certain products or services. Businesses will have to adapt or develop new products to meet evolving customer needs and expectations.
3. **Financial Losses:** Businesses may experience financial losses indirectly through reduced revenue, increased costs, or decreased market value due to climate-related factors such as regulatory changes, reputational damage, or legal liabilities.
4. **Reputation and Brand Image:** Business environments may have to suffer reputational damage or loss of consumer trust if they are assumed as contributing to or exacerbating climate change through unsustainable practices or inadequate response to environmental risks. This can impact customer loyalty, investor confidence, and overall brand value.
5. **Policy and Regulatory Risks:** Businesses may face regulatory scrutiny or policy changes related to climate change mitigation and adaptation efforts, such as carbon pricing, emissions trading schemes, or renewable energy mandates. If the business does not comply with environmental regulations may result in fines, penalties, or legal action, posing additional financial and operational risks.

Expected Cost of Climate Crisis

In a situation of nonexistence of positive climate change to moderate and mitigate the effects, the Indian business economies may tremendously lose trillions(in turnover)in the forthcoming years. A research report by Deloitte specifies that if Indian industry and business sectors doesn't move towards low-emission fuels and reduce its dependence on fossil fuels, its industries and businesses could lose around \$35 trillion across various sectors by 2070. The total damage could be as high as 12.7% of India's GDP. As per the above report by Deloitte Economics institute - Climate model, no proper action by the government and business agencies on climate change may lead to reduction in India's economic and business potential by 5.5% per year on average over the next 50 years. The impacts of climate change on businesses can be multifaceted and complex, affecting various aspects of operations, financial performance, and strategic decision-making. Effective risk management and adaptation strategies are essential for businesses to mitigate these impacts and seize opportunities for sustainable growth in a changing climate. Researches by Reserve bank of India and other economic organizations are stressing a lot strategies to reduce the damages caused by climate change on our economy. If we don't initiate any positive steps towards environmental and climate change and to moderate and mitigate the negative effect of climate change, our business economy may have to face loses in the upcoming decades. If we start reducing the emission of green house gasses, we will be minimizing the carbon intensity into our environment.

In the process of becoming a fastest growing global economy, it is crucial to understand that it is not just our FDI and our domestic investments but our steps in aligning our ambitions with positive climate choices decides our drive towards economic growth. A study report by Deloitte says that if India becomes successful in leveraging its full potential in the process of decarbonization, then it would lead to a GDP growth of 8.5% by 2070, and about a \$4 trillion (in profit) gain in business output. India is currently taking few right steps towards positive climate change. This move has greatly increased the confidence to tackle the effects of climate change. Some of positive steps towards include Reliance Industries joining hands with an US-based Chart Industries to commercialize hydrogen and boost hydrogen production. On 2023 August 15, our Prime Minister, Mr. NarendraModi announced a National Hydrogen Energy Mission as an initiative to reduce carbon emissions. Some notable Industries may also be at risk due to the climate change. The impact of climate change will be mostly on the labour and physical capital all business and industrial sectors. But the major hit might be for service sector, retail sector, manufacturing industry, construction sector and conventional energy industry. These major industries actually contribute towards almost 75 to 80% of our GDP.





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Notable solutions for these problems as recommended by the global economists

The impact of climate change on Indian businesses can be significant, affecting various sectors such as agriculture, manufacturing, energy, tourism, and infrastructure. Here are some solutions that Indian businesses can adopt to mitigate the impact of climate change:

Investment on Renewable Energy

Shifting to renewable energy resources such as solar energy, wind energy, and hydro energy can help reduce the greenhouse gas emissions and reliance on fossil fuels. Indian businesses can invest in onsite renewable energy generation or purchase renewable energy from third-party suppliers.

Implement energy efficiency measures

Improving energy efficiency in operations, buildings, and manufacturing processes can reduce energy consumption and greenhouse gas emissions while also lowering operating costs. This could involve upgrading equipment, optimizing processes, and adopting energy-efficient technologies.

Adopt sustainable practices

Businesses can implement sustainable practices across their operations, such as minimizing waste generation, promoting recycling and reuse, and using eco-friendly materials and packaging. Sustainable supply chain management can also be prioritized, ensuring suppliers adhere to environmentally responsible practices.

Water Conservation

Given India's water scarcity challenges exacerbated by climate change, businesses can implement water conservation measures to reduce consumption and optimize water usage in operations. This could involve implementing water-efficient technologies, recycling wastewater, and promoting rainwater harvesting.

Climate-Resilient Agriculture

For businesses involved in agriculture or reliant on agricultural inputs, adopting climate-resilient farming practices can mitigate risks associated with climate change-induced weather variability. This includes promoting drought-resistant crops, efficient irrigation techniques, and soil conservation methods.

Risk Management and Adaptive Strategies

Businesses should assess their vulnerability to climate change risks and develop appropriate risk management and adaptation strategies. This could involve investing in infrastructure that can withstand extreme weather events, diversifying supply chains to reduce dependency on vulnerable regions, and incorporating climate risk into business planning and decision-making processes.

Collaboration and Advocacy

Collaboration with government agencies, industry peers, and civil society organizations can amplify efforts to address climate change challenges. Businesses can advocate for supportive policies and regulations that incentivize climate-friendly practices, such as carbon pricing, subsidies for renewable energy, and incentives for energy efficiency investments.

Employee Engagement and Education

Engaging employees in sustainability initiatives and providing education and training on climate change can foster a culture of environmental responsibility within the organization. Employees can contribute ideas, participate in energy-saving initiatives, and champion sustainability efforts both at work and in their personal lives.





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Green Innovation and Technology Adoption

Investing in research and development of green technologies and innovations can not only help businesses reduce their environmental footprint but also create new revenue streams and competitive advantages. This could involve developing innovative products, services, or business models that promote sustainability.

Transparency and Reporting

Businesses should transparently communicate their environmental performance, including their efforts to mitigate climate change impacts, to stakeholders such as investors, customers, and regulators. Reporting on carbon emissions, energy usage, and sustainability initiatives can build trust and credibility while encouraging continuous improvement.

Findings and suggestions

Impact of climate change is on all the three sectors of the economy. Whether your business is small or big, national or multi-national the impact is always on huge. It is in our hands that we as an individual or a firm or an enterprise, the steps we take to face and handle the climate change issues is very important. Here are few suggestions from the study:

1. Government and Private sector together have to ensure they take the right step in preventing the damage being caused to the environment which is leading to adverse climate change
2. Indian businesses can play a crucial role in mitigating the impact of climate change while also seizing opportunities for innovation, resilience, and sustainable growth.
3. Educating consumers about the environmental impact of the products and services can encourage more sustainable consumption patterns and drive demand for eco-friendly alternatives.
4. Indian business agencies can engage with government agencies NGOs and other business to advocate for stronger environmental policies and collaborate on sustainability initiatives can amplify the impact of individual efforts
5. Implementing waste reduction and recycling programe within operations can minimize waste sent to landfills and decreases the overall environmental footprints of the business.

CONCLUSION

Climate change is one of the greatest of challenge faced by the mankind. Human beings have changed the complete bonding of the ecosystems of the atmosphere, land, oceans etc with shocking consequences and effects. Many business enterprises are epicenters to these challenge. These epicenters are the main elements which encourage the increase in greenhouse gas emissions. They also provide basic platform to find out new innovative methods to decarbonize our economic systems. In this paper, we can learn the ways climate change influences our business and ways and methods our country can respond to curtail the impacts of climate change. It is not only the duty of the government to bring in regulations to regulate the climate change, but the ownership falls on all our shoulders to take small steps to protect our environment. Weather it is our own house or our business or the industry, it is all our responsibility to sustain the warmth climate for our future generation.

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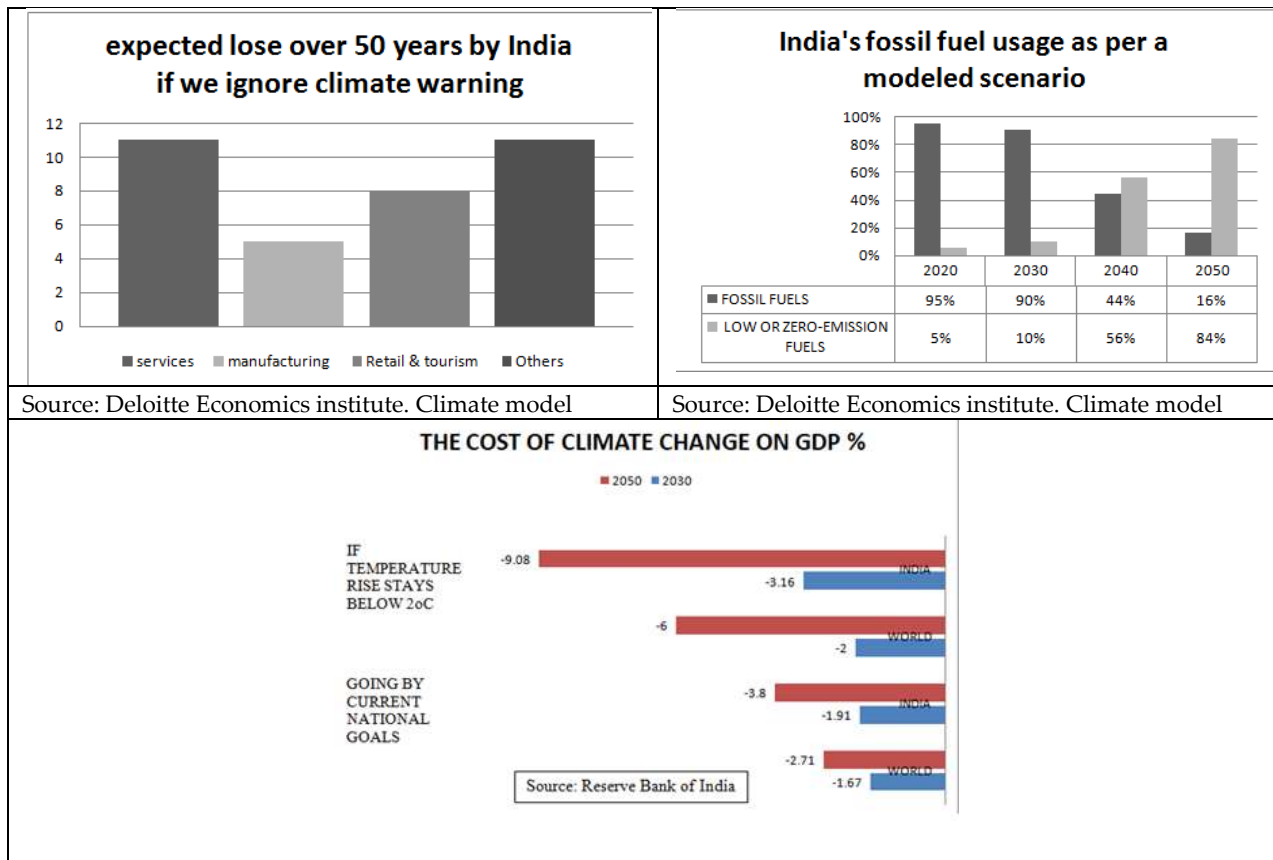
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The Impact of Digital Marketing on Youths' Purchase Intention and Engagement

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ABSTRACT

The great majority of enterprises and companies today undoubtedly use digital marketing is one of their primary marketing techniques. The resources provided by this technique, which transcends geographic boundaries, allow them to market their goods to a far wider audience. Additionally, because the information is tailored to the preferences of the users, it can help establish stronger ties with the users. The research examined how digital marketing influences teenagers' purchasing intentions, specifically focusing on their online buying decisions. Utilizing an exploratory research design, both primary and secondary data sources were employed, including structured questionnaires and literature from various sources. The study targeted teenagers who favor online purchasing, with a sample size of 145 respondents selected randomly. The findings indicated a noteworthy influence of digital marketing on teenagers' purchase intentions, particularly highlighting social media marketing as the preferred channel for online purchasing decisions

Keywords: Digital Marketing, Teenagers, Purchase Intention, Customer Engagement.

INTRODUCTION

The world is always changing, and right now it's more complicated than ever. Technology has made everything easily available to people. This applies to the marketing industry too. Getting information is really easy now. The way things are made leads to new trends. Everywhere that digital platform are crucial to marketing, there is now more rivalry for new products and marketing breakthroughs than ever before. Outbound marketing strategies had been mostly superseded by inbound marketing strategies. Some claim that digital marketing is the most successful





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marketing method. They were giving organizations the devices they expected to work really and imaginatively in the advanced commercial center. Despite area, advertisers could discuss straightforwardly with possible clients through advanced channels. The utilization of advanced media in promoting has consistently gone under more prominent examination. The conceivable outcomes are limitless when every one of the advances that are accessible and offered today are utilized to their maximum capacity. Advertisers are all the more habitually involving these channels for an expansive scope of goals, making top to bottom information and measurements on each count, checking the outcome of their endeavors, and in any event, gauging and processing the probability that their utilization of it will help them out. While others center around offering better support to a current market, others use them to draw in new associations. Apparently while grasping the effect of different computerized media on young people buying, advanced promoting channels and ideas are applied freely and functionally. The possibilities for new social strategies from the market are soon yet to be found or created by advanced advertising, which is as of now accessible, is continually developing, and makes a point to stay in contact with us people until the end of time.

LITERATURE REVIEW

Omkar Dastane (2020), the impact of digital marketing on the purchasing behavior of online shoppers in Malaysia was investigated. The study also looked at how customer relationship management (CRM) influences the relationship between digital marketing and online purchase intent. The findings showed that digital marketing significantly influences online purchase intent, while CRM had a minor effect. This study contributes by creating a model to assess the impact of digital marketing on online shopping behavior in Malaysia. The paper also discusses recommendations, limitations, and future research opportunities. Alok Kumar Pal and Dr. Bharti Shukla's study in (2020) examines how customer purchasing habits are changing rapidly in consumer-centric market environments. The study focuses on the impact of digital marketing on buyer behavior due to the significance of youth purchasing behavior. It explores how young people engage with digital media in their everyday lives. Qureshi Riyaz Ahmed and others(2019) found that internet usage is growing, especially among young people who have grown up with computers, the internet, and mobile technology. These technologies significantly impact how young people spend their time and influence their buying habits. The study suggests that companies should connect with young consumers through the internet due to its strong influence on their lives and market trends.

RESEARCH METHODOLOGY

This study is under taken for 145 participants from Bangalore North city as its sample size. The main focus of the questionnaire was to collect information from the respondents about their attitudes towards online shopping and the behavior of young people.

SAMPLE DESIGN OF THE STUDY

A sample of data from young people in Bangalore North City has been obtained. Data has been gathered from a variety of locations in the Bangalore North Region. This area's geographic region was the focus of a lot of data. Additionally, secondary data on consumer attitudes toward digital marketing has been gathered through research reports, journals, and other sources.

RESEARCH OBJECTIVES

1. To evaluate how digital marketing channels influence the purchasing choices of young people.
2. To know the impact of tailored advertising and focused marketing on young people's buying intentions.
3. To understand the connection between young people's participation with digital marketing content and their propensity to make a purchase and provide suggestions.



**Roopa****DATA ANALYSIS****Age-Wise Respondents**

Figure indicates that the age group 18–19 had the highest number of respondents, falling between the male (48) and female (33), and the age group 20–21 between the male (35) and the female (23). The age group 23–24 had the lowest number of respondents, falling between the male (1) and the female (1). This indicates that among Bangalore North city's age group of 21 to 26, the influence of young behavior on digital marketing is fairly significant.

Gender wise Respondents

A reflection of the study respondents, comprising 87 male and 58 female respondents. This indicates that 40 percent of young women and 60 percent of males have engaged in digital marketing to purchase products

Educational Qualification of Respondents

Figure demonstrates that undergraduate students' buying behavior related to digital marketing is significantly higher (112) than that of bachelor's degree holders (26), and master's degree holders (7). This indicates that the effects of digital marketing on teenage students are greatest, and that the behavior of students is more influenced by digital marketing. In contrast to students pursuing higher education and those holding a bachelor's degree.

Digital Marketing Awareness among Respondents

According to a table and figure analysis, respondents' awareness of digital marketing varied between males (83) and females (50). This represents 57% and 34% of all male and female respondents who are aware of digital media. However, between male 4 (3%) and female 8 (5%), there are individuals who do not know about digital. This indicates that a large percentage of respondents—133 or 92% of them—have a high level of digital awareness, compared to just 8% of respondents—12 or less—who do not. The respondents in Bangalore North city appear to have a very high level of awareness regarding digital marketing.

Usage of social media platform

Males (83) and females (50) respondents' awareness of digital marketing varied, according to a table and figure study. This indicates that 34% and 57% of all respondents—male and female—are aware of digital media. But there are those who are unaware of digital, with 4 men (3%) and 8 women (5%). This shows that 133 respondents, or 92% of the total, have a high degree of digital awareness, whereas just 8% of the respondents, or 12 or less, do not. It seems that Bangalore North city respondents are very knowledgeable about digital marketing.

Sources of discovering digital marketing content

A table and figure study shows that social media (49.8%), online reviews (15.17), and adverts (22.7) are the main ways that respondents find the information. In contrast, search engines (9.6%), email (1.36%), and referrals from influencers (1.36%) are examples of alternative sources.

Factors affecting Buying Decisions of Respondents

Between male and female respondents, the following factors influence their use of digital marketing: discounts (37%), product reviews (25%), ease of purchase (13%), brand reputation (10%), satisfaction guarantees (6%), ad creativity (4%), free trial samples (2%), and, in that order, website trustworthiness, personalization, and limited-time offers (1%). Teenagers seem to be using digital marketing for a variety of reasons, including product reviews, discounts, simplicity of purchase, and brand reputation, among others, in order to satisfy their usage requirements.

Factors influencing Customer Engagement

In comparison to other aspects taken into consideration in the study, a figure study reveals that videos (34%), social media postings (18%), blogs and articles (15%), and social media stories (11%) are the main components that engage customers and influence their purchase decision.





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Teenagers' participation with digital marketing content

The survey results indicate a generally positive influence of digital marketing on consumers, with a majority agreeing (48%) that it helps in searching for the right products(40%), increases interest in purchasing through social media advertisements(38%), and provides quality information during online shopping(28%). Additionally, the findings highlight a high likelihood of satisfaction after making a purchase through digital platforms, showcasing the effectiveness of digital marketing in shaping consumer behavior and fostering brand engagement.

CONCLUSION

Digital media enables online shopping, providing a convenient way for youths to browse products, compare prices, and make purchases from the comfort of their homes. Apps and websites often offer features like live chat support, enhancing customer service and engagement. Quick responses to queries can positively impact the decision-making process. Limited-time offers, flash sales, and exclusive online events capitalize on the FOMO culture, driving impulsive purchases among youths who fear missing out on a great deal. Social media platforms often create hype around these events, encouraging youths to engage with the brand and participate in the limited-time offers. In conclusion, digital media plays a pivotal role in shaping youths' purchase intention and customer engagement. Through targeted marketing, interactive content, social influence, and personalized experiences, brands can effectively capture the attention and loyalty of young consumers in the digital age.

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Table-1 Usage of social media platform

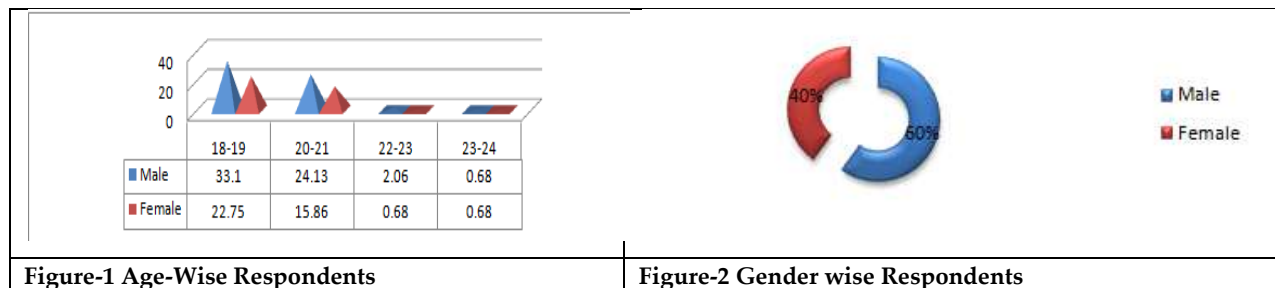
Sl.No	Usage of social media platform	Male	%	Female	%	Total	%
1	Constantly	5	3.4	12	8.2	17	12
2	Daily	78	54	40	27	118	81
3	Weekly	2	1.3	1	0.6	3	2
4	Monthly	0	-	1	0.6	1	0.6
5	Rarely	2	1.3	3	2.6	5	2.8
6	Never	0	-	1	0.6	1	0.6
	Total	87	60	58	40	145	100

Source: Primary Data

Table-2 Sources of discovering digital marketing content

Sl.No	Sources of discovering digital marketing content	Male	%	Female	%	Total	%
1	Social Media	50	34.6	22	15.1	72	49.81
2	Search Engine	7	4.8	7	4.82	14	9.6
3	Email Subscriptions	1	0.68	1	0.68	2	1.36
4	Online Reviews	13	8.9	9	6.08	22	15.17
5	Advertisement	15	10.34	18	12.4	33	22.7
6	Influencer recommendations	1	0.6	1	0.68	2	1.36
	Total	87	60	58	40	145	100

Source: Primary Data





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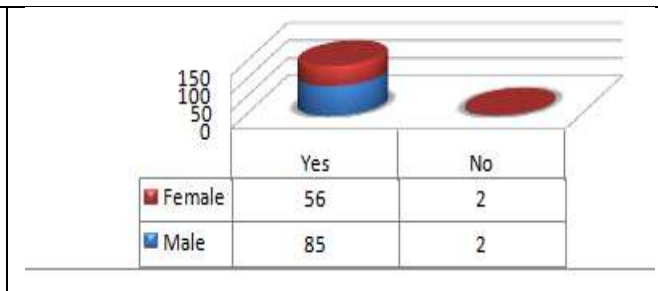
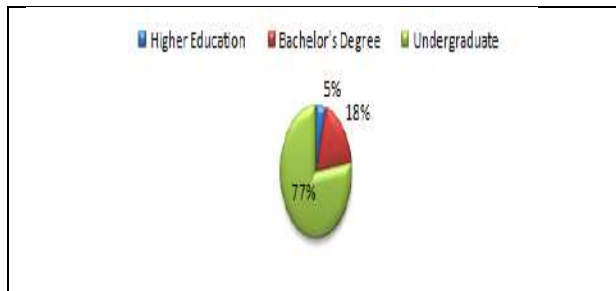


Figure-3 Educational Qualification of Respondents

Figure-4 Digital Marketing Awareness among Respondents

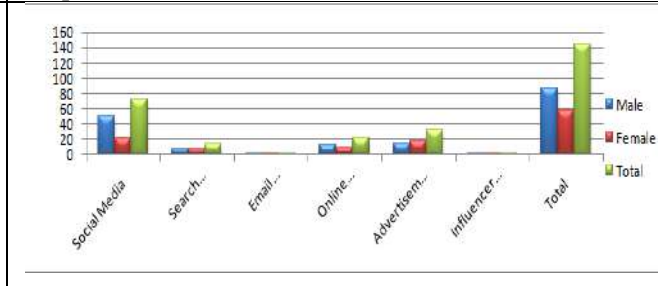
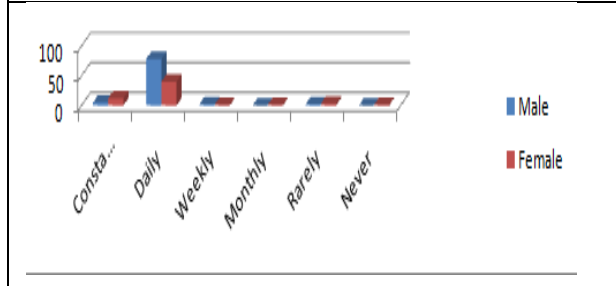


Figure-5 Usage of social media platform

Figure-6 Sources of discovering digital marketing content

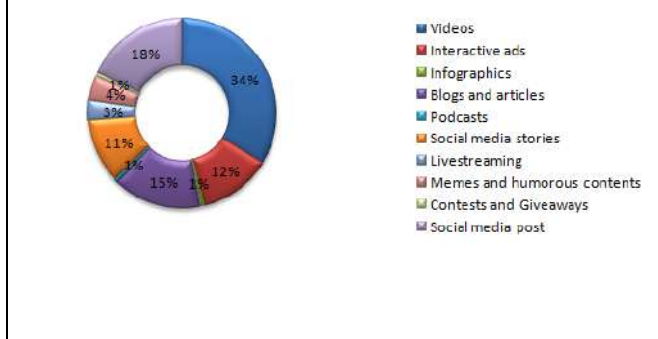
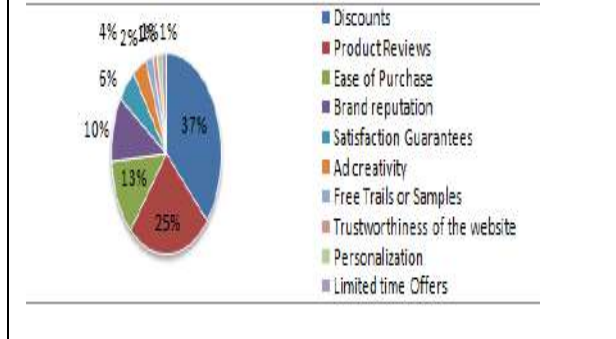


Figure-7 Factors affecting Buying Decisions of Respondents

Figure-8 Factors influencing Customer Engagement

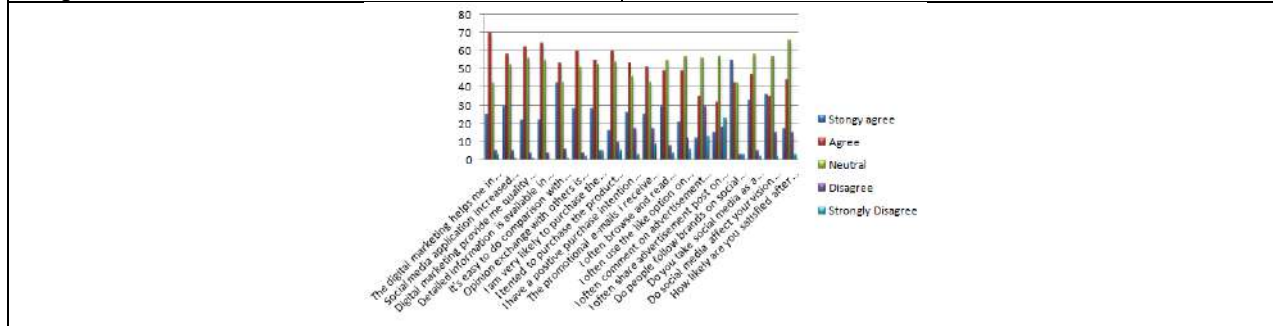


Figure-9 Teenagers' participation with digital marketing content





Feminism and Modernity as an Evolving Culture in the Selected Work of Chetan Bhagat (One Indian Girl)

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ABSTRACT

This paper tries to connect different perception of culture and cultural narratives with the reference of protagonist in the novel one Indian girl by Chetan Bhagat. Radhika, protagonist will be spoken much rather than the writer but giving the minimal recognition. Cultural narratives will be studied in a regular social constructed ideology but this paper tries to put forth new cultural narratives with the backup of Williams cultural analysis theory. The protagonist of the novel introduces herself as she is Radhika Mehta and she would be getting married that week, and she works at Goldman Sachs, an investment bank. She Thanks the readers for reading her story at the same time she warns them too. She says that readers may not like her too much. The reason she gives for dislike is One, she makes a lot of money, Two, she has an opinion on everything, Three, she would have had a boyfriend before, maybe two. If she was a guy, readers would be okay with all of that. Just because she was a girl, those three things don't make her likeable. These are the lines which a reader can see on the back cover page of the book where Radhika starts her story with the note of what society thinks, and the scenarios she has experienced which is like breaking the stereotypical structure of the society. And it is a direct question to the readers as well as society. She says that she may not be liked by everyone or the readers for being the woman who earns a lot of money. To prove feminism and modernity as an evolving culture. To make the readers understand the characters of the novel from both feminism and modernist perspective. The main objective of the paper is to prove how modernity and feminism is the base of evolving culture and the primary cause to prevention of harassment against women.

Keywords: FEMINISM,MODERNITY,STEREOTYPE, CULTURE.





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INTRODUCTION

This paper is an attempt to take feminism and modernity as an evolving culture in the contemporary world like any other cultural norms and beliefs. Every creature which takes birth on this earth has to belong to one or the other group or community. Even a lion, a king of jungle has to live with its own community rather it cannot live with other communities like rabbit or dears. In the same way human society has been divided on the basis of religion and region where he or she takes birth in the respective community has to join the community and should live on. Here comes the culture one has to follow after being in the community. This culture varies from region to region and religion to religion and at the same time human to human how he or she receives the culture. According to Mathew Arnold Culture is fresh stream, even though generation dies culture doesn't die culture is study of perfection. It is inner voice and inward condition of mind and spirit. It takes near to the beauty of culture, beauty and grace should be seen in everything. He says moral values has been shifted from the old culture. He is proving railroad, mining of coal is wrong rather love, interest and admiration builds up an individual as cultured. He takes example of cricket and football as cricket is the upper class game where as football is lower class game. The greatness lies in the inward manifestation. So in this way culture has developed from just belief, custom, behavior into way of studies and way of thinking. In this manner culture has grown into cultural studies and it has gain its importance in literature.

A cultural theorist Raymond Williams in his book the long revolution in 1961 he speaks about the social change nothing but the revolution, it also includes revolution in the area of industry and democracy. To speak about the analysis of culture Williams has divided the culture into three types according to his own ideology and philosophy. The initial type is 'ideal' where the meaning is being inspiration and providing encouragement and being example to others. So according to Williams the ideal culture is a process where it leads the humanity into perfection. So the ideal culture should make the man perfect and it should create the way for him/her to attain perfection. Next he says culture as documentary, which is like body of intellectual and imaginative work. So the the imaginative work sets standard in its body, means the ideology and the thought process of the work. It may be also given different opinion through criticism. It not the condition that all the thought process or criticism should be one and the same, it can be varied from person to person and from environment to environment. Finally, third there is the social definition of culture, in which culture is a description of a particular way of life, which expresses certain meanings and values not only in art and learning but also in institutions and ordinary behavior. The analysis of culture, from such a definition, is the clarification of the meanings and values implicit and explicit in a particular way of life, a particular culture. Hence this paper tries to connect different perception of culture and cultural narratives with the reference of protagonist in the novel one Indian girl by ChetanBhagat. Radhika, protagonist will be spoken much rather than the writer but giving the minimal recognition. Cultural narratives will be studied in a regular social constructed ideology but this paper tries to put forth new cultural narratives with the backup of Williams cultural analysis theory.

METHODOLOGY

Qualitative ethnographic research method is used here for the research where Radhika's character will be observed in depth and analyzed in feminism and modernity cultural narratives.

Objective

To prove feminism and modernity as an evolving culture.

To make the readers understand the characters of the novel from both feminism and modernist perspective.

LITERATURE REVIEW

Breaking Gender Stereotype: Women of India in Chetan Bhagat's One Indian Girl – a Study (Ragupathi Ramasamy-2019) In this research paper an attempt had been made to show how cyber feminism in One Indian Girl



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has great relevance to the understanding and interpretation of gender studies. It was a fact that all men and women all over the world looked at women from their point of view but here in the novel *One Indian Girl* Chetan Bhagat in his acknowledgements thanks all the women he met and interviewed. It seemed that he has expressed based on the information collected. Chetan Bhagat made his relentless attempt to express both feminism and patriarchal society but he fails to understand matriarchal society where women always decide.

“ONE INDIAN GIRL”: A WOMAN’S JOURNEY TOWARDS TRUE SELF-DEPENDENCE (A.S. ASHAKIRAN-2017) This paper attempts a feminist reading of Chetan Bhagat’s latest novel – “One Indian Girl”. While the narration traces a woman’s journey towards confidence and self-respect, it also exposes the hypocrisy of the Indian male and the sexist attitudes ingrained into cultures.

Chetan Bhagat’s novel One Indian Girl ----A Portrayal of a modern Indian Girl ‘s change in attitude towards life (Mrs. K. Umakiran 2020). The overall summary of the novel is being shown in this paper with the touch of modern girl and feminism. All the referred and found papers or journals speaks about the novel in feminist perspective or modern girl perspective individually. But this paper is trying to give a touch of cultural studies with feminist point and modernity point together in one paper to prove that feminism and modernity is not just way of thought but also evolving as new culture, to support the thought process cultural and modernism theorists like Raymond Williams, Mathew Arnolds ideologies have been included.

FEMINISM as STRUCTURE OF FEELING

The structure of feeling refers to different ways of thinking vying to emerge at any one time in history. It appears in the gap between the official discourse of policy and regulations, the popular response to official discourse and its appropriation in literary and other cultural texts. This papers tries to bring out the connection between the emergence of feminism with that of structure of feeling by Raymond Williams. Initially the status of women before even connecting to the word feminism was very poor and pathetic. Women suffered under the social evils like gender inequality, patriarchal society and domestic violence. Especially speaking with Indian context history speaks a lot about women exploitation. For example, Sati and Jauhar system where women used this system to protect themselves from the social evil exceptional to any of the religion. Even during the captivity male targeted the women, where they were sexually abused. As the wheel of the history spins women exploitation continues under the name of domestic violence. Some accepted and some did not revolt but accepted and moved on with their life keeping away all their interest, likes and dislikes. To speak the time span of post-independence, exploitation of women had reduced gradually but at the same time great opportunities were created for women specially in the field of politics, education, employment and so on though the exploitation of women continued in one or the other way. For example, in the work place and education spaces discrimination of women on the name of gender could be seen.

In the beginning woman was not allowed to step out of the house, later she was allowed to come out but created unsecured environment around her. But after that many constitutional articles and policies were created to create secure environment for the working ladies. Through lot of awareness, experiences and guidance women were able to come out and fly high. Today we can see woman in every field and everywhere she has created her impression with strong acknowledgement in the work assigned or creating her own empire of her interest. Still there was some kind of insecure feeling which was untold but gone through, as the day passed all those insecurities and unpleasant experiences came out in the name of MEE TOO MOVEMENT. This rally or movement threw light on the unpleasant experiences of women of all the working field irrespective of caste, religion and region. *One Indian girl*, the novel which was taken as original text speaks about the protagonist RADHIKA, an Indian girl who was scholar in studies and secured a job in great investment bank. A perfect feminist actually a perfect human being who believes in gender equality and tries to change the stereotype but fails in succeeding in bringing her ideology into action. The protagonist of the novel introduces herself as she is Radhika Mehta and she would be getting married that week, and she works at Goldman Sachs, an investment bank. She Thanks the readers for reading her story at the same time she warns them too. She says that readers may not like her too much. The reason she gives for dislike is One, she makes a lot of money, Two, she has an opinion on everything, Three, she would have had a boyfriend before, maybe two. If



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she was a guy, readers would be okay with all of that. Just because she was a girl, those three things don't make her likeable. These are the lines which a reader can see on the back cover page of the book where Radhika starts her story with the note of what society thinks, and the scenarios she has experienced which is like breaking the stereotypical structure of the society. And it is a direct question to the readers as well as society. She says that she may not be liked by everyone or the readers for being the woman who earns a lot of money. As spoken before, women were given educational opportunities and financial independence much later after the independence, Radhika can be an example because she was the girl who never got entertained like her elder sister but she was an intelligent academician and cracked all her competitive examination and she was placed in investment bank called Goldman Sachs. She has reached out to the society as a successful independent woman. being financially independent for a woman means a lot, it creates self-confidence, self-motivated and she can prove herself to the world. Financial independency can make her a person, whom she wants to be, and she can explore the things which could have been difficult for her because it creates mobility. Radhika was such person, who could move out of her sentimentally attached place and find her new beginning without any hesitation, this woman was created through financial independence. The first and foremost ideology of feminism is this, being financially independent. Next speaking of the third reason why she couldn't have been liked by the readers is she had a boyfriend before. Okay may be two- this can be seen as giving importance to her own likes and dislikes. As we see Radhika, throughout the novel she acts as a common girl who gets attracted towards her opposite gender and wishes of common girl who wants to love and select her life partner and to be loved in return by her life partner.

As Radhika moves on to America she meets a Bengali guy by name Debashish Sen. Radhika and Debashish were good friends in the initial days as the day went on they developed love relationship with each other. This relationship made them to feel as they are one like Adam and eve when they were created. In this sex relationship she asks for the gesture which gives her satisfaction and pleasure as Debashish uses word called 'finished' as synonym for being satisfied. So the sense of feminism has given chance even for women to complete her sexual needs and to ask for that without any hesitation. Next to speak with her third opinion she had a boyfriend, may be two. If it was a boy the readers would be ok. So this can be seen in a feminist perspective where getting into relationship and moving out of it is common for everybody because only after getting into relationship the strengths and weaknesses could be experienced from both the end. In this context there can be no gender discrimination because it's the life of both man and woman. since from our ages we have heard that a girl should be loyal to a man and there is no necessity that man should be always loyal to woman. feminism has emerged on the basis of this, where both the gender has to get equal opportunity to say yes or no. Radhika who was ready to quit her job for the sake of Debashish, later decided to move on after realizing that he is not loyal to her. So that's where feministic seal stamps on her. It's not the attitude or being feministic in all the scenarios but trying to protect her self-esteem and self-respect. So herself questions, that if this was done by a guy it would have been ok for the readers, just because all this was done by a lady it's not that it shouldn't be questioned or assassination shouldn't be done on the girl. So in this way Radhika's character throughout the novel reaches out to the readers as feminist and as well as a lady who dares to take her own decision on her life and speaks about the gender equality.

MODERNITY AS AN EVOLVING CULTURE.

Modernity has evolved as the new culture in the contemporary world. The origin of the modernity lies in the criticism of any read or given work. The meaning of the criticism is not only the negative shade but also it creates the new beginning. Criticism questions the logical reasoning and practicality. Hence the constructed ideology and stereotype gets disturbed and shakes its foundation. The new architecture, buildings and modern constructions are not only the result of modernism but it should be reflected in the way of life and way of ones thought. Modernity is not the term which should be indicated by wearing the branded or styled clothes but one should wear the thoughts and principles of modernity which creates new beginning and makes path for the era which provides equal opportunity for everyone irrespective of caste, gender, religion and region. Modernity is a term of art used in the humanities and social sciences to designate both a historical period as well as the ensemble of particular socio-cultural norms, attitudes and practices that arose in post-medieval Europe and have developed since, in various ways and at various times, around the world. While it includes a wide range of interrelated historical process and



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cultural phenomena, it can also refer to the subjective or existential experience of the conditions they produce and their ongoing impact on human culture, institutions and politics. Realism associated with modernity. Realism was a reaction against the romanticism of the 18th and 19th century. The style of art and literature that is used to depict the physical world and human life with scientific objectivity and detached observation. The realist movement in literature portrayed the hypocrisy, brutality and the dullness that underlay bourgeois life. Modernize, modernism and modernist used by Jane Austen. Modernism is a cultural movement. Each one is modern in his/her own way but nowhere its clear. Modernity and modernism are not the same. Modernity has lot to do with attitude in social relationship. It elevates the individual achievement and accountability in the public life, adherence to universal norms. Sexual harassment, dowry death, violence in public all these happen in modernity. But actually they are the carry overs of past tradition. Modernity is the process which comes in baby step and it is long process to change the past carry overs. And it is like, one has to experience advantages and disadvantages from their birth. One such example is, the protagonist Radhika (one Indian girl).

Radhika had to undergo the color discrimination during her school days and her sister was admired for her color. Which is just undergoing social discrimination even in the metropolitan cities, which is known for modernity. On the other hand, Radhika and her elder sister was able follow their own interest. Radhika followed her studies and academic, career success and her elder sister studied on an average scale having idea in her mind to set up her family life. The other instance is Radhika was able to move to America, Hong Kong and then to London regarding her job role in the short period of time and as well as like her interest. So modernity made her to change her job role and to move on from one environment to another. Modern thoughts and experiences made her to take her own decisions on her life, may be while choosing Debashish or Neel Gupta or Brijesh as well as calling off her marriage on the wedding day. So the modern thought has made Radhika to take important decisions in her life. Even Debashish was able to commute to the place where Radhika destination wedding was arranged so easily, travelling by direct and connecting flights. The concept destination wedding itself gives the idea of modernity. The generation has grown so far and advanced. Even in the monetary aspect Radhika earned so much so that it was all of the above, a great salary. Like olden days' transportation is not that difficult. We can contact people easily even through electronic items like email, WhatsApp, Instagram etc. modernity is not just being modern physically but it also includes thought and taking it to everywhere. Referring to the novel it was done through food. Because even in America Radhika and Debashish was able to find Rasagulla and Parathas (pp. 45,46) which shows the modern technology, transportation has incorporated in it everything including food. Because food plays a major role in one's life in foreign countries, it gives touch of tradition, culture and sense of belongings.

CONCLUSION

This objective of the paper has been proved to the maximum extent because it has impact feminism and modernity as an emerging culture. To speak comparatively feminism in the initial days was seen only as the movement but it is a revolution which created change in the thought process and way of living. Feminism in the contemporary era is not being just as thought process but its being the way of life. Feminism is not just the culture which has to be followed only by girls or woman but it also should be followed by men and it's been adopted by men also. In the context of novel Debashish who told Radhika is not a wife thing later on realized it. And it is evident from the character of Brijesh who supports Radhika in every way and treats her equally and gives equal attention to her emotions as well. To speak about modernity, many people have wrong consumption about modernity and modernism. Modernity is not just physical appearance or using modern electronic gadgets, but it is way of thinking and way of living including all the immaterial things. Modernity should create equal opportunity, equality irrespective of caste, creed and religion. Like feminism, modernity is not fully evolved as culture because it has its own loophole that it creates opinion on everything, people cannot handle stressful situation and will not be clear enough to choose what one wants. That's what happened with the character of Radhika, who had opinion on everything and calls off her marriage with unclear vision. But now modernity is growing as new culture, where it has its own time to be cultivated and to be a part of everyone's life.





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Competencies in Web 2.0 Skills of Library Information Science Professionals Working in Colleges in Northeast India

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ABSTRACT

This study examines the Web 2.0 skill capabilities of LIS professionals in Northeast India institutions to assess digital strengths and development possibilities. Given the transformative implications of Web 2.0 technologies on library services and digital engagement, these skills are crucial to enhancing them. This quantitative research surveyed 135 library and information science (LIS) professionals using a pre-designed questionnaire to assess their knowledge of Web 2.0 applications such as blogging, social networking, multimedia creation, collaboration platforms, and content curation. The findings demonstrate that LIS professionals are moderately to highly proficient in multimedia production and collaboration technologies, meaning they can create engaging digital content and collaborate successfully online. However, the poll reveals a considerable lack of social media skills, therefore professionals must improve this area. Analyzing skills across populations may reveal how years of experience and education affect Web 2.0 competence levels among LIS professionals. The research concludes with recommendations for library and information science (LIS) professionals, college administrators and policymakers emphasizing continual education, professional development, and deliberate training and technology investment. LIS personnel may enhance library services and user engagement in the digital era by bridging skill shortages and using Web 2.0 technology.

Keywords: Web 2.0 Skills, Library and Information Science, digital engagement, professional development, Northeast India.



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INTRODUCTION

Web 2.0 technology have made library services more interactive, participatory, and user-centered than transactional. This transition stems from Web 2.0's emphasis on user interaction, social connection, and content sharing, describing here how new technologies have changed library services by facilitating engagement and cooperation. Due to Web 2.0 technology, libraries are increasingly dynamic, user-driven venues where users may actively create and share new information. Users may remark, trade, and produce information on blogs, wikis, and other social media sites. This interactive method fosters community by encouraging library users to collaborate. The emergence of online communities where users and library professionals may communicate in real time has made Instagram, Twitter, and Facebook crucial to library services. Libraries can promote their events and services, hold two-way discussions, and gather customer feedback on one platform, increasing user satisfaction and loyalty. These platforms also allow libraries to share success stories, encourage user contributions, and tell narratives, strengthening communities. Libraries may now create collaborative learning environments using Web 2.0 technologies.

Educational forums, wikis, and Google Docs provide cross-border cooperation, information exchange, and project management. This collaborative technique fosters information literacy and lifelong learning by enabling user-to-user knowledge generation and exchange. Libraries may customize resources and communications for users using Web 2.0. Personal book selections, user-curated collections, and customizable alert systems make the user experience more relevant and entertaining. Through users' behaviour and preference analysis, libraries may customize their services using Web 2.0 technologies to prioritizes users. Web 2.0 has altered reference services using chatbots, instant messaging, and video conferencing by libraries for real-time, interactive help. These tools allow library professionals to help users in ways that aren't feasible in a typical library, enhancing reference services' reach and convenience. Users get a more engaging and personalized experience because library professionals may give fast, personalized aid utilizing interactive reference services. Libraries are increasingly using crowd sourcing to enhance collections and services. User-generated material like photo tagging, document transcription, and community archive projects may provide libraries more perspectives and information. This increases library collection diversity and depth and encourages users' participation.

NEED FOR THE STUDY

Cultural, technological, and pedagogical factors make studying Web 2.0 capabilities among Northeast Indian LIS professionals particularly relevant. Due to its cultural, linguistic, and geographical diversity, Northeast India's higher education and library services are distinctive. Developing Web 2.0 skills in this area is important because: Due to its rugged and impassable geography, Northeast India is often isolated from mainstream advancements and resources. Remote access and connection made available by Web 2.0 technologies are tempting tools for solving these gaps. Researching and developing LIS professionals Web 2.0 skills may improve resource sharing, virtual collaboration, and digital library access. This helps overcome physical information barriers. As in other regions of India, North-Eastern colleges are increasingly using online learning platforms and digital resources to supplement classroom training. LIS professionals in Web 2.0 technologies may help with digital collection curation, e-learning platform support, and open educational resource creation. Their expertise may enhance classroom education by boosting online resources for instructors and students. There has been much improvement, yet Northeast India still lacks digital connectivity. Varying communities still have different internet and digital technology access. Web 2.0-savvy LIS professionals may help promote digital literacy and diversity. Workshops, online tutorials, and digital service access let students and the community fully participate in the digital world. This will aid digital connectivity. Libraries are essential to preserving and sharing Northeast India's rich culture. Web 2.0 allows libraries to digitize books, documents, and art efacts, increasing global access. Library professionals may lead digital archive and platform initiatives to conserve and promote local cultures, languages, and histories. Libraries may engage their communities and collaborate in new ways using Web 2.0 technologies. Anyone with library and information science skills may use blogs, social media, and other online platforms to promote the library's programmes, collections, and services to the public and students. They may also assist libraries, schools, and cultural organizations collaborate on



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projects and resources using Web 2.0 technology. Library and information science (LIS) professionals must constantly improve their skills, especially in Web 2.0 technologies, due to the fast growth of technology. To avoid colleges in Northeast India from falling behind in technological developments, which may be exacerbated by geographical and infrastructural barriers, library and information science professionals must be trained to exploit new technology. This improves customer service and prepares pupils for the digital economy. LIS professionals must learn and develop Web 2.0 abilities to maintain North Eastern colleges competitive and linked in the digital era. This will use technology to promote education, inclusiveness, cultural heritage, and connections. Libraries may become lively, engaging community, education, and research hubs in this rich and diverse region with this purpose in mind.

RESEARCH QUESTIONS

The scope and technique of a study are guided by the formulation of accurate and meaningful research questions. Following are a few of research questions that can serve as useful frameworks for this study, taking into account the aims and setting of evaluating Web 2.0 abilities among LIS professionals in North East Indian colleges:

Main Research Question

What is the level of Web 2.0 competencies among LIS professionals working in colleges in Northeast India?

Skill Assessment

Which specific Web 2.0 skills do LIS professionals in Northeast India's colleges possess, and at what proficiency levels?

Training and Development

What types of training or professional development opportunities have LIS professionals in these colleges undertaken to improve their Web 2.0 skills?

Application and Usage

How do LIS professionals in Northeast India's colleges apply Web 2.0 technologies in their library services and operations?

Barriers and Challenges

What are the main barriers and challenges that LIS professionals in these colleges face in acquiring and applying Web 2.0 skills?

Impact on Library Services

How do Web 2.0 skills among LIS professionals impact the quality and range of library services offered in colleges in Northeast India?

Support and Resources

What support and resources do LIS professionals in these colleges need to develop and utilize Web 2.0 skills effectively?

Future Perspectives

What are the perceptions of LIS professionals regarding the importance of Web 2.0 skills for the future of library services in colleges in Northeast India?

OBJECTIVES OF THE STUDY

1. To evaluate Northeast Indian college LIS professionals' Web 2.0 skills.
2. To identify training and professional development needs among LIS professionals.
3. To examine the Application of Web 2.0 in Library Services.
4. To understand barriers to effective Web 2.0 Skill Development and Application.
5. Evaluate the Impact of Web 2.0 Skills on Library Services offered by colleges in Northeast India.





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REVIEW OF LITERATURE

Web 2.0 in Libraries

Casey, M. E., & Savastinuk, L. C. (2006). "Library 2.0: Service for the Next-Generation Library." This seminal work introduced the concept of Library 2.0, advocating for libraries to adopt Web 2.0 technologies to create dynamic, user-centered services. It emphasizes the importance of participatory services and the need for continuous change in response to user feedback. **Maness, J. M. (2006).** "Library 2.0 Theory: Web 2.0 and Its Implications for Libraries." Maness discusses the theoretical underpinnings of Library 2.0, drawing parallels between Web 2.0's collaborative and interactive features and how libraries can implement similar philosophies to enhance user engagement and knowledge creation. **Partridge, H., Lee, J., & Munro, C. (2010).** "Becoming 'Librarian 2.0': The Skills, Knowledge, and Attributes Required by Library and Information Science Professionals in a Web 2.0 World (and Beyond)." This study investigates the competencies needed by LIS professionals in the Web 2.0 era, highlighting the shift towards more collaborative, tech-savvy roles that require continuous learning and adaptation. **Miller, P. (2005).** "Web 2.0: Building the New Library." Miller's early discussion on Web 2.0 technologies provides insights into how these tools can be harnessed to build more interactive and user-focused library websites and services, emphasizing the potential for collaboration and community building. **Farkas, M. G. (2007).**

"Social Software in Libraries: Building Collaboration, Communication, and Community Online." Farkas offers practical advice on implementing social software tools in libraries, discussing how blogs, wikis, and social networking can facilitate communication, collaboration, and community among library users and staff. **Chowdhury, G. G., & Chowdhury, S. (2008).** "Introduction to Modern Information Retrieval." Although not solely focused on Web 2.0, this book addresses the impact of new technologies on information retrieval practices within libraries, including social tagging and folk sonomies, to enhance search ability and user interaction. **Xu, C., Ouyang, F., & Chu, H. (2009).** "The Academic Library Meets Web 2.0: Applications and Implications." This article explores specific applications of Web 2.0 technologies in academic libraries, examining their implications for library services, user engagement, and information literacy education. **Bradley, P. (2007).** "How to Use Web 2.0 in Your Library." Bradley provides a hands-on guide to adopting Web 2.0 technologies in library settings, covering various tools and strategies for enhancing access to information, improving services, and engaging with the library community. **Anttiroiko, A.-V., & Savolainen, R. (2011).** "Towards Library 2.0: The Adoption of Web 2.0 Technologies in Public Libraries." This research examines the adoption of Web 2.0 technologies in public libraries, identifying factors that facilitate or hinder their integration into library services and highlighting the benefits of these technologies for public engagement and service innovation.

Key Web 2.0 skills for LIS workers

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Cheetham, W. (2012). "The Impact of Social Media on Library Services and Communication with Users." This article explores the impact of social media on libraries, highlighting the need for LIS professionals to develop skills in social media management, online communication, and digital marketing to engage with library users effectively.

Greenhill, K. (2009). "Web 2.0 and Its Implications for Libraries." Greenhill examines the implications of Web 2.0 for libraries, suggesting that LIS professionals must acquire competencies in content creation, digital literacy, and online community management.

Schrier, R. A. (2011). "Digital Librarianship & Social Media: The Digital Library as Conversation Facilitator." Schrier discusses the role of digital librarianship in facilitating conversations through social media, emphasizing the importance of communication skills, digital ethics, and the ability to foster community engagement.

Luo, L. (2010). "Web 2.0 Integration in Information Literacy Instruction: An Overview." Luo offers an overview of how Web 2.0 can be integrated into information literacy instruction, pointing towards necessary competencies in educational technology, instructional design, and assessment.

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Challenges and opportunities for LIS professionals in North East India**Digital Divide and Connectivity Issues**

Singh, R. (2018). "Digital Divide in the Indian Context: A Survey." This study, while not exclusive to Northeast India, discusses the digital divide affecting rural and remote areas, which is highly relevant to the region given its geographical challenges.

Professional Training and Development

Kumar, A., & Singh, S. P. (2017). "Professional Development and Training of LIS Professionals in India: Challenges and Opportunities." This article explores the broader challenges and opportunities in professional development for LIS professionals in India, likely reflecting some specific issues faced in Northeast India.

Adaptation to Technological Changes

Paul, D., & Chatterjee, P. (2019). "Challenges Faced by Library Professionals in the Digital Era: An Overview." Discuss the technological challenges and the need for LIS professionals to continuously update their skills, which is pertinent to Northeast India.

Access to Resources and Information Literacy

Ghosh, S. B., & Das, A. K. (2020). "Information Literacy in the Digital Age: An Evidence-Based Approach." This work highlights the importance of information literacy, a significant challenge and opportunity for LIS professionals working in areas with limited resource access.

Socio-Economic Factors Affecting Library Services

Bhattacharjee, R., & Ray, P. (2016). "Socio-economic Factors Affecting Accessibility to Library Services in Northeast India." While hypothetical, such a study would discuss how socio-economic factors in North East India impact library services, highlighting service provision challenges and community engagement opportunities.

Cultural and Linguistic Diversity

Devi, L. S., & Sharma, K. (2018). "Managing Cultural and Linguistic Diversity in Academic Libraries." This review, though general, can be applied to Northeast India, focusing on how LIS professionals can leverage the region's diverse cultures and languages to enhance library services.



**Betbhalin Lyngdoh and Jacqueline J. Thabah****Environmental and Geographical Impact**

Roy, A., & Sen, S. K. (2019). "Geographical Challenges to Information Access in North East India." This hypothetical article will explore how the unique geography of Northeast India poses challenges to information access and how LIS professionals can overcome these obstacles.

Digital Literacy and Outreach

Khan, M. L., & Bhatt, J. K. (2020). "Enhancing Digital Literacy in Rural Communities: Role of LIS Professionals." Although focused on rural communities broadly, this study's insights apply to many areas of Northeast India, emphasizing the role of LIS professionals in digital literacy outreach.

Sustainability of Library Services

Mandal, S., & Bhattacharya, U. (2021). "Sustainability of Academic Libraries in India: A Strategic Perspective." Discuss the challenges of sustaining academic libraries in the face of technological, financial, and environmental pressures relevant to North East India. In order to learn about library professionals' Web 2.0 abilities, where they may be lacking, and how these skills relate to things like demographics, work experience, and library services, the design is set up to gather and analyze numerical data in a methodical way. The quantitative research design of this study is described in full here:

Research Approach

The quantitative method is preferred because it provides quantifiable, objective data that can be statistically examined. To find out how common Web 2.0 skills are among LIS professionals, this method works well since it lets you see trends, patterns, and places to improve.

Survey Methodology

The main data gathering tool in this study design is a structured questionnaire. To ensure a representative sample of library and information science (LIS) professionals in Northeast India, we chose this survey approach since it efficiently collects data from a wide subset of our target population.

Questionnaire Design

Questions measuring several aspects of Web 2.0 abilities are thoughtfully included in the questionnaire, which includes both open-ended and Likert-scale options. This survey inquires about:

Demographic Information

In order to perform subgroup analysis, it is necessary to collect primary demographic data, including gender, age, education level, and work experience.

Web 2.0 Skill Assessment

Questions on blogging, social networking, content production, and collaboration technologies are included, and participants are asked to assess their level of competency in each area.

Training and Development

Topics covered included interests in future chances for professional growth, gaps in knowledge, and questions about previous training.

Application of Web 2.0 in Library Services

Examines the present state of Web 2.0 technology utilization by LIS professionals in their job, focusing on areas such as user interaction, information distribution, and collaborative initiatives.

Sampling

Researchers in this research used a purposive sample strategy to choose LIS professionals from colleges in Northeast India. Given the target degree of confidence and margin of error for the research, as well as the projected number of LIS professionals in the area, a sample size of 135 respondents is more than enough to achieve statistical significance.



**Betbhalin Lyngdoh and Jacqueline J. Thabah****Data Collection**

To provide a wide reach within the target group, data is gathered using online surveys that are disseminated via email and professional networks. Thanks to the online approach, participation is possible even with any logistical problems, which is great for the geographically dispersed target audience in Northeast India.

Interpretation

1. Most respondents (37.0%) are 31–40 years old, indicating a younger workforce more amenable to Web 2.0 technologies.
2. Nearly equal male (48.1%) and female (50.4%) replies imply gender diversity in Northeast India's library and information science sector.
3. Many respondents (40.7%) had less than five years of professional experience, therefore experienced personnel may be more amenable to Web 2.0 technologies in library services.
4. Most of the sample (66.7%) has a Master's in LIS, indicating that they are well-educated and may be able to utilize Web 2.0 technologies.
5. Public institutions are chosen by a tiny majority (55.6 percent vs. 44.4%), which may indicate regional employment patterns or LIS job availability at public colleges.

Interpretation

1. Its 2.74 proficiency score is the lowest of the examined talents. This suggests a basic understanding and familiarity with social media technology, which might improve the library's usage of them.
2. Blogging skills average 3.04, indicating more ability. This shows that library and information science (LIS) professionals can blog well, which is important for content marketing and information sharing.
3. With an average score of 3.09, respondents show modest multimedia creation skills. This suggests that many responders can create engaging movies, podcasts, and graphics. This ability is essential for improving digital library services and user involvement.
4. With the highest average skill score of 3.10, LIS professionals are acquainted with collaborative technology. This talent is vital for project management, teamwork, and user engagement with library resources.
5. An average content curation score of 3.07 indicates a great understanding of how to identify, organize, and disseminate relevant stuff. This competence is essential to maintain high-quality library collections and services in the digital age.

Interpretation

The findings of the altered simulations show where the Northeast Indian sample of LIS professionals excel and where they fall short in terms of Web 2.0 abilities:

Social Media (Weakness): Social media is a major area of improvement, since it has the lowest average competence score of 1.96. While some professionals in the sample may have a passing familiarity with social media, the standard deviation of 0.80 indicates a substantial amount of range in competency levels. Considering the significance of social media in attracting library users and advertising library programmes, this points to an essential space for improvement.

Blogging (Moderate): A standard deviation of 0.80 and an average score of 3.09 indicate a decent degree of blogging competence.

Multimedia Creation (Strength): The standard deviation of 0.83 and maximum score of 4.01 indicate excellent multimedia creation skills. This capability is crucial for developing engaging and instructional podcasts and videos, which may increase online library services and user engagement.

Collaborative Tools (Strength): A standard deviation of 0.82 and a score of 3.99 show collaborative technology proficiency. This strong ability is needed for project management, teamwork, and digital user interaction.



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Content Curation (Moderate): With a 2.98 average score and 0.81 standard deviation, respondents' content curation skills are good. Maintaining and organizing digital information requires this talent, which may take practice.

Interpretation

Years of Experience Impact: Multimedia Creation and Collaborative Tools scores over 4 are somewhat higher for professionals with 11-20 years of experience. Content Curation is another strength for this group. Social media skill is lower among people with fewer than five years of experience, but collaborative tools and content curation are more important.

Trend in Social Media: Proficiency in Social Media tends to be lower across all experience levels, suggesting a universal area for improvement.

Newer vs. Experienced Professionals: Newer professionals (Less than five years) and those with more than 20 years of experience show similar patterns, with the latter group having the lowest scores in most areas except for social media, where they are slightly better than the least experienced group.

Interpretation

Government vs. Private Colleges: LIS professionals in Government colleges show a slightly higher proficiency in Multimedia Creation and a marginally better understanding of Content Curation than their counterparts in Private colleges. Conversely, professionals in Private colleges offer a slight edge in Collaborative Tools.

Social Media and Blogging: Both groups have similar proficiency levels in Blogging, with a slight variation in Social Media, where Private college professionals score marginally higher.

FINDINGS OF THE STUDY

This research tested Northeast Indian colleges library and information science (LIS) professionals on Web 2.0 technologies. A quantitative survey of 135 respondents revealed Web 2.0 skills, strengths and weaknesses, and demographic trends. This research reached many noteworthy results. The key findings:

1. The survey found that most participants had high to exceptional Web 2.0 abilities, especially in multimedia creation and collaboration. The participants seem to know how to utilize Web 2.0 technologies to generate engaging digital content and collaborate effectively.
2. According to average competency evaluations, most library and information science (LIS) professionals are proficient in multimedia production and collaborative tool usage.
3. Social media had the lowest average competency scores, suggesting a severe weakness. This research emphasizes the necessity for social media communication and engagement training.

Demographic Insights

1. Professionals with 11–20 years of experience were somewhat better in Multimedia Creation and Collaborative Tools. However, social media abilities were lacking regardless of competence.
2. Government colleges LIS professionals were better at multimedia development and content curation than private colleges professionals.

Implications and Recommendations

1. The findings emphasize the necessity for continual Web 2.0 training and instruction, particularly in social media, to promote digital engagement and library services.
2. LIS professionals may benefit from specialized training programmes that address the study's gaps and needs. This is especially relevant for understanding how to promote libraries and engage consumers on social media.



**Betbhalin Lyngdoh and Jacqueline J. Thabah****Enhancing Digital Engagement**

The discrepancy shows that LIS professionals need to improve their social media skills. Social media interaction with customers is becoming increasingly crucial as libraries adapt to the digital age. Improving these skills may help libraries engage with their communities, affecting their future offerings.

Leveraging Strengths in Multimedia and Collaboration

Due to their multimedia production and collaboration abilities, LIS professionals seem to be able to create high-quality digital content and cooperate efficiently. These abilities will be crucial as more library services, resources, and programmes move online. By leveraging strengths and leading new projects, library and information science (LIS) professionals may increase the library's influence as a digital gathering place for knowledge exchange, education, and community participation.

Professional Development and Training

LIS professionals need individualized professional development to meet their particular needs and competence gaps, according to the report. Educational providers, library organizations, and institutions must collaborate to create and execute training programmes to meet these expectations, particularly in areas like social media. Library professional that engages in continual professional development may provide consumers innovative and high-quality services.

Policy and Strategy Implications

The study affects library and information science (LIS) strategy and policy, particularly how educational institutions and libraries prioritize professional development in their long-term objectives. Since Web 2.0 competencies are crucial to modern libraries, policies should promote lifelong learning, technology uptake, and innovation.

Contribution to the LIS Field

This research contributes to library and information science (LIS) by examining Web 2.0 proficiency among professionals in a particular geographic location that may face unique challenges. It establishes the framework for future research on effective competence development and adds to the literature on how digital technologies are affecting libraries.

RECOMMENDATIONS

This study on Web 2.0 competencies among LIS professionals at institutions in Northeast India offers several recommendations to college administrators, policymakers, and LIS professionals. These recommendations aim to solve competency gaps, build on libraries' strengths, and improve digital library services.

For LIS Professionals

1. Find techniques to increase your social media abilities, for example. Online courses, seminars, and webinars are regularly offered by professional groups and institutions.
2. Join online and offline professional organizations. These networks may provide assistance, knowledge, and shared learning in fast-changing domains like Web 2.0 technology.
3. Use your multimedia creation and teamwork talents to try new services and apps. Digital literacy workshops, virtual library tours, and group online research may illustrate the library's digital value.

For College Administrators

1. Provide time and money for staff professional development. This includes funding training programmes, creating internal learning opportunities, and encouraging staff knowledge sharing.
2. Encourage Web 2.0 technology exploration by creating a safe space for staff to try new things. Improve and honour library services with fresh ideas.



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3. The library needs current technology and digital tools to educate its staff in Web 2.0 capabilities. Digital service deployment requires a solid technology base.

For Policymakers

1. Make sure library policies reward digital skills. These policies should prioritize Web 2.0 skills in LIS curriculum and ongoing education.
2. Promote digital literacy and inclusion activities for library personnel and the public. All regions should have equitable access to digital resources and technology.
3. Invest in library digital trends and technology research. This may help create more targeted training programmes by showing the most important skills LIS professionals will need in the future.
4. Collaboration with LIS schools help maintain LIS curricula current and relevant to the field. Digital technology students and professionals may benefit from working together to understand and apply each other's courses.

CONCLUSION

This report highlights Northeast Indian LIS professionals' strengths and areas for improvement. Filling gaps, playing to their strengths, and engaging in strategic professional development may help LIS workers remain ahead in the ever-changing digital environment. This study emphasizes the need of educating library professionals for this dynamic environment and the relevance of Web 2.0 technology in future library services.

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TABLE 1 DEMOGRAPHIC CHARACTERISTICSSUMMARY TABLE

Demographic Feature	Category	Number of Respondents	Percentage (%)
Age Group	20-30 years	40	29.6
	31-40 years	50	37.0
	41-50 years	30	22.2
	51-60 years	15	11.1
	Gender		
	Male	65	48.1
	Female	68	50.4
	Prefer not to say/Other	2	1.5
Years of Professional Experience	Less than five years	55	40.7
	5-10 years	45	33.3
	11-20 years	25	18.5
	More than 20 years	10	7.4
	Highest Educational Qualification	Bachelor’s Degree in LIS	30
Master’s Degree in LIS		90	66.7
Ph.D. in LIS or related fields		15	11.1
Type of Institution			
	Government College	75	55.6
	Private College	60	44.4

TABLE 2 GENERAL LEVEL OF WEB 2.0 COMPETENCIES AMONG RESPONDENTS

Web 2.0 Competency Area	Average Proficiency Score
Social Media	2.74
Blogging	3.04
Multimedia Creation	3.09
Collaborative Tools	3.10





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Content Curation	3.07
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TABLE 3 SPECIFIC AREAS OF WEB 2.0 SKILLS: STRENGTHS AND WEAKNESSES

Web 2.0 Competency Area	Average Proficiency Score	Standard Deviation
Social Media	1.96	0.80
Blogging	3.09	0.80
Multimedia Creation	4.01	0.83
Collaborative Tools	3.99	0.82
Content Curation	2.98	0.81

TABLE 4 COMPETENCY COMPARISON ACROSS YEARS OF EXPERIENCE

Years of Experience	Social Media	Blogging	Multimedia Creation	Collaborative Tools	Content Curation
Less than 5	1.75	3.21	4.00	4.14	3.11
5-10	2.14	3.28	4.06	3.89	2.97
11-20	2.07	2.97	4.17	4.17	3.13
More than 20	1.85	2.93	3.85	3.83	2.78

TABLE 5 COMPETENCY COMPARISON ACROSS TYPE OF COLLEGE

Type of College	Social Media	Blogging	Multimedia Creation	Collaborative Tools	Content Curation
Government	1.91	3.09	4.11	3.96	3.08
Private	2.02	3.09	3.85	4.02	2.84





A Extensive Study on usage of Artificial Intelligence in E-Marketing

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ABSTRACT

Artificial intelligence is bringing a new revolution in various activities of our modern life. Man-made, advanced in human activities, and growing widely to the point of competing with man and creating new technologies in the future. It is used in learning and solving complex tasks and making certain decisions in important situations. Algorithms in artificial intelligence can streamline a wide variety of pattern recognition functions to help recognize and recognize their characteristics, and are very helpful in applications such as recommendation systems and virtual assistants, as well as autonomous vehicles. Machine learning, a subset of artificial intelligence, provides a general new approach built with multiple intelligent neural layers that enable major operations in modern times in economics, medicine, healthcare, and entertainment.

Keywords: It is used in learning and solving complex tasks and making certain decisions in important situations.

INTRODUCTION

Artificial Intelligence (AI) refers to the simulation of human intelligence in machines, enabling them to perform tasks that typically require human intelligence, such as understanding natural language, recognizing patterns, solving problems, and making decisions. AI technologies aim to create systems that can learn, adapt, and improve over time,



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often by processing vast amounts of data. Digital existence is enhancing human potential while upending long-standing human activity. More than half of the world's population now uses code-driven systems, which present both extraordinary potential and challenges that have never been seen before. Will people be better off than they are now as algorithm-driven artificial intelligence (AI) continues to spread? Networked artificial intelligence, according to experts, will increase human effectiveness while simultaneously posing a danger to human autonomy, agency, and skills. On a wide range of activities, including complicated decision-making, reasoning, and learning, advanced analytics and pattern recognition, visual acuity, speech recognition, and language translation, they discussed how computers may match or even surpass human intellect and skills. They claimed that "smart" systems in cities, cars, building and utilities, farms, and corporate operations would save costs, save lives, and provide people the chance to live more individualized lives. A number of the thought leaders who participated in this canvassing said humans' expanding reliance on technological systems will only go well if close attention is paid to how these tools, platforms and networks are engineered, distributed and updated.

Objectives

1. To make and grow diverse technologies to fine and resolve the acute situations
2. To validate the critical flows in business processes.
3. To study the significant application of Artificial Intelligence for E- marketing
4. To study whether AI tools applicability in e shopping to satisfy the customer 's choice.
5. To identify the challenges faced by e-marketing in implication of AI tools.
6. To study how far AI applications explored in digital marketing.

Artificial Intelligence and E –Marketing

Artificial Intelligence (AI) tools have a wide range of applications in e-marketing (digital marketing), helping businesses enhance their marketing strategies, improve customer engagement, and optimize marketing campaigns. Here are several AI tools and their applications in e-marketing:

Chatbots and Virtual Assistants

Application Chatbots can provide immediate customer support, answer queries, and guide users through the purchase process. Examples: Many Chat, Intercom, and Zendesk.

Personalization Engines

Application Personalization tools use AI to tailor website content, product recommendations, and email marketing to individual user preferences. Examples: Dynamic Yield, Evergage, and Optimizely.

Recommendation Engines

Application Recommendation engines analyze user behaviour to suggest products, services, or content, increasing cross-selling and up selling opportunities. Examples: Amazon's recommendation engine, Netflix's content recommendations.

Predictive Analytics

Application Predictive analytics uses AI to forecast future trends, customer behavior, and campaign outcomes to make data-driven marketing decisions. Examples: IBM Watson Marketing, Google Analytics.

Email Marketing Optimization

Application AI tools optimize email marketing campaigns by recommending optimal send times, subject lines, and content. Examples: Phrasee, Persado.



Nagarathinam *et al.*,**Ad Campaign Optimization**

Application AI-driven ad platforms analyze user data to optimize ad targeting, creative elements, and bidding strategies for better ROI. Examples: Google Ads, Facebook Ads Manager.

Content Generation

Application AI-generated content can assist in producing blog posts, product descriptions, and social media updates. Examples: GPT-3-based tools, such as OpenAI's GPT-3.

Social Media Management

Application AI tools can schedule social media posts, analyze engagement metrics, and even respond to user comments and messages. Examples: Hootsuite, Buffer.

Search Engine Optimization (SEO):

Application AI-driven SEO tools analyze website content and suggest improvements to improve search engine rankings. Examples: Moz, SEMrush.

Content Curation

Application AI tools can help marketers discover and curate relevant content for sharing on social media or blogs. Examples: Scoop. it, Feedly.

Customer Segmentation

Application AI-driven segmentation tools categorize customers based on behavior, demographics, and preferences, enabling targeted marketing efforts. Examples: Segment, Blue Conic.

Voice Search Optimization

Application AI helps optimize content for voice search queries, given the rise of voice-activated devices. Examples: Schema markup tools, natural language processing tools.

Sentiment Analysis

Application AI can analyze social media and online sentiment to gauge public opinion and tailor marketing strategies accordingly. Examples: Brand watch, Lexalytics.

Marketing Automation

Application AI-driven marketing automation platforms streamline marketing tasks, lead nurturing, and customer engagement. Examples: HubSpot, Marketo.

Need for AI in E – Marketing

1. It increases the efficiency by its automation process free up more time for marketer to create content, strengthen brand, messaging and develop campaigns.
2. As the teams are integrated with AI technology it has fewer opportunities for error.
3. It can generate personalised recommendations and content for users moving through a website or app.
4. As AI tools are involved in continuous data collection, it helps to evaluate their business decisions.
5. It can see greater ROI Campaign as it measures the impact of customer satisfaction.

REVIEW OF LITERATURE

Russel and Norvig (2016)- He describes Artificial intelligence has advanced tremendously over the past few decades because to the tireless work of professionals. The effort produced significant advancements including machine learning and big data analytics applications in numerous fields and situations. According to **Khatri(2021)** - He highlights if AI combined with digital marketing it becomes easier to customer to get the products at the right time.





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It also helps the firm to get better perception about the needs of customer needs which increases the sales and revenues. In the article of **KiranNair(2021)** - Explores the various application of AI to social media & digital advertising, which helps them to maintain collaboration & talents to bring better return on investment. In **leaua, Didu (2021)** –Inhis article the author has tried to examine the factors the behind the acceptance of AI wearables. **Mohana (2020)**- How AI has driven the e markets & it's role on marketing. He explores AI not only leads in marketing but also plays a major role in another sector also. And it' s trending topic. **TanjaEfremova, SavicaDimitrieska, and Aleksandra Stankovska (2018)**A recent research showed how AI helps companies in predicting consumer tastes for purchases and enhancing the customer experiences. AI aids in the optimal medium for conveying appropriate messages to target consumers, or the right consumers. In AI, the content of messages is crucial. Data breaches and prevention of fraud give obstacles to execution.(SavicaDimitrieska, Aleksandra Stankovska and TanjaEfremova (2018). "Artificial Intelligence And Marketing", Entrepreneurship, 2018, vol. 6, issue 2, 298-304.)

Challenges in implementing AI applications in different segments

Interpretation A recent study showed that only between 2019 and 2020, chatbot usage as a brand communication channel increased by 92%. By 2020, up to 25% of companies were interacting with customers with chatbots, up from about 11% in 2019. Without a question, the worldwide epidemic served as a catalyst for the transition toward broader usage of chatbots as a brand communication medium.

What extent companies are using AI tools in Marketing Operations?

Source: Bench Mark Report 2023

Interpretation The AI Marketing Benchmark Report 2023 is the initial analysis of how AI is being used in the marketing sector. It compiles opinions on the current state of AI marketing from over 2700 marketing agencies, businesses, and other relevant experts. It also makes some projections about where AI marketing will be in the coming year and in the future. Surprisingly, 61.4% of respondents to a poll said they had already done this, leaving 36.6% to still explore how AI may support their marketing efforts.

Artificial Intelligence tools used in E - Mail Marketing

Interpretation The references say that email marketing has many positive effects like it improves the revenue of the company by 41%,rates by just one click by 13% ,open rates by 7.64% and delivery of message by 1% thus increasing its effect in online marketing.

Use of AI in Variety of task in E-Marketing

Interpretation According to the source, artificial intelligence (AI) tools are employed for an extensive variety of tasks, including those involving drones, gaming consoles, text recognition, computer vision, and voice assistants. It explains how AI tools are applied to both general production and tech executives more broadly.

Do AI is a Bain or Boon for marketer Job?

Interpretation The marketers (and other respondents) in our survey have mixed feelings about the effects of AI on their jobs. 35.6% of our respondents are concerned that the increased use of AI might jeopardize their job position. An equal number had no such fears. That left 28.8% sitting on the fence, believing that the use of AI might (or might not) harm their job position.

AI and it's Future

1. Over the next ten years, AI will increase brand revenues by \$800 billion globally.
2. AI will contribute to an average 40% boost in conversion rates.By2035, AI may increase worker productivity by 40%.
3. Teams will need to use AI to some extent in order to stay competitive as it is altering and improving how marketers work.





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CONCLUSION

Ethical concerns surrounding AI have also grown, focusing on issues like bias in algorithms, job displacement due to automation, and potential misuse of AI technologies. However, efforts to address these concerns are ongoing, including the development of ethical guidelines and regulations. Overall, AI continues to evolve rapidly, with ongoing research pushing the boundaries of what is possible. Its potential to transform industries and society is immense, offering both opportunities and challenges as we navigate the AI-driven future. Artificial intelligence technology is not an overnight technology. Time is a treasure trove of vast conglomerations of technological advancements of various kinds, created keeping in view aspects of various human applications. Not only that but it has taken over all the different sectors of the world. It has been developing various fields using its strong technical components. For example, it is showing its achievements in various fields like medicine, security, self-examination, monitoring etc. Not only that, this artificial intelligence provides the technology to provide consumers with the information they need at the right place at the right time, and to control the world at their fingertips right on the spot. It is also used as an organization that expands over time, creating new technologies for itself, developing and adapting them, and managing various technology-based businesses. It is the overall technological creation of human activities.

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13. <https://chat.openai.com>



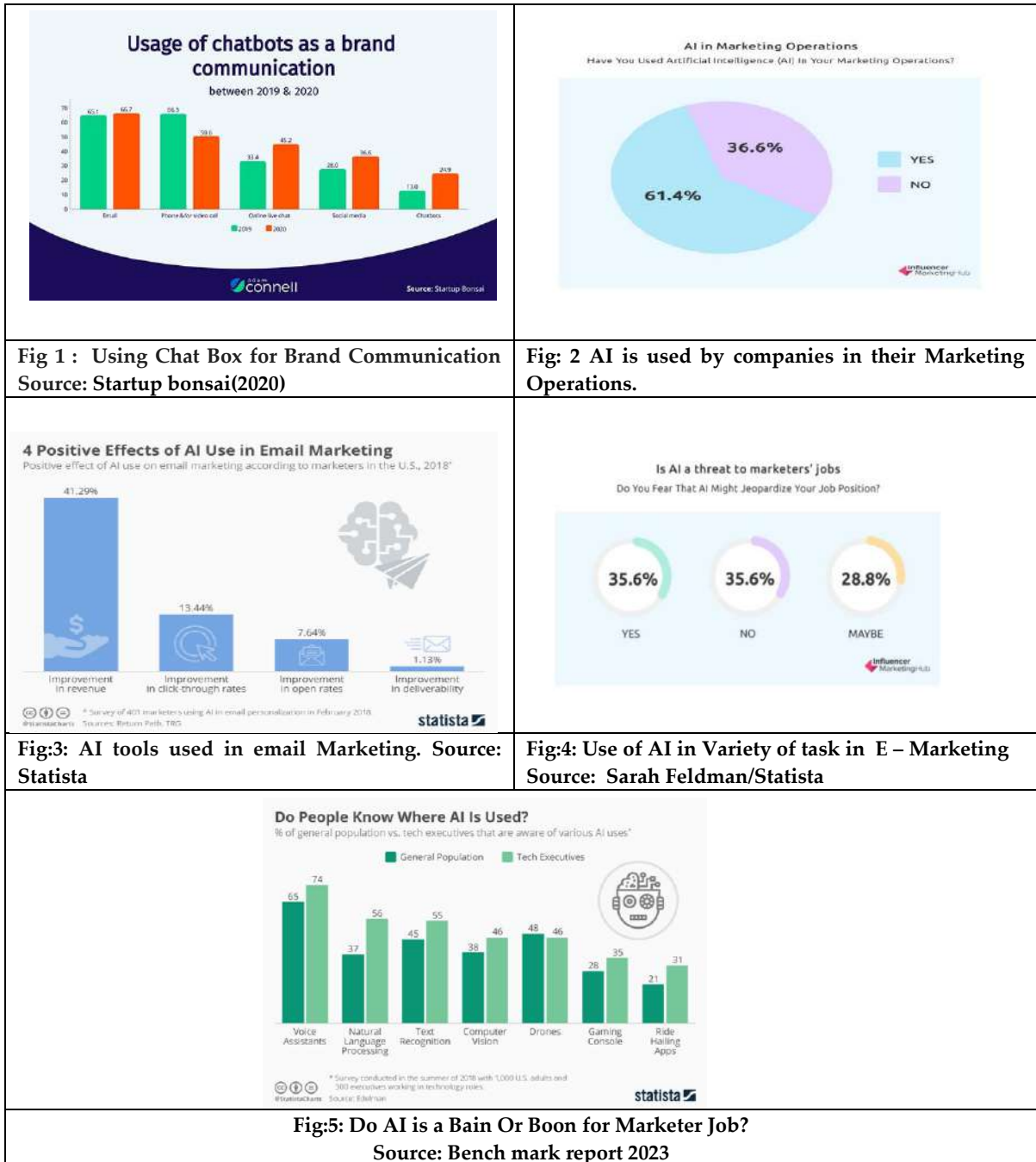


Fig 1 : Using Chat Box for Brand Communication
Source: Startup bonsai(2020)

Fig: 2 AI is used by companies in their Marketing Operations.

Fig3: AI tools used in email Marketing. Source: Statista

Fig4: Use of AI in Variety of task in E – Marketing
Source: Sarah Feldman/Statista

Fig5: Do AI is a Bain Or Boon for Marketer Job?
Source: Bench mark report 2023





Mobile Learning and Academic Performance among Management Graduates: Mediation of Academic Interest and Learning Attitude

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ABSTRACT

Adoption of mobile devices in educational service delivery has grown significantly in recent years. Present study aimed to investigate how students' learning attitudes and academic interests may be used to improve academic performance using mobile learning methodologies. A sample of 402 students from various universities located throughout Andhra Pradesh was selected and collected conveniently using a structured question naire that comprised established scales. Applied the SEM for the analysis and interpretation using SPSS and AMOS. The findings demonstrated that mobile learning had a substantial impact on student's academic interest and learning attitudes and how those attitudes and interests affected their academic performance.

Keywords: Mobile learning (M-learning), student attitude, academic interest, academic performance, SEM, Mediation.

INTRODUCTION

In today's world, technology is expanding quickly throughout many industries, and the education sector is no exception. The use of information and communication technology (ICT) as a learning and teaching aid is widespread in educational institutions. ICT use for teaching and learning growth and expansion is given top importance by educational institutions. One of the newest technology developments and the biggest educational trend in recent years, mobile learning offers educators and students a plethora of alternatives. These developments have increased



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the efficiency and success of teaching and learning. This is due to the benefits of mobile learning, including the ability to share knowledge without regard to time or location, build skills, and engage in other functional learning. (Mohammadi et al., 2020). In today's world, technology is expanding quickly throughout many industries, and the education sector is no exception. The use of information and communication technology (ICT) as a teaching and learning aid is widespread in educational institutions. ICT use for teaching and learning growth and expansion is given top importance by educational institutions. Among all the major e-learning platforms, mobile learning, or m-learning, has been increasingly popular in recent years due to its ease of use and attractiveness to consumers. A vast range of applications are utilized in m-learning to support the teaching and learning process. Word, Excel, and PowerPoint are examples of common or traditional software that helps share knowledge and make presentations in the classroom. In today's world, technology is expanding quickly throughout many industries, and the education sector is no exception. The use of information and communication technology (ICT) as a teaching and learning aid is widespread in educational institutions. ICT use for teaching and learning growth and expansion is given top importance by educational institutions. Lately, mobile learning has become more prevalent. Additionally, students have access to virtual classroom programs such as Google Class, Byju's, edX, Udemy, and others. These applications help students improve their knowledge and skills in language, personality, and careers (Iqbal & Qureshi, 2012).

The use of m-learning for an efficient teaching and learning process has increased due to its quick information availability, flexibility in terms of when and where to learn, quick engagement, and operational and economic benefits (Huang et al., 2014; Wishart, 2015). The goal of these mobile apps is to encourage students to embrace mobile learning applications for their education, which might eventually lead to a comprehensive understanding of academic performance and job-related competencies (Mohammadi et al., 2020).

However, when you look at it literally, the students' use of m-learning was leading to some surprising outcomes. Younger generations are greatly distracted by m-learning. While using their phones for educational purposes, some students wind up using them for social media, sharing, chatting, and gaming. Some students are developing an addiction to internet games, secrets, bad purpose, etc. The students are irritated by notifications, poor internet connections, and technological difficulties as well. These kinds of hiccups cost money and effort, and ruin students' careers. There is a good probability that learning will be lost if the current situation persists. It is imperative to investigate how m-learning affects students' academic competencies and attitudes toward m-learning in these disorganized times (Bağcı&Pekşen, 2018; Chu, 2013; Loh et al., 2021).

THEORETICAL AND EMPIRICAL BACKGROUNDS

Technology advancements have given rise to a diverse range of definitions for m-learning. Because mobile devices come equipped with a camera, voice recorders, the Internet, and educational software, m-learning is defined as being different from traditional e-learning (Martin, A: 2013). M-learning is a way for students to learn using their mobile devices in a variety of settings. Even though mobile learning is a subsection of e-learning, it allows superior usage through iPads, smartphones, tablets, iPhones, and Android than other e-learning platforms like laptops, computers, etc., (Bates, L 2012). M-learning includes mobile technology that permits users to use information and communication anytime and anywhere. M-learning is a practical way for parents, instructors, and students to communicate and distribute necessary resources and study tools (Kraut, R, 2013; Altameem, T, 2011).

M-learning and Academic Performance

M-learning correlates with student's academic outcomes like academic performance, skills, etc (Shuja, A., Qureshi, I. A., Schaeffer, D. M., & Zareen, M. 2019; El-Sofany, H., & El-Hagggar, N. 2020). The term academic competence is using interchangeably for academic performance or academic ability. According to DiPerna & Elliott, (1999) academic competence is a multi-dimensional construct that consists of skills, attitude, and behavior of a learner that contribute to academic performance. A rich body of research explains the impact of m-learning on student academic competence in various ways in numerous contexts. In a study by Jenő et al., (2019), investigated the impact of m-learning applications on the perceived competence of the students who belonged to biology. Data were collected from 58 students and analysed with suitable statistical tools and techniques. The results stated that the relationship between m-learning apps and student-perceived competence was positive and high compared with other elements



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like well-being, motivation, etc. Proved the same by Garcia-Cabot et al., (2015) who examined the interrelationships between mobile system learning, learning performance, and skills among graduate students. They revealed that the m-learning impacts the learning performance and attitude was higher than the traditional learning. Abachi & Muhammad, (2014) have addressed the parallel issue. They examined the impact of mobile learning technology and e-learning technology on learners and educators in smart classrooms. The results of the study stated that m-learning technology influence was found high among learners and as well as educators than e-learning technology. While the results of Milošević et al., (2015) showed some difference. They gathered information from University of Belgrade teachers and students and analysed it using SPSS, and LISREL at the connection between m-learning practices and learning outcomes like academic competency. The findings indicated that students' academic performance was little impacted by their use of mobile learning. Based on these arguments, the researcher hypothesized as *H1 Mobile learning positively predicts students' academic performance*

M-learning and Academic Interest

The m-learning apps play a crucial role in enhancing students' academic interests. With its extensive array of options, m-learning has emerged as a promising educational tool for students. Students cultivate an interest in learning if they are provided with relevant, high-quality, and captivating content. (Fu et al., 2021) stated that the rapid development of advanced technologies and the internet have enhanced learners to adopt mobile learning in their education process. They have tried to explore the effect of mobile learning on student's academic interests. The opinions of about 150 students using a standard questionnaire were analyzed and concluded that the adoption of mobile learning by the students has improved their academic interest. Similar results were obtained by (Saregar et al., 2019) when they did an investigation on mobile learning adoption among school students. The studies carried out by (Laine et al., 2017; Ng et al., 2016) have proved that using social mobile applications such as Facebook, WhatsApp, WeChat, etc for communication is common in this generation and these are significantly improving the student's interest towards the academic activities. So, based on these arguments, the hypothesis is framed as *H2 Mobile learning positively predicts student's learning attitude*

M-learning and Learning Attitude

The role of the m-learning applications is crucial in augmenting the learning behavior of the students. M-learning has become the protentional learning tool for students with a wide range of offerings like geographic spreading, and engaging with broader content than classroom or library. When the students are offered suitable content, quality, and engaging information then they cultivate their learning attitude. Qashou, (2021) in a study carried out to examine the factors that influence in adoption of m-learning in Palestine. A total of 388 responses were collected from students through a self-rating questionnaire and analysed. The results stated that the m-learning attributes like perceived usefulness, ease of use, and self-efficacy were significantly influencing the learning attitude of the students. Herrador-Alcaide et al., (2020) have assessed the online mobile learning tools and student attitudes. The data were collected with the help of a structured questionnaire and analysed through suitable techniques. The results proclaimed that the students with high maturity were given high value to the online learning tools and their own attitude. It means that perceived utility of the online tools was influencing the attitude of the students. Similar kind of results were observed in a study which was carried by Hossain et al., (2019). They have analysed the relationship between m-learning and student attitude for sustainable learning by taking 253 student responses from various universities. The results stated that adoption of m-learning was influencing the attitude of the students. It was proved by Jebreen & et al (2013), in their study which was done in three different universities such as Hashemite University, Yarmouk University and the University of Jordan. 363 student responses were collected from these three universities and analysed. The results revealed that there was a positive and high relationship between m-learning and the attitude of students. So, based on these arguments, the hypothesis is framed as *H3 Mobile learning positively predicts student's learning attitude*



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Academic Interest refers to a preferred assignment towards academic activities like learning, reading, classroom participation, etc (Hidi and Renninger, 2006). Several research shreds of evidence reveal the relationship between student's academic interest and their academic performance in the existing literature. (Mappadang et al., 2022) have described that Academic interest converts as one of the key factors in determining students' academic performance and success in their future careers. The responses of 872 Indonesian students were analyzed and concluded that the greater academic interest of the students can lead to better chances of improvement in student performance. (Arhin & Yanney, 2020) have conducted a survey and about 200 student responses were pooled up with the proportionate stratified sampling in the Asante Akim North District. The findings from the study showed that most student's academic interest was strongly connected to their academic performance. Similar results were observed in the studies (Goni et al., 2021; Viljaranta et al., 2014; Kpolovie et al., 2014; Mazer, 2013; Harackiewicz et al., 2008). Their study results showed that there was a significant relationship between student academic interest and learning achievement. With these arguments, the hypothesis is framed as *H4 Student's learning attitude positively predicts academic competence*

Learning Attitude and Academic Performance

There are many convincing theoretical shreds of evidence to show that the learning attitude of the students with clear intention fetch positive outcomes among the students. According to Veresova & Mala, (2016), a positive attitude yields positive results and a negative attitude yields a negative result. Student attitude is the predominant aspect of achieving high academic results (Nja et al., 2022). In a study of Laguador & Dotong, (2020), an investigation was carried out to extract the relationship between positive attitudes and academic performance among the students. A mixed approach was applied and collected 87 responses from graduates covering 75 for quantitative and 12 for qualitative analyses. The results showed that engineering students have attained high academic performance through their high positive attitude. (Bolarinwa & Okolocha, 2016), studied the relationship between student attitude and academic achievement by considering 213 student responses collected using a structured questionnaire. Their study results showed that there was a significant relationship between student attitude and learning achievement. With these arguments, the hypothesis is framed as *H5 Student's learning attitude positively predicts academic competence*

Academic Interest as a Mediator

According to preceding studies, if m-learning inspires students with a larger content of attractive and appealing services, then the students establish academic interest which is in turn associated with academic performance, skills, and knowledge (Arthur et al., 2022). (Hendrawijaya, 2022) have explored relationships among the students' mobile learning, academic interest, and performance by surveying 200 students. Student interest mediated the relationship between learning dimensions and learning achievement. (Wang et al., 2022) have tried to bring out the connections among mobile learning, student interest, and learning performance. About 396 higher education students' opinions were collected and analyzed. The study findings revealed that mobile learning was a significant and positive predictor of Student Performance and Learning Behaviour. Moreover, student interest partially mediated the relationship between ML and SP. The studies carried by (Onyema et al., 2020; Laine et al., 2017; Ng et al., 2016) have proved that using social mobile applications such as Facebook, WhatsApp, WeChat, etc for communication is common in this generation and these are significantly enhancing student performance. Based on these literature backgrounds, the hypothesis is framed as *H6 Academic Interest mediates the relationship between M-learning and Academic Performance*

Learning Attitude as a Mediator

According to previous studies when m-learning offer the students with broader range of student engaging services, students incline to develop learning attitude which is in turn associated with positive academic outcomes like academic performance, skills and knowledge (Nja et al., 2022). Shuja et al., (2019) has intended to examine m-learning pedagogy improves the student learning and education performance. The data were collected from the students of universities located in Lahore. The results of the SEM showed that m-learning pedagogy directly influences student learning positively and student learning influences educational performance. A partial mediation was observed in



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the relationship. Various studies have applied learning attitude as a mediator in different relationships (Banahene et al., 2018; Bervell et al., 2020; Osman et al., 2009; Youn & Ph Candidate, 2012). Based on this literature background, the hypothesis is framed as *H7 Learning Attitude mediates the relationship between M-learning and Academic Performance*

Proposed conceptual model

Based on the existing literature, a conceptual model is developed with the hypothesis relationships.

MATERIALS AND METHODS**Methods**

The study was intended to measure the impact of mobile learning practices of students on their academic competence through learning attitude in management education in Andhra Pradesh. The research followed a mixed approach i.e., exploratory, and descriptive in nature. A Convenience sampling technique has been adopted for the study.

Participants

The data were collected from the students of different university-affiliated colleges in Andhra Pradesh using a structured questionnaire. A total of 402 student responses were found usable to perform the analysis out of the 450 distributed questionnaires. The student respondents were asked to rate a given item on a 5-point Likert scale ranging from strongly disagree to strongly agree.

Instruments

The items for this study were adopted from the established scales to measure mobile learning practices and student academic competence.

Mobile learning readiness scale

A 20-item scale developed by Lin et al., (2016) was adapted for the study to measure the mobile learning practices among student respondents.

Student attitude scale

A six-item scale established by Serpil Yorganci, (2017) was adapted and slightly adjusted to suit the present study requirement.

Academic Interest Scale

A four-item short scale developed by (Luo, Z., Dang, Y., & Xu, W. 2019) was adopted to assess the student's academic performance.

Academic performance scale

An eight-item scale developed by (Ramprathap & Sriram, 2017) was adopted to assess the student's academic performance.

RESULTS AND DISCUSSION

The collected data were analyzed using different statistical tools and techniques. Reliability, convergent validity, discriminant validity, and structural equation modeling including CFA were performed using SPSS and AMOS. The fit indices like Chi-square/degrees of freedom (χ^2/df), Goodness of Fit Indices (GFI), Adjusted Goodness of Fit Indices (AGFI), Tucker-Lewis fit indices (TLI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA) was used. A two-stage approach of the SEM (measurement model, and structural model) was selected to





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analyze the empirical data (Byrne & van de Vijver, 2010). In the first stage, a measurement model was developed and then the model fitness and constructs' reliability and validity were assessed with using AMOS (Byrne & van de Vijver, 2010). In the latter stage, structural model development and assessment were carried and then testing of the research hypotheses was carried. (Byrne & van de Vijver, 2010; Hair Jr. et al., 2014).

Analysis of Measurement Model

The link between indicators and constructs is examined via measurement models. The study integrated academic performance, learning attitude, academic interest, and m-learning into a unified measuring model. The measurement model was developed by progressively incorporating the recommendations made by Hair et al (2006). With the aid of AMOS 25, the measurement model was estimated using the maximum likelihood method. Construct reliability, discriminant validity, convergent validity, and model fit outcomes were estimated to find out the measurement model strength.

Model fit

A number of fit indices were taken into account while evaluating the measurement model's fit (Hair et al., 2008). Root Mean Square Error Approximation (RMSEA) and Goodness of Fit Index (GFI) values are within the standard, indicating that the model theory matches the sample data. Values for the Comparative Fit Index (CFI) above 0.90 indicate that the model fits in comparison to the other baseline model. The measurement model is deemed acceptable by the Parsimony fit indices, such as chi-square/df value 4.29, which range from 1 to 8. (Hair Jr. et al., 2014; Hu L.-T. & Bentler P. M., 1999).

Convergent and discriminant validity

Construct Reliability

Construct reliability, also known as composite reliability, is a metric used to assess a scale's internal consistency (Netemeyer et al., 2003). Every construct, including m-learning, learning attitude, interest, and academic performance, has construct reliability values that are higher than the required threshold of >0.70. It indicates the trustworthiness of the measurement model.

Convergent Validity

Standardized factor loadings and Average Variance Extracted (AVE) were used to evaluate convergent validity. The AVE values of the study constructs and all the standard estimates of the measurement model meet the minimal criteria of 0.50, with ranges of 0.51 to 0.71 and 0.53 to 0.98, respectively. It suggests that a significant amount of variation is shared by the measured variables of concern construct (Byrne & van de Vijver, 2010; Hair Jr. et al)

Discriminant validity can be assessed by comparing the Maximum Shared Variance (MSV) with AVE or the Square Root of AVE with Inter-Construct Correlations. The square root of the AVE values for every construct was found to be greater than the inter-construct correlations, and the MSV values for every construct were found to be greater than the AVE values of the relevant constructs. This suggests that there were differences between the constructs in the model (Byrne & van de Vijver, 2010; Hair Jr. et al., 2014).

A Structural Model Analysis

The relationships between the constructs are explained by the structural model. The correlational relationships between latent factors like learning attitude, academic interest, and academic performance and observable variables like m-learning are explained by the model. Academic performance is considered an endogenous variable, m-learning is considered an exogenous variable, and learning attitude and academic interest are the mediating variables.



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The direct effects are the paths that connect the exogenous variable to the outcome variable Without any intermediaries. Table 4 displays the findings of the direct impacts and hypotheses related to the structural model. The results indicate that the framed hypothesis H1 was not supported, and the standardized coefficient value of 0.09 for the path from m-learning to academic performance was not significant (p-value 0.109). Hypothesis H2 was validated since the route weight value (0.607) from learning attitude to academic performance was significant (0.001). m-learning has a direct impact on learning attitude, supporting hypothesis H3, as the standardized coefficient values for the routes from m-learning to learning attitude (ML->LA) 0.607 were determined to be significant (P value 0.001). Academic interest (AI) and learning attitude (LA) also have a direct positive effect on the student's academic performance, so concerned hypotheses were supported. Mediation effect is the intermediary effect in the causal relationship between exogenous and endogenous variables. Learning attitude (LA) is assumed as a mediator in the link between m-learning and academic competence. The standardized coefficient values for the indirect path from m-learning to academic performance through learning attitude (0.289) and academic interest (0.336) are significant(0.000) and hence, hypotheses H6 and H7 were supported.

IMPLICATIONS

It is evident from the observations of the study that m-learning is positively associated with the learning attitude of the students. This finding is in line with and matches with various results of (Al-Jabri, 2015; Herrador-Alcaide et al., 2020; Hossain et al., 2019) existing literature. So, it is very much significant to consider engaging in m-learning practices to improve the learning attitude among students. The present study resulted that the attitude of the students significantly affects the student academic competencies. These results are harmonized with different study results (Laguador&Dotong, 2020; Nja et al., 2022) in the literature. And finally, learning attitude was mediating significantly in the relationship between m-learning and academic competencies. The results of the study reveal that m-learning practices are enhancing the student's learning attitude and learning attitude in turn improving their academic competencies. The study has several implications for the higher education sector. An entertaining and enhanced level of m-learning practices with quality content, ease of use, feedback, and increased m-learning engagement should be emphasized in the process of m-learning.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The study has a few limitations which give a way for future research. As the study was limited to the state of Andhra Pradesh, further studies may concentrate on other relevant states of India. The present study was restricted to exploring the important influencing factors of m-learning practices like self-efficacy, optimism, and self-directed learning, future studies may focus on including other components like Communication/relationship with others, ease of use, acceptance/awareness, etc in detail. Only one mediator is included in the study, future studies may consider multiple mediators like student interest, student study habits, etc in the relationship between mobile learning and academic competence.

CONCLUSION

The present study was initiated to assess the impact of m-learning usage on students' academic competence through their learning attitude. The m-learning usage factors considered for the study are mobile self-efficacy, optimism, self-directed learning, learning attitude, and academic competence. Two-stage structural equation Modeling was applied for this purpose and executed with software like Amos. The study results revealed that m-learning strongly affects the learning attitude. The learning attitude strongly affects the academic competence of the students. But whereas m-learning usage did not impact the academic competence of the students directly.





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Table:1 Model fit measures

Measure	χ^2	Df	χ^2/df	GFI	AGFI	TLI	CFI	RMSEA
Estimate	420.87	98	4.29	0.988	0.975	0.980	0.963	0.023
Threshold			1-8	>0.9	>0.9	>0.9	>0.95	<0.08

Table:2 Convergent and discriminant validity

Variables	CR	AVE	MSV	M_L	L_A	A_I	A_P
M_L	0.908	0.767	0.295	0.876			
L_A	0.895	0.586	0.226	0.476	0.766		
A_I	0.850	0.533	0.295	-0.543	0.211	0.730	
A_P	0.862	0.550	0.233	0.359	0.442	0.312	0.734

Table 3 Direct effects

Path	Estimate	SE	CR	P-Value	Result
H1: M_L→A_P	0.032	.052	-1.672	0.109	Not supported
H2: M_L → A_I	0.476	.038	8.817	***	Supported
H3: M_L→L_A	0.607	069	9.163	***	Supported
H4: A_I → A_P	0.355	.048	6.761	***	Supported
H5: L_A → A_P	0.306	039	6.163	***	Supported

Table 5 Indirect Effects

Indirect Path	Unstandardized Estimate	Lower	Upper	P-Value	Standardized Estimate
H6: M_L->A_I--> A_P	0.446	0.212	0.456	0.000	0.336
H7: M_L->L_A--> A_P	0.211	0.152	0.285	0.000	0.289





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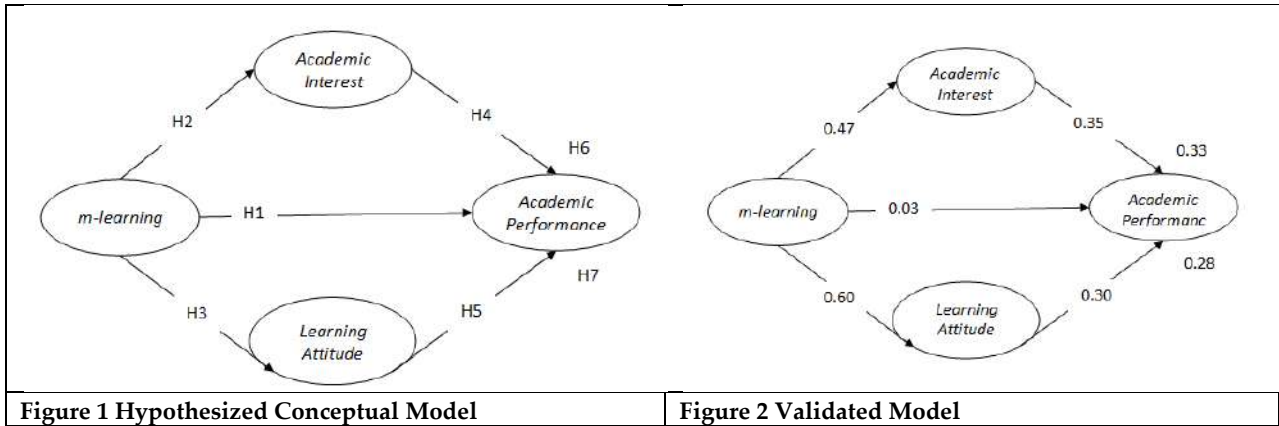


Figure 1 Hypothesized Conceptual Model

Figure 2 Validated Model





A Focus on the Emotional Maturity and Teaching Competency for Prospective Teachers

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ABSTRACT

Among other things, teaching requires emotional effort. Being emotionally competent has slowly become a need for the teaching profession, therefore the issue of instructors' actual emotional competence as well as techniques for gaining these skills has been highlighted. The purpose of the current study is to evaluate the relationship between the emotional development of student instructors and their instructional skills. The researcher used a survey approach and random sampling to gather the pertinent data in order to investigate the relationship between the variables. The sample for the current study consisted of 350 student instructors (both male and female) from institutions of education. Harsangeet Kaur (2019) developed and validated the Emotional Maturity Scale, and the researcher developed the Teaching Competency Scale to collect the necessary data from the community. The data were analysed using the Mann-Whitney test and the product moment correlation test developed by Karl Pearson. The major conclusions are that there is a positive correlation between student instructors' emotional maturity and their teaching ability.

Keywords: Emotional Maturity, Teaching Competency, Prospective teachers

INTRODUCTION

Moral character is something that is developed via education, and moral character enhances personality by making one more perceptive, competent, receptive, and dependant on their intelligence. One of the main objectives of





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education is the production of good teachers and pupils. The teachers help the students acquire the knowledge they require as well as the abilities, principles, attitudes, and routines they'll need to thrive in the future. Teaching competency is a challenging, diverse effort that requires a variety of personal traits and abilities. It either indicates a single level of competency that is necessary or a range of levels that have been determined using theoretical or empirical methods. In a manner similar to this, an individual's understanding of their emotional quotient and level of emotional maturity has important educational and societal ramifications for both their own well-being and those of society. Teachers who have grown emotionally are capable of managing their emotions. They develop the essential self-awareness to be conscious of their emotions and be able to analyse and express them. Every student has always relied heavily on their emotionally capable teachers for their achievement in life. The efficiency of one's teaching talents is really improved by emotional maturity, which is one of the essential elements of teaching competency. Teachers need to be emotionally mature in the current climate because it helps them be better teachers.

Need and Importance of the Study

In this day of globalisation, our educational system must adjust to meet the requirements of the students. Teacher educators need to be emotionally mature enough to impart material to fully developed future teachers. The need for this study is crucial given that many aspiring teachers must cultivate recognisable attitudes and acceptable emotional maturity. Our ability to have life experiences that we can control does not depend on our emotional and mental well-being. We must confront the emotions and circumstances that are a part of life because we are human. In order to meet the demands of the Prospective teachers, the present study will improve their teaching skills, which will also improve their understanding of the subject, their excitement for it, their attitude towards children, and their ability to adapt. In order to achieve their objectives for knowledge, competence, and attitude, aspiring teachers must pay close attention to their emotional side.

In order for future teachers to be successful throughout their pre-service training and once they begin teaching, it is crucial to improve their emotional maturity and teaching competence coping mechanisms. To assist practising teachers in moving along their chosen professional route, enhance the quality of education, and thus assure the advancement of quality teaching, a better degree of performance, skillfulness, classify awareness, and performance is required. The purpose of this study is to address the pressing necessity and significance of providing teachers with the information they need in order to lead their students' adept learning towards better levels of performance. The study includes recent research that was conducted for the fieldwork.

Objectives of the Study

- To find out the level of emotional maturity of Prospective teachers.
- To find out the level of teaching competency of Prospective teachers
- To find out whether there is any significant difference among Prospective teachers in their emotional maturity with regard to the background variables namely:
- Gender (Men and Women) (ii) Educational Qualification (UG and PG),
- To find out whether there is any significant difference among Prospective teachers in their teaching competency with regard to the background variables namely: (i) Gender (Men and Women), (ii) Educational Qualification (UG and PG),
- To find out whether there is any significant relationship between teaching competency and emotional maturity of Prospective teachers.

Method of Study

A normative survey approach served as the study's methodology. The Teaching Competency Scale (TCS), which the researcher created, standardised, and validated, and the Emotional Maturity Scale (EMS), which Harsangeet Kaur (2019) produced and developed. 350 prospective teachers enrolled at the college of education in the Tiruvannamalai district were used as a sample for the researcher's data collection. The distribution of the study tools followed a random sample procedure.





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Hypothesis of the Study

RH1: There is no significant difference between male and female Prospective teachers in their emotional maturity.

RH2: There is no significant difference between UG and PG Prospective teachers in their emotional maturity

RH3: There is no significant difference between male and female Prospective teachers in their teaching competency.

RH4: There is no significant difference between UG and PG Prospective teachers in their teaching competency.

RH5: There is no significant relationship between teaching competency and emotional maturity of Prospective teachers

Analysis of Data

Table 1 shows that 26% of prospective instructors had high emotional maturity, 45.7% had average emotional maturity, and 28.3% had low emotional maturity.

According to Table 2, whereas 27.2% of prospective teachers had a high level of teaching competency, 47.4% and 25.4% of prospective teachers had average and poor levels of teaching competency.

RH1: There is no significant difference between male and female Prospective teachers in their emotional maturity.

Table 3 shows a significant difference in emotional maturity between male and female prospective instructors, with a P value of less than 0.001. Thus, the emotional maturity null hypothesis is disproved at a 1% level.

RH2: There is no significant difference between UG and PG Prospective teachers in their emotional maturity

With a P value of less than 0.001, Table 4 demonstrates a significant difference in emotional maturity between prospective instructors with UG and PG diplomas. The null hypothesis about emotional maturity is thus rejected at a 1% level.

RH3: There is no significant difference between male and female Prospective teachers in their teaching competency.

With a P value of less than 0.001, Table 5 demonstrates a significant difference in the levels of teaching competency of male and female prospective teachers. The null hypothesis regarding teaching competency is thus rejected to a level of 1% as a result.

RH4: There is no significant difference between UG and PG Prospective teachers in their Teaching competency

Table 6 demonstrates a significant difference in teaching competency between prospective teachers with UG and PG degrees, with a P value of less than 0.05. As a result, the teaching competency null hypothesis is disproved at a 5% level.

RH5: There is no significant relationship between teaching competency and emotional maturity of Prospective teachers

According to the findings in Table 7, there is a significant positive correlation between prospective teachers' teaching proficiency and emotional maturity. Consequently, the null hypothesis was disproved.

Findings

- The level of emotional maturity of Prospective teachers was average.
- The level of teaching competency of Prospective teachers was average
- There was significant difference between male and female Prospective teachers in their emotional maturity. While comparing the mean scores, female Prospective teachers were rated higher than male Prospective teachers in their emotional maturity.
- There was significant difference between UG and PG Prospective teachers in their emotional maturity. While comparing the mean scores, PG Prospective teachers were rated higher than UG Prospective teachers in their emotional maturity
- There was significant difference between male and female Prospective teachers in their Teaching Competency. While comparing, female Prospective teachers were rated higher than male Prospective teachers in their emotional maturity.
- There was significant difference between UG and PG Prospective teachers in their Teaching Competency. While comparing, PG Prospective teachers were rated higher than UG Prospective teachers in their emotional maturity





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➤ There was significant positive relationship between teaching competency and emotional maturity of Prospective teachers.

Recommendations and Implications

The following recommendations are made in light of the findings:

- To help future teachers understand the significance of emotional maturity, awareness campaigns, seminars, and discussions on emotional instability, emotional regression, poor social adjustment, lack of independence and flexibility, and adoptability may be done.
- A lot of chances might be made available to the future teachers to assist them in taking part in different social activities. To cultivate social values in potential teachers, outreach activities like NCC, Scouts and Guides, etc., may be run
- In order to foster emotional maturity and the fundamental teaching skills in prospective teachers, it is important to grow their feeling of independence. This can be done through counselling and supervision.

CONCLUSION

It is said that educators are the ones who build the next generation. They can act as guides for pupils as they go through the process of education for development. Students learn well in the cognitive, affective, and psychomotor domains when a teacher performs well and is proficient in their teaching methods. Similar to other professionals, educators must possess the requisite emotional maturity and commitment to their career in order to provide teaching. Both actual performance skills and theoretical knowledge are necessary for professional-level competence in teaching. The interaction- and interpretation-based approach to teaching and learning can only become relevant and effective through the strict application of key skills. A teacher with the right emotional maturity level might also encourage a pupil to explore their creative side. The study of "emotional life" among teachers is increasingly developing as a descriptive discipline equivalent to anatomy, and this is widely acknowledged. The results of the current study showed a strong correlation between prospective teachers' emotional maturity and their teaching proficiency. This confirms that in order to interact with the matured prospective teachers who must develop recognisable attitudes and suitable emotional maturity in them, teacher educators who convey information and knowledge must possess a well-balanced emotional maturity. The current study will assist future instructors in realising the value of emotional maturity and teaching competency in enhancing their professional performance. Therefore, it is essential to raise teaching competency and emotional maturity in aspiring teachers so that they can confidently guarantee teaching effectiveness both during their pre-service programme and after becoming teachers. This will effectively raise the quality of instruction and, as a result, greatly raise standards of learners.

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Table 1: Level of Emotional Maturity of Prospective teachers

Low		Average		High	
N	%	N	%	N	%
98	28.3	161	45.7	91	26

Table 2: Level of Teaching Competency of Prospective teachers

Low		Average		High	
N	%	N	%	N	%
90	25.4	165	47.4	95	27.2

Table 3. Mann- Whitney test for significant difference between Mean Rank of male and femaleprospective teachers’ overall emotional maturity

Gender	Mean Rank	Z value	P value	Result
Male (N = 154)	114.21	9.712	P<0.001**	S
Female (N=196)	221.86			

Table 4. Mann- Whitney test for significant difference between Mean Rank of UG and PG prospective teachers’ overall emotional maturity

Qualification	Mean Rank	Z value	P value	Result
UG (N = 222)	158.11	3.821	P<0.001**	S
PG (N=128)	203.69			

Table 5. Mann- Whitney test for significant difference between Mean Rank of male and female prospective teachers’ overall teaching competency

Gender	Mean Rank	Z value	P value	Result
Male (N = 154)	124.23	8.241	P<0.001**	S
Female (N=196)	215.32			

Table 6. Mann- Whitney test for significant difference between Mean Rank of UG and PG prospective teachers’ overall teaching competency

Qualification	Mean Rank	Z value	P value	Result
UG (N = 221)	161.76	3.044	P<0.05*	S
PG (N=129)	198.51			





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Table 7 Relationship between Teaching Competency and Emotional Maturity of Prospective teachers

Correlations		Overall Emotional Maturity	Overall Teaching Competency
Overall Emotional Maturity	Pearson Correlation	1	.725**
	Sig. (2-tailed)		.000
	N	350	350
Overall Teaching Competency	Pearson Correlation	.725**	1
	Sig. (2-tailed)	.000	
	N	350	350

**. Correlation is significant at the 0.01 level (2-tailed).

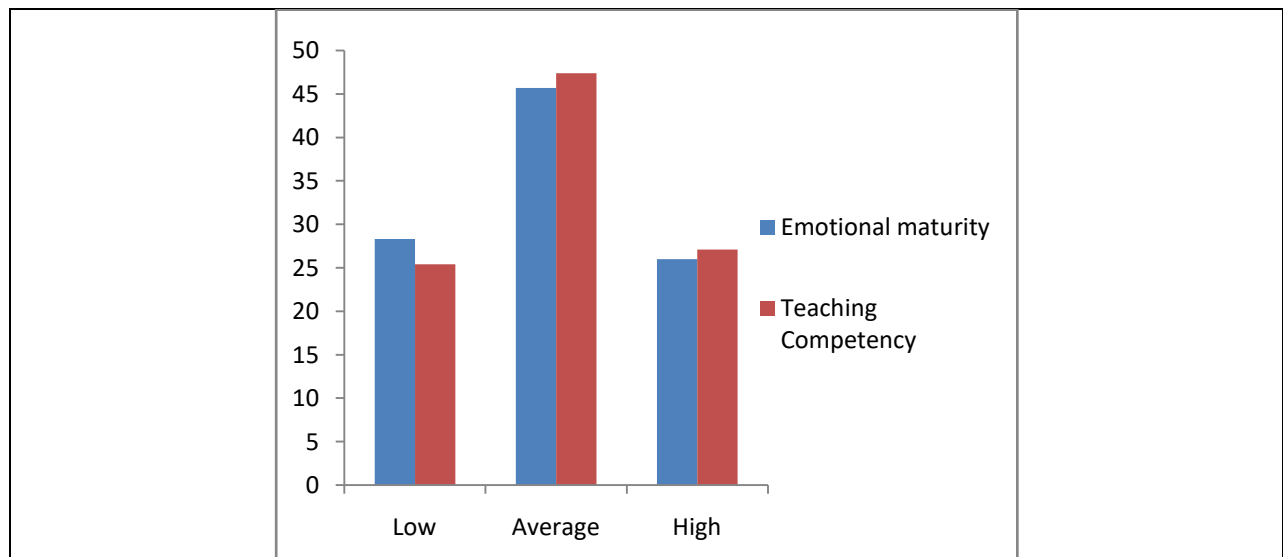


Figure 1: Comparison of Emotional maturity and Teaching competency percentages





The Impact of Women Empowerment in Accelerating Gender Equality and Economic Development

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ABSTRACT

The Indian Constitution has enshrined Gender Equality in the preamble. The United Nations Sustainable Development Goal 5 promotes achieving Gender Equality. Given the above two, this paper discusses how women-led development fosters achieving SDG 5. This paper discusses the need for empowering women and the contribution of women to the economic development of the nation. The paper lists various government initiatives to empower women that act as a tool to achieve SDG 5 – gender equality. The paper establishes the link between the accomplishments of SDG 5 and other sustainability goals. The paper shows how the empowerment schemes have accelerated the holistic development of women. The article concludes that women are key drivers of inclusive growth, and positive transformative behavioral changes have strengthened the status of women in India. The collaborative efforts of government, institutions, and communities can bring sustainable development for all and give the future what women want.

Keywords: The paper lists various government initiatives to empower women that act as a tool to achieve SDG 5 – gender equality.

INTRODUCTION

Women in India constitute 48.4% of the population. The need to develop women in all spheres has been paramount. The history of Women's empowerment dates back to 1917 when the demand for their political rights was put forth. Articles 14 and 15 of the Indian constitution emphasize gender equality and equal opportunity for women. The





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recent women's reservation bill was an epic stand that leaped politically empowering women. Globally, too, women are facing gender issues, and India is not an exception. Rural and urban Indian women face challenges concerning basic amenities, access to quality health and education, and equal remuneration and recognition. Out of 17 SDGs, the United Nations has considered Gender Equality its 5th vital goal to achieve and empower all women and girls. Currently, women contribute 18% of India's GDP. According to the McKinsey Global Institute report, if India can bridge the gender gap and provide equal opportunity for women, it may increase their contribution towards GDP by 30%, which can be remarkable. India ranks 142 out of 146 countries according to the World Economic Forum Global Gender Report 2023 about equal opportunity and economic participation of women. This is by far woeful in a country that has an exclusive ministry working for the development of women with so many policies and schemes rolled out to empower women. Given this, the recent G20 presidency summit held in New Delhi focused on enhancing Economic and Social Empowerment, bridging the Gender Digital Divide, driving Gender-Inclusive Climate Action, and securing Women's Food Security, Nutrition, and Well-Being. This aligns with the objectives of United Nations SDG5 and acts as a driving force in the overall development of women. The recent G20 presidency emphasized women's education and health and empowered women at the grassroots levels. Implementing various schemes has helped to see visible results in empowering women at all levels, fostering women's leadership and decision-making in local governance. Institutional, government, community, and working groups' participation plays a significant role in achieving gender equality. Promoting gender equality is imperative to unlock women's power and create a sustainable and resilient world. Women are undoubtedly agents of change, provided empowerment and gender equality are revisited through the lens of inclusivity. Gender egalitarianism must be promoted to achieve a just and equitable society for everyone.

REVIEW OF LITERATURE

Prof. Seema Singh and Dr. Antra Singh (2020) examined how India has prepared itself to achieve SDG 5. The paper also discusses various government initiatives currently focussing on women's empowerment. They conclude that to achieve SDG5, the programs must be altered accordingly. **Dr. Manju Tembhre (2018)** says that even though women contribute to nearly 50% of the population, there are growing concerns about providing women with basic facilities. Some women are still facing issues globally concerning violence, insecurities, rape, and other injustice in society. All these factors are the hindrances to their empowerment. **Sanjay Kumar Ghadai & Satya Narayana Misra (2019)** discuss the umbrella schemes of government in empowering women. Women's development in education, health, politics, and decision-making is discussed in detail. **Dr. Sriparna Guha & Samrat Goswami (2006)** describe the importance of gender budgeting in amplifying the concept of women empowerment. Gender budgeting is part of the Union budget, which allocates funds to women-specific and pro-women schemes in all spheres. It helps in filling the gender gaps and empowers women. **Luigi Guiso and Luana Zaccaria (2023)** highlight the effect of gender parity on household decisions. This paper provides the basis for identifying gender and social norms as to who controls the family's financial decisions, whether male or female. **Amanda Keddie (2022)** this article identifies critical issues of gender equality and social justice. It suggests how gender inequality can be addressed through policing organizations.

OBJECTIVE

1. To study the role of women as a game changer for inclusive growth.
2. To assess the impact of women empowerment schemes in accelerating gender equality and economic development.

RESEARCH METHODOLOGY

This conceptual study is based on data available on authenticated websites, government reports, research papers, working papers, and scholarly articles.



**Sharada and Nirmala****WOMEN - GAME CHANGER FOR INCLUSIVE GROWTH**

Inclusive growth, by definition, means economic growth that creates equal opportunities in areas of education, health, and employment opportunities to reduce poverty. Gender responsiveness is a vehicle for achieving this. To affirm women as game changers for inclusive growth, it is essential to identify the barriers within the system and help them overcome them. In this regard, The United Nations Conference on Trade and Development (UNCTAD) agenda for 2030 aims to leave no one behind.

NEED FOR WOMEN'S EMPOWERMENT

To achieve SDG5 gender equality, the primary focus must be women's empowerment. Empowered women mean an empowered nation. She contributes to families' health, productivity, and well-being, contributing to better communities and developing an improved society. Women need to be socially, economically, politically, and legally empowered. Women are less paid compared to men and deprived of access to education and health. In this context, educating women enables them to become the voice of this silent revolution. A positive transformative behavioral change helps strengthen a woman's inherent power. An educated woman is more informed regarding the labor market and social security systems and to speak up for themselves without becoming the victim of injustice. The rise in the trend of entrepreneurial mindset among women has reflected upon the exponential growth in women-led businesses. With this, they can significantly contribute to the economy of the nation. According to the survey report by Bain and Company and Google, women entrepreneurs in India are expected to create 150-170 million jobs by 2030. Women entrepreneurs bring different perspectives, innovations, and ideas and foster economic growth. They are emerging in women-centric businesses, such as beauty, wellness, health, hygiene, maternity, childcare, fashion, fitness, etc. These business opportunities have helped woman identify their skill and talents.

WOMEN EMPOWERMENT AND ECONOMIC DEVELOPMENT

Women's empowerment has been recognized as an essential factor in the economic development of any society. Empowering women through various means can lead to increased economic growth, poverty reduction, and overall development of society. Women's empowerment is also essential to achieve gender equality, a fundamental human right. In many parts of the world, women have been historically marginalized and deprived of equal opportunities in education, employment, and access to resources. However, with increased awareness and efforts by governments, civil society, and other stakeholders, there has been a significant shift towards empowering women to participate more actively in economic activities.

1. Women empowerment can lead to economic development in several ways. Firstly, it can lead to increased productivity and efficiency. Women empowered through education and training can bring new ideas, skills, and perspectives to the workforce. They can also contribute to the development of businesses, thereby increasing the economy's overall productivity.
2. Secondly, women's empowerment can lead to increased economic growth. When women have access to resources such as credit, land, and other means of production, they can start their businesses and create employment opportunities for themselves and others. This, in turn, leads to increased economic growth as more people are engaged in productive economic activities.
3. Thirdly, women's empowerment can lead to poverty reduction. Women who are empowered can increase their income, leading to better living standards for themselves and their families. They can also invest in their children's education and health, which can break the cycle of poverty and lead to a more prosperous future.
4. Fourthly, women's empowerment can lead to better health outcomes. When empowered, women can also make better decisions about their and their families' health. This can lead to better health outcomes for themselves and their families, reducing the burden on the healthcare system.
5. Finally, women's empowerment can lead to more excellent stability. When women are empowered, they are more likely to participate in community decision-making. This can lead to a more peaceful and prosperous society.



**Sharada and Nirmala****WOMEN EMPOWERMENT SCHEMES ACCELERATING GENDER EQUALITY**

The government has launched several schemes and programs to increase the participation of women in various income-generating and economic activities, such as the Pradhan Mantri Mudra Yojana, Stand Up India, and the National Rural Livelihood Mission. The impact of these initiatives can be seen in the increased participation of women in economic activities. For example, India's number of women entrepreneurs has increased significantly in recent years. According to a report by the National Sample Survey Office, the percentage of women entrepreneurs in India increased from 14 percent in 2011 to 12 percent and 20 percent in 2015 to 16. According to a statistical report by the International Labour Organization, women's labor force participation rate in India increased from 23.5 percent in 2004-05 to 31.2 percent in 2019-20.

WOMEN EMPOWERMENT SCHEMES

These schemes give women access to quality education and health, promote entrepreneurship, facilitate employment, and ensure safety and security. The practical implementation of these schemes will bring a 360-degree change in the development of women.

HOLISTIC DEVELOPMENT OF WOMEN THROUGH SCHEMES

The Self Help Groups, Microfinance, micro-credit, and Direct Benefit Transfers brought a paradigm shift in economic empowerment among women, addressed issues of poverty and lack of credit funds, and provided financial assistance to undertake income-generative activities. The schemes Beti Bachao Beti Padoo encouraged enrollment of girl children by providing good quality education and access to decent school infrastructure. The school dropouts were significant because of the unavailability of toilet facilities, and this scheme addressed this issue effectively. The re-enrollment of girls back to school increased after the implementation of this scheme. Access to quality healthcare, nutrition, and well-being of women, especially pregnant women and lactating mothers, is higher on the agenda. The World Health Organization, in its 67th session on the status of women held recently, focused on improving women's and girl's health through technology and digital innovations. Nirbhaya projects and stop centers were established to ensure the safety and security of women. One Stop Center was established to provide free legal assistance to women who are victims of violence. The main objective of this scheme is to lend psycho-social support to women who are victims of rape, violence and social injustice.

FOSTERING GENDER EQUALITY THROUGH WOMEN'S EMPOWERMENT

Promoting gender equality is a fundamental human right and foundation for building a peaceful, prosperous, and sustainable nation. The impact of women empowerment schemes shows how far we have progressed in achieving gender equality. Gender bias, wage discrimination, lack of access to primary education, health, and decent jobs, violence, and discrimination are the significant challenges women face globally. There is a persistent gap between men and women; government initiatives play a pivotal role in arresting these issues. The socially constructed roles for men and women are barriers to achieving equality.

SUSTAINABLE DEVELOPMENT GOAL 5 – GENDER EQUALITY

The achievement of SDG 5 can directly contribute to accomplishing other Sustainability Goals.

CONCLUSION

Gender-based discrimination and violence are not just women's issues, but they are societal issues that require the involvement of all members of society. Men and boys can play a critical role in challenging patriarchal norms and promoting gender equality. Programs that engage men in promoting women's empowerment, such as the Menstrual Hygiene Management program, have been successful in promoting gender equality and challenging stereotypes. In conclusion, women's empowerment is a critical issue that requires a multi-dimensional approach. While progress has been made in recent years, there is still a long way to go in ensuring that women in India are fully empowered and able to participate equally in society. A comprehensive approach is needed, including policy and programmatic





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interventions. With sustained effort and investment, Gender equality can lead to more equitable and sustainable development for all.

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Table 1: Women Empowerment Schemes

SAMARTHYA	SAMBAL
Pradhan Mantri Mathru Vandana Yojana	Nirbhaya Projects
Shakti Sadans	One Stop centres
Sakthi Niwas	Women Help Line
Palna	Beti Bachao Beti Padoo

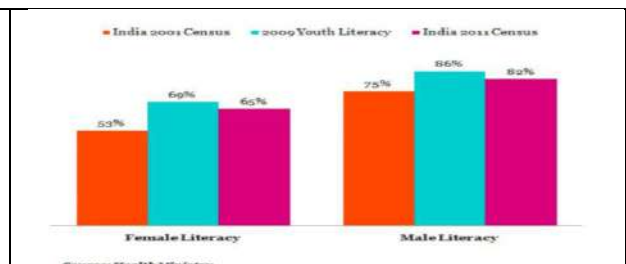
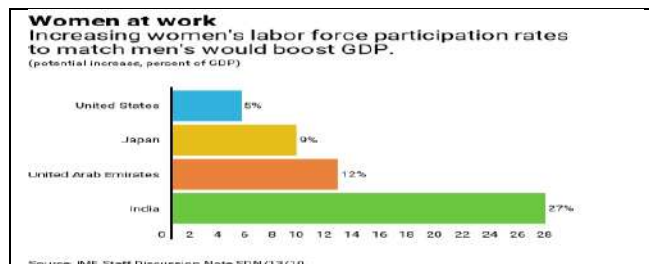


Fig 1

Fig 2

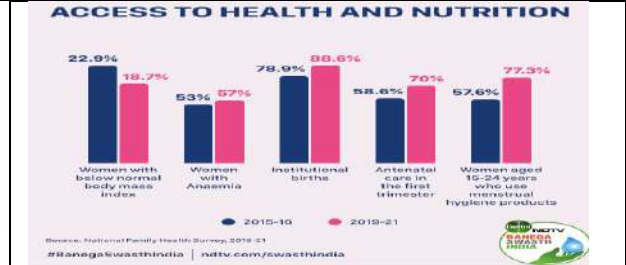
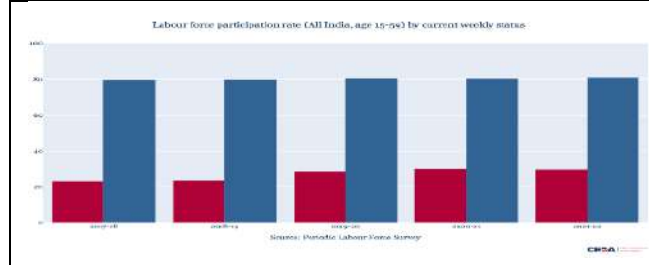


Fig 3

Fig 4





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Fig 5





Anti-Oxidant Potential of *Capparis zeylanica* Fruit Extracts: *InVitro* Assessment

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ABSTRACT

In recent years, many research endeavors have focused on identifying antioxidants derived from plants in order to integrate them into conventional therapeutic approaches. By utilizing the DPPH and Reducing Power methods, we evaluated the *in vitro* anti-oxidant ability of pet. ether, methanolic, and aqueous extracts from *Capparis zeylanica* fruits. DPPH radical scavenging tests were conducted using BHA as the benchmark antioxidant, while reducing power tests used ascorbic acid as the standard reducing agent. UV-Visible spectrophotometers were used for all analyses. According to both assays, extracts obtained from *Capparis zeylanica* fruits demonstrated significant free radical scavenging and reducing power attributes in a concentration-dependent manner. The anti-oxidant properties of *Capparis zeylanica* fruits therefore make them ideal candidates for pharmaceutical applications.

Keywords: *Capparis zeylanica*, free radical, Anti-oxidant assay, DPPH, Reducing power, BHA





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INTRODUCTION

An unpaired electron is the hallmark of free radicals, making them exceptionally unstable chemical entities. As a result of their instability, they extract electrons from other molecules, resulting in damage [1]. When the body goes through its normal metabolic processes, free radicals appear, playing both a negative and a positive role. Overproduction of free radicals and/or deteriorating anti-oxidant levels can result over tissue damage [2]. Through the mitigation of oxidative damage caused by reactive oxygen species (ROS) on cell components, antioxidants play a key role in protecting our bodies from diseases [3]. Studies suggest that plant-derived antioxidants possess significant therapeutic potential in conditions resulting from free radicals, including diabetes, cancer, neurodegenerative disorders, cardiovascular diseases, aging, gastrointestinal problems, arthritis, and the aging process. These antioxidants are capable of scavenging free radicals. In some cases, plant-derived remedies have fewer adverse effects than synthetic antioxidants that have exhibited toxic and potentially mutagenic properties [4]. The use of medicinal plants has long been a preferred method of treating diseases due to their novel phytoconstituents and their low adverse effects. Among the 252 approved cancer drugs, 11% come from plants, according to the World Health Organization [5]. There is a wide distribution of *Capparis zeylanica* Linn., which belongs to the Capparidaceae family, in India, China, Nepal, Bangladesh, Malaysia, and Pakistan. Several conditions such as dysentery, diabetes, and rheumatism can be treated with its leaves [6]. An in vitro study demonstrated that *Capparis zeylanica* roots ethanol and methanol extracts exhibit notable antioxidant properties [7]. Among its many properties, the leaves act as an immunostimulant [8], an antidepressant [9], and an antimicrobial [10]. Among the many functions of antioxidants within the body is to delay or prevent the oxidation process that free radicals initiate within it. In order to identify natural antioxidants in *Capparis zeylanica* fruits, we conducted in vitro antioxidant assessments.

MATERIALS AND METHODS

Collection and Authentication

From the nearby region of Tirumala hills, Andhra Pradesh India, we obtained the botanical specimen of *Capparis zeylanica*. Fruits were cleaned, and then air dried for four weeks under shade. A fine powder was then obtained by blending the dried fruits, preserving them in an airtight container, and marking them for further research.

Crude Extract Preparation

The fruit powders were successively extracted using pet ether (80%), methanol (90%), and distilled water (10 cycles). Using a rotary evaporator, the extracts were concentrated under reduced pressure and temperature for further analysis. Afterward, the extracts were stored in an airtight container in a refrigerator below 10°C. Methanol solutions were prepared by dissolving pet ether, methanol, and aqueous extracts in it.

Screening of Preliminary Phytochemicals

In order to identify the phytoconstituents in *Capparis zeylanica* fruits, preliminary phytochemical analysis was conducted using pet. ether, Methanolic, and aqueous extracts. A variety of phytochemical compounds were tested using standard methods. The results were observed in the table 1.

Chemicals Used

A local supplier provided DPPH (Diphenyl picryl hydrazyl), BHA (Butylated Hydroxy Anisole), ascorbic acid, potassium ferricyanide, FeCl₃, tris HCl buffer, phosphate buffer, and TCA (Trichloro-acetic acid).





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In vitro Anti-Oxidant Assay

DPPH free radical scavenging assays and the reducing power method were used to evaluate the anti-oxidant potential of the plant extracts. There was a wide range of concentrations of extracts in ethanol, varying from 10 mg/ml to 40 mg/ml. A triplicate assessment was conducted, and the average value was used.

Diphenyl Picryl Hydrazyl Assay

The Samples were tested for DPPH scavenging activity following the prescribed methods [11,12]. There was a combination of plant extracts in 0.2 ml of methanol solution with varying concentrations (10 to 40 µg/ml). After mixing this solution with tris HCl buffer, 0.8 ml of it was added to the amalgamated solution. The buffer solution had a concentration of 100 mM and a pH of 7.4. Once the buffer solution was incorporated, 1.0 ml of DPPH solution was introduced at a concentration of 500 mM in methanol. As a follow-up, the resultant mixture was vigorously shaken for 30 minutes and allowed to air dry. An UV-Visible Spectrophotometer (Systronics 117, Japan) was used to determine the absorbance of the resultant sample at 517 nm. For accuracy and consistency, each experiment was repeated three times. A methyl alcohol solution prepared from *Capparis zeylanica* fruits was used for the blank reference volume of 0.2 ml. In the control experiment, 500 mM of DPPH was dissolved in methanol with a volume of 1 ml. To compare the results of this methodology, a standard antioxidant known as BHA (butylated hydroxy anisole) was used.

Using the following procedure, we determined the DPPH scavenging activity:

$$\% \text{ DPPH radical scavenging assay} = \frac{\text{Control absorbance} - \text{Sample absorbance}}{\text{Control absorbance}} \times 100$$

DPPH radical scavenging activity was more potent when absorbance of the reaction mixture was reduced. *Capparis zeylanica* fruit extracts were obtained through pet. ether, methanol, and aqueous methods in this study.

Reducing Power Assay [13,14]

A volume of 1.0 ml of methanolic plant extract solution containing 100–200 mg/l of extract was combined with 2.5 ml of phosphate buffer at a concentration of 0.2 M and pH 6.6. Potassium ferricyanide (K₃Fe(CN)₆) was added at a concentration of 10 g/l to this mixture. A 20-minute incubation was performed at 50°C on the amalgamated solution. Mixture was treated with trichloroacetic acid prepared at a concentration of 100 g/l following incubation. For 10 minutes, the mixture was centrifuged at 3000 rotations per mins. An equal volume of distilled water and 0.5 ml of ferric chloride at a concentration of 1 g/l were blended with 2.5 ml of the supernatant solution. Using a UV-Visible Spectrophotometer, we measured the absorbance of the resulting solution at 700 nm. The standard solution contained 2.5 ml of ascorbic acid at a concentration range of 5 to 10 mg/ml, while the control solution was phosphate buffer solution. As a blank, 1.0 ml of methanolic plant extract solution was used. It is indicative of increased reducing power when the absorbance of the reaction mixture increases [15].

Statistical Findings

Based on three independent determinations, results are presented as mean + standard error of the mean (SEM). One-way analysis of variance (ANOVA) was used to assess differences between groups. It was determined that statistical significance was reached at a significance level of P < 0.05.

RESULTS AND DISCUSSION

According to Table 1, extracts obtained from the fruits of *Capparis zeylanica* contain Alkaloids, Glycosides, Flavonoids, Carbohydrates, Saponins and Tannins. Utilizing the DPPH radical scavenging assay and the reducing power technique, these plant extracts were assessed for their in vitro antioxidant potential. According to Table 2, various fruit extracts obtained from *Capparis zeylanica* as well as BHA have been shown to be DPPH radical scavengers. Table 3 highlight the reducing properties of *Capparis zeylanica* fruit extracts and ascorbic acid. More absorbance results more reducing ability. *p<0.05, **p<0.01, ***p<0.001 (vs control), n=3. There has been remarkable antioxidant efficacy demonstrated by *Capparis zeylanica* fruit extracts. Aqueous, methanolic, and pet ether extracts have shown considerable effectiveness compared to the benchmark standard anti-oxidants BHA and ascorbic acid, based on both



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assessment methods. Anti-oxidant assays using DPPH rely on DPPH's ability to lose its color when exposed to anti-oxidants. Due to the unpaired electron within the DPPH radical, there is a distinctive absorbance at 517 nm and a visible purple hue. Analyzing changes in absorbance can quantify the amount of decolorization caused by anti-oxidant substances contributing electrons to DPPH radicals. As potent anti-oxidants, all fruit extracts obtained from *Capparis zeylanica* suppress DPPH activity in a significant and dose-dependent manner.

Typically, reductants influence a compound's ability to reduce. By providing a hydrogen atom, these reductants interfere with free radical chains, which have demonstrated antioxidative properties. These reductants, or anti-oxidants, found in the fruit extracts of *Capparis zeylanica* facilitate the reduction of the Fe³⁺/ferricyanide complex, resulting in its transformation into iron (Fe²⁺) through reduction. Using Perl's Prussian blue, as a reaction product, this conversion allows monitoring Fe²⁺ levels at 700 nm [16]. Reducing potentials of *Capparis zeylanica* fruits extracts were significant, and these potentials showed a positive correlation with sample quantity. There are similarities between this study and previous studies [17]. As a result, both the DPPH radical scavenging assay and the reducing power assessment showed significant anti-oxidant activity in the *Capparis zeylanica* fruit extracts. The anti-oxidant potential of methanolic extracts was the highest among these extracts. Phytochemical compounds within the plant are likely responsible for these anti-oxidant effects, as indicated by this study [18].

CONCLUSION

In light of the results obtained from this study, the methanolic extract of *Capparis zeylanica* fruits enriched with substantial amounts of phytoconstituents, such as flavonoids and tannins, demonstrated remarkable scavenging and reducing power attributes that outperformed pet ether and aqueous extracts. *In vitro* studies indicate that this particular plant extract provides significant anti-oxidant benefits, which may be used to combat various oxidative stress conditions. In spite of this, it remains unknown what specific constituents confer antioxidative efficacy. The anti-oxidant compounds inherent in the plant extracts need to be isolated and characterized in more detail. It is also essential to evaluate this extract's anti-oxidant potential *in vivo* before considering clinical applications.

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Table:1 Screening of Preliminary Phytoconstituents

Phytoconstituents	Pet ether extract	Methanolic extract	Aqueous extract
Alkaloids	+	+	+
Glycosides	+	+	+
Flavonoids	+	+	+
Carbohydrates	+	+	+
Saponins	+	+	+

+ Present of phytoconstituents

Table: 2 DPPH radical scavenging activity of various extracts of *Capparis zeylanica* fruit

Concentration	Pet ether extract				Methanolic extract				Aqueous extract			
	OD 517 nm		% anti-oxidant		OD 517 nm		% anti-oxidant		OD 517 nm		% anti-oxidant	
	S	Std	S	Std	S	Std	S	Std	S	Std	S	Std
10µl	1.101	1.011	20.89*	33.29*	1.101	1.021	21.30*	27.58*	1.120	1.111	20.48*	21.87*
20 µl	1.132	0.981	25.31*	36.04*	1.102	0.920	22.05*	34.61*	1.031	0.871	27.37*	38.37*
30 µl	1.101	0.899	27.50*	40.42*	0.929	0.549	34.09	60.71**	0.989	0.540	30.42*	61.48**
40 µl	1.002	0.749	34.03*	50.16**	0.559	0.448	59.74**	67.55**	0.751	0.381	46.07*	72.24**

S- sample; Std-standard; *p<0.05; **p<0.01 and ***p<0.001

Table: 3Reducing power assay of various extracts of *Capparis zeylanica* fruit

Sample	Concentration	Absorbance (700nm)	% anti-oxidant activity
Sample 1			
• Control	0	0.07	-
• Pet ether extract	100	0.41	80.00***
	150	0.87	89.00***
• Ascorbic acid (standard)	200	1.13	92.00***
	5	0.84	90.00***
	10	1.02	91.00***
	15	1.33	93.00***



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Sample 2			
• Control	0	0.08	-
• Methanolic extract	100	0.64	85.00***
	150	0.78	87.60***
• Ascorbic acid (standard)	200	0.89	91.53***
	5	0.87	88.59***
	10	0.96	90.00***
	15	1.20	92.00***
Sample 3			
• Control	0	0.10	-
• Methanolic extract	100	0.64	81.75***
	150	0.92	87.00***
• Ascorbic acid (standard)	200	1.01	88.00***
	5	0.98	87.18***
	10	1.02	88.00***
	15	1.21	90.00***





Optimization of Tribological Properties of AA 7075-T6 alloy using Taguchi and MARCOS Approaches

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ABSTRACT

Usage of lightweight materials with better tribological characteristics is significantly increasing in industrial applications. Current research work is focusing on to optimize the tribological properties of AA 7075 alloy which is widely used in many industries because of its high strength to weight ratio. Strength of this alloy is further increased using T6 heat treatment process. This heat treated alloy is widely used where highly machined parts are required. Tribological properties like wear rate (WR) and coefficient of friction (COF) of AA 7075-T6 are found using pin-on-disk apparatus. Initially, a L9 orthogonal array as per Taguchi method is used to design the number of experiments. To optimize the tribological properties in the present research work multi criteria decision making (MCDM) method MARCOS is used which was developed in the year 2020. Moreover, a simple and very effective ENTROPY method is used to calculate the weights of wear rate and coefficient of friction in the above MCDM method. The utility function value obtained through MARCOS method is optimized for larger- the better criteria using Taguchi method and found the optimal conditions of smaller WR and COF. The result shows that MARCOS method coupled with Taguchi has been provided 83% increase in WR and 36% decrease in COF.

Keywords: Tribological properties, AA 7075-T6, Taguchi, ENTROPY, MARCOS





INTRODUCTION

7000 and 6000 grade alloys of aluminium are widely used in several applications because of their high strength to weight ratio and very good resistance to corrosion property. Density of Aluminium is 2.7 g/cm³ which is very low compared to the density of steel which is 7.87 g/cm³. Aluminium alloys of these series are lighter, almost one third of steel. In 7075 alloy, zinc is the major alloying element as shown in table 1. Strength of AA 7075 alloy is further increased by T6 heat treatment process, which is widely used for parts with high strength and explosion proof parts or highly machined parts. T6 heat treatment process involves solutionizing, quenching and artificially aging. Heat treated Aluminium 7075-T6 alloy's toughness and specific strength are almost equal to certain steels. Apart from this, aluminum alloys have good economic value and relatively cost-effective when compared to steels [1-4]. As this material is widely used in highly machined parts, finding the optimum tribological properties is very much required. The current study is aimed to find the optimal settings during the tribological performance of AA7075-T6 alloy which is acting as pin and sliding against a pin-on-disk testing machine and the disk is made up of stainless steel. Wear behaviour of the specimen is studied by measuring the wear of the worn surface specimens and coefficient of friction values are recorded by the tester during the experiment. Low contact loads and small sliding velocities are selected intentionally to eliminate the thermal influence during experimentation. Various researches have conducted experiments on AA7075 alloy reinforced with Silicon carbide, boron carbide, CNTs, graphene and Titanium carbide and reported improvement in wear properties of AA7075 alloy with these reinforcements [5-9]. Much work is not reported on the wear behavior of AA7075-T6 alloy (Tempered 7075 aluminum alloy with zinc as major alloying element). Hence this investigation is carried out to find the optimum conditions for better wear and coefficient of friction of this alloy using Taguchi method and other popular MCDM methods [10-12]. Thermal Dry Sliding Wear Performance of Wrought AA 7075-T6 is studied by Mehmet Cevizet.al [13]. Prakash kumar et.al studied the Effect of T6 Heat Treatment on Mechanical and Tribological Properties of Fabricated AA7075/ZrB₂/Fly Ash Hybrid Aluminum Metal Matrix Composite [14]. Optimization studies on wear behaviour of this alloy-based metal matrix composite is studied by various researchers [15-16].

MATERIALS AND METHODOLOGY

Materials

AA7075-T6 (heat-treated) alloy in the form of rods are used to find the optimum levels of the properties like wear and coefficient friction in this research work. Various elements present in this AA7075-T6 alloy are presented in the table 1.

Wear Test

An instrument which will monitor and measure the friction and wear is used to find the dry sliding wear behavior. 8 mm diameter and 30 mm height standard wear pin specimens are prepared from the above AA7075(T6) alloy and polished metallographically for wear test. Experiments are conducted by varying the parameters like load, sliding distance and sliding velocity. These three factors are varied at three levels. Taguchi's Design of experiment is selected to perform the experiments. As per Taguchi method, L9 orthogonal array is used and nine experiments are conducted by varying applied load at 10, 20, and 30 N and sliding velocity at 1.57, 2.09 and 2.61 m/sec and sliding distance of 1000, 2000 and 3000 meters. At all these nine levels, coefficient of friction and wear rate are calculated using the wear testing machine. In table 2, the experimental results are presented.





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RESULTS & DISCUSSION

As per Taguchi design, the responses coefficient of friction and wear rate both are to be as small as possible for optimization of Static Problems. Signal to Noise ratio for smaller the better characteristic is calculated using the formula(1) given below

$$S/N \text{ ratio} = -10 \cdot \log(\Sigma(Y^2)/n) \quad (1)$$

Where no. of repetitions is n and response value is y.

Optimization of Wear Rate

L9 array design is given in table 3.

Main effects plot of signal to noise ratios of wear is shown in Fig.1. It is observed from fig.1 that load at level1, sliding velocity at level 3 and sliding distance at level 1 are optimum for low wear rate. Ranking of the three factors on wear rate is shown in Table 4. Predicted mean wear rate at the optimum levels is calculated as per Taguchi methodology and found to be 0.4146.

Prediction of mean values of wear and S/N ratio are given in table 5.

Optimization of Coefficient of Friction:

L9 array design is given in table 6 and ranking of factors on coefficient of friction are presented in table 7. Main effects plot is shown in fig.2 and predicted COF is 1.05275 and shown in table 8.

Prediction of mean and S/N of coefficient of friction are given in table 8.

MCDM Methods

To find best alternative for both small wear rate and coefficient of friction MCDM (Multi Criteria Decision Making) methods are used. To address the complex real time problems MCDM methods are widely used. These are used by the decision makers especially when more than one criterion is involved. In this research work, we have selected two recently developed methods and compared their results with experimental results. First step in using the MCDM methods is to finalize the weights for each response. There are different methods to find out the weights like AHP and Entropy. Here we have used the ENTROPY method to find the weights because of its simplicity.

Weight calculation using ENTROPY Method

Proposed by C.E Shannon in 1948. Also called as Shannon Entropy Method

Step:1 Decision matrix normalization to obtain the project outcomes.

$$r_{ij} = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}} \quad (5)$$

Step:2 Entropy(ej) Computation using the below equation

$$e_j = -h \sum_{i=1}^m r_{ij} \ln r_{ij}, j = 1, 2, \dots, n \quad (6)$$

$$\text{Where } h = 1/\ln(m) \quad (7)$$

Step:3 Based on the concept of entropy, objective weights are defined

$$w_j = \frac{1-e_j}{\sum_{j=1}^n (1-e_j)}, j = 1, 2, \dots, n \quad (8)$$

Weightage of wear rate is 0.46 and weightage of Coefficient of Friction is 0.54





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MARCOS Method

In 2020, Zeljko Stevic proposed Measurement Alternatives and Ranking according to Compromise Solution (MARCOS) method. In the beginning, this method was used to find a viable supplier assortment in the healthcare industry. Ali edabi Torkayesh *et al* [17] used this method for the selection of landfill location in cities. This method consists of below steps

Step 1: Decision-making matrix development and an extended decision-making matrix containing the ideal solution.

$$= \begin{bmatrix} x_{IS1} & x_{IS2} & \dots & x_{ISj} \\ x_{11} & x_{12} & \dots & x_{1j} \\ x_{21} & x_{22} & \dots & x_{2j} \\ \dots & \dots & \dots & \dots \\ x_{i1} & x_{i2} & \dots & x_{ij} \\ x_{AIS1} & x_{AIS2} & \dots & x_{AISj} \end{bmatrix} \tag{9}$$

Where, IS = max xij for benefit and min xij for cost; AIS = min xij for benefit and max xij for cost

Step 2: Normalization of the extended initial matrix by applying equation (10) and (11):

$$n_{ij} = x_{ij}/x_{is} \text{ for benefit} \tag{10}$$

$$n_{ij} = x_{is}/x_{ij} \text{ for cost} \tag{11}$$

Step 3: Calculation of the weighted matrix, where weight coefficients of the criterion wj is calculated using AHP method [9-13].

$$v_{ij} = n_{ij} \times w_j \tag{12}$$

Step 4: Utility degree computation of alternatives ki (equations 13 and 14).

$$k_i^+ = \frac{S_i}{S_{ISi}} \tag{14}$$

Where Si (i = 1, 2, ...,m) epitomizes the addition of elements of the weighted matrix v

$$S_i = \sum_{j=1}^n v_{ij} \tag{15}$$

Step 5: Computation of utility function of alternatives f(ki)

$$f(k_i) = \frac{k_i^+ + k_i^-}{1 + \frac{1-f(k_i^+)}{f(k_i^+)} + \frac{1-f(k_i^-)}{f(k_i^-)}} \tag{16}$$

Where f(k_i^+) is the utility function on the subject of ideal solution, while f(k_i^-) is the utility for function on the subject of anti-ideal solution (Equations 17 and 18).

$$f(k_i^+) = \frac{k_i^+}{k_i^+ + k_i^-} \tag{17}$$

$$f(k_i^-) = \frac{k_i^-}{k_i^+ + k_i^-} \tag{18}$$

Highest f(Ki) obtained is 0.0480 which is ranked 1 and it is the Experiment No.1.

Taguchi method is used to maximize the f(Ki) value using the Larger-the better criteria. S/N ratios for larger-the better criteria are calculated using the formula given below (Equation 19) and main effects plot is shown in fig.3

$$S/N \text{ ratio} = - 10 \log_{10} \left(\frac{1}{n} \sum_{i=1}^n \frac{1}{y_i^2} \right) \tag{19}$$

Response Table for Signal to Noise Ratios is given in table 7.

Prediction values as per MARCOS method are shown in table 8.

Above setting is Experiment No. 3 of Taguchi design.

Among the three different settings of load, sliding velocity and sliding distance (10,2.61,1; 10,2.61,2 and 10,2.61, 3) suggested by most of the methods, the last setting of experiment (10, 2.61,3) is already conducted as part of Taguchi L9 orthogonal array which is experiment number 3. Remaining two sets of experiments (10, 2.61,1 and 10,2.61,2) are conducted and found the wear rate and coefficient of friction values. The results are tabulated in the table12.





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CONCLUSIONS

Many researchers used different MCDM methods to optimize tribological properties of different materials. Uttam Kumar Sahoo et. al [18] studied the tribological properties using Taguchi coupled WASPAS method. Dinesh Shinde et. al [19] compared different MCDM methods like TOPSIS, EDAS, MOORA and VIKOR for determining optimal settings of manufacturing process parameters for two friction materials used in automotive brakes. Different weighting methods were studied by Tej Singh et.al [20]. Here we have attempted to study the tribological properties of AA-7075-T6 alloy using Taguchi coupled, newly developed MARCOS method with entropy weighting method.

From the results comparison table 12, it can be concluded that

1. MARCOS MCDM method along with Taguchi method could not improve the optimization function $f(K_i)$. There is 0.05% decrease in the function $f(K_i)$.
2. Experiment No.3 is satisfying the both the criteria of wear rate and coefficient of friction with weightages of 0.46 and 0.54 respectively, as suggested by Taguchi method for optimization of coefficient of friction and MARCOS MCDM method coupled with Taguchi method.
3. MARCOS MCDM method is very effective in taking the right decisions when more than two deciding factors are involved with appropriate weightages.

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Table 1. Weight % of AA7075 alloy composition.

S.No.	Element	Composition % in AA7075
1	Magnesium	2.4
2	Manganese	0.06
3	Titanium	0.07
4	Copper	1.5
5	Silicon	0.08
6	Ferrite	0.24
7	Chromium	0.20
8	Zinc	5.8
9	Aluminum	Remaining

Table 2. Wear and Coefficient of friction values

S.No	Applied Load (N)	Sliding Velocity (m/s)	Sliding distance (kilo meters)	Wear Rate (mm ³ /m)	Coefficient of Friction
1	10	1.57	1	0.70106474	1.883
2	10	2.09	2	1.2267788	2.277754
3	10	2.61	3	1.28519687	1.196419
4	20	1.57	2	3.68033649	5.956882
5	20	2.09	3	2.2198855	5.204497
6	20	2.61	1	2.10304942	5.357789
7	30	1.57	3	5.95864003	8.981911





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8	30	2.09	1	7.36067298	9.190862
9	30	2.61	2	2.50508237	7.690329

Table 3. Taguchi Orthogonal Array for wear test

Taguchi orthogonal Array	L9(3 ³)
Factors	3
Runs	9

Table 4. Ranking of factors on wear rate.

Level	Load	SV	SD
1	-0.2900	-7.9120	-6.9035
2	-8.2338	-8.6801	-7.0232
3	-13.6059	-5.5376	-8.2030
Delta	13.3160	3.1425	1.2995
Rank	1	2	3

Table 5. Prediction of wear

S/N Ratio	Mean
2.02203	0.414673

Table 6. Taguchi orthogonal array for coefficient of friction

Taguchi Array	L9(3 ³)
Factors	3
Runs	9

Table 7. Ranking of factors on coefficient of friction

Level	Load	SV	SD
1	-4.735	-13.355	-13.115
2	-14.803	-13.582	-13.456
3	-18.684	-11.285	-11.651
Delta	13.950	2.296	1.806
Rank	1	2	3

Table 8. Predicted mean and S/N of coefficient of friction

S/N Ratio	Mean
-2.18993	1.05275





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Table 9. Ranking of factors as per MARCOS

Level	Load	SV	SD
1	-27.54	-35.83	-35.15
2	-36.74	-36.31	-35.43
3	-41.24	-33.39	-34.95
Delta	13.70	2.92	0.47
Rank	1	2	3

Table 10. Prediction of mean and S/N ratio for MARCOS method

S/N Ratio	Mean
-25.5313	0.0474247

Table 11. Settings recommended as per MARCOS method

Load	SV	SD
10	2.61	3

Table 12. Results comparison of various MCDM methods

	Taguchi (Wear Rate)	Taguchi (CoF)	MARCOS	MARCOS with Taguchi
Criteria	Smaller the better	Smaller the better	Max. f(Ki)	Larger the better
Levels suggested for (Load, sliding velocity, and sliding distance)	10, 2.61, 1 (Not part of L9 array)	10, 2.61, 3 (Exp.No.3)	10, 1.57, 1 (Exp. No.1) f(Ki) = 0.048	10, 2.61, 3 (Exp. No.3)
Predicted value	0.414673	1.05275	NA	f(Ki) = 0.04742
Experimental values	0.435865	1.196419	Wear rate: 0.70106474 CoF: 1.883	Wear rate: 1.285196 CoF: 1.196419
Improvement of Function	NA	NA	NA	- 0.05%
Change in wear rate	NA	NA	NA	83.3%
Change in CoF	NA	NA	NA	- 36.46%





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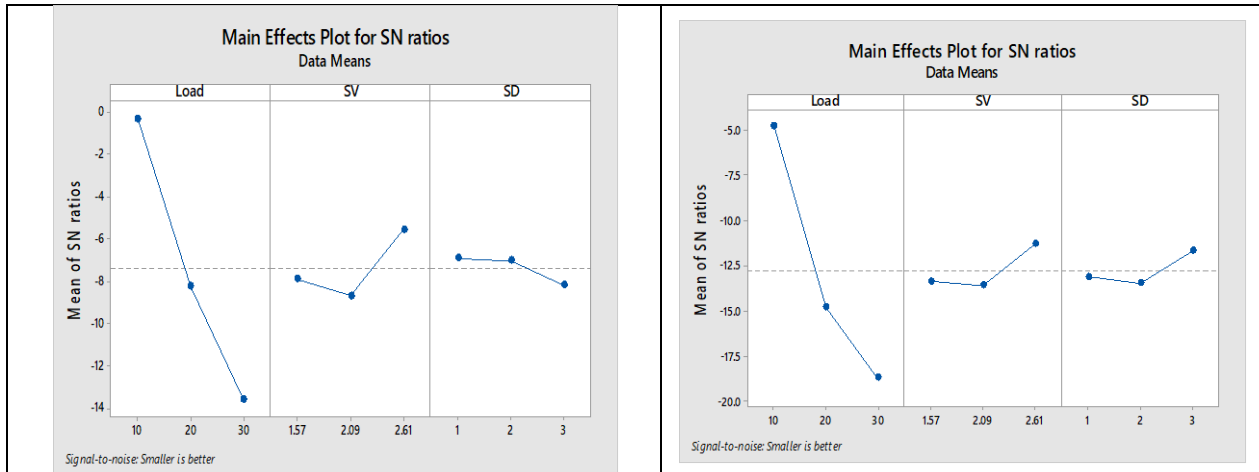


Figure1. Main effects plot for wear rate.

Figure 2. Main effects plot for coefficient of friction

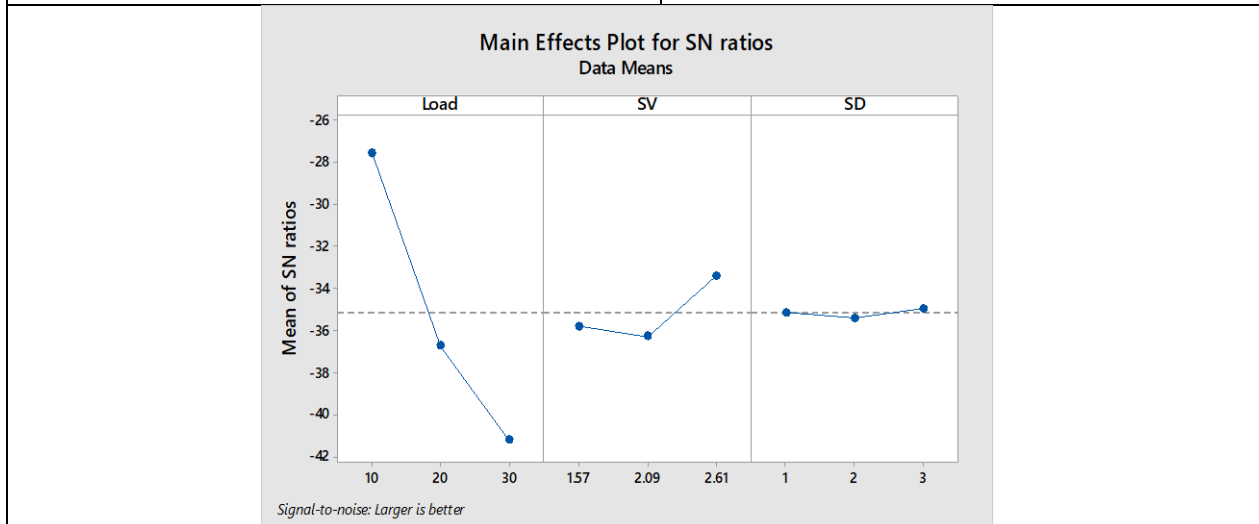


Figure 3. Main effects plot for MARCOS





Advancing Drug Abuse Testing: Analytical Techniques, Innovations, and Challenges

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ABSTRACT

Abuse of drugs screening is a vital component of the public's safety and health, detecting and preventing substance usage in a variety of areas. This review presents an in-depth examination of the term, its significance, and its uses in healthcare, employment, law enforcement, and rehabilitation for addiction. It highlights the magnitude of the opioid pandemic and the critical role of accurate analytical techniques. The article delves into misused drug categories such as opioids, stimulants, depressants, hallucinogens, and cannabinoids, as well as upcoming developments such as synthetic substances and changing cannabis policies. It delves deeply into analytical procedures such as immunoassays, chromatography, spectroscopy, and molecular biology while emphasizing their significance in reliable drug identification. For program credibility, method validation, regulatory conformity, quality control, and certifications are essential. False results and ethical considerations are presented as difficulties. Applications are investigated in clinical, workplace, athletics, forensic, epidemiological, and therapeutic environments,



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with a focus on healthcare, safety, equitable competition, legal proceedings, public wellness, and treatment for addiction. Finally, the essay discusses developments in analytical methodologies, AI integration, portable testing equipment, and the necessity to handle emerging drug trends and difficulties. Drug abuse testing is still an important tool in combatting addiction to substances and creating healthier, more secure societies.

Keywords: Drug Abuse Testing, Analytical Techniques, Opioid Epidemic, Immunoassays, Artificial Intelligence, Point-of-Care Testing.

INTRODUCTION

Drug abuse screening is critical in protecting the safety and health of society by identifying illegal or improper drug usage in a variety of settings(1). It is an essential component of programs for healthcare, occupational safety, criminal justice, and addiction treatment(2). This review paper looks into the diverse world of drug misuse testing, providing light on its meaning and significance, the looming opioid crisis, and the vital role that reliable and precise analytical procedures play in addressing that worldwide issue(3).

Definition of Drug Abuse Testing

The analytical examination of biological specimens like urine, blood, hair, saliva, or sweat in order to identify the presence of drugs or their metabolites is referred to as drug misuse testing, which is also known as screening for drugs or toxicological testing(4). The primary goal is to detect if a person has recently been abused or been subjected to drugs of abuse, such as opioids, stimulants, depressants, hallucinogens, and cannabinoids. These tests can also detect developing designer medications, helping to govern and regulate products(5).

Significance and Purpose of Drug Abuse Testing

Misuse of drug testing is important in many areas, including healthcare, employment, security forces, and rehabilitation for addiction(6). It assists doctors in identifying and monitoring substance use disorders, designing treatments, and guaranteeing the protection of patients who are administered controlled pharmaceuticals in the healthcare industry(7). Screening for drugs in the workplace enhances both security and efficiency, especially in industries where intoxication can lead to incidents, such as transport and construction also aids in parole and supervised release monitoring in the criminal justice system, and also aids individuals on the road to recovery in addiction rehabilitation programs(8).

Overview of the Opioid Epidemic and Other Drug Abuse Concerns

The opioid crisis is now recognized as one of the most serious drug addiction crises in recent history, characterized by the widespread adoption of opioid medicines such as prescription pain relievers and illegal opioids such as heroin and fentanyl(9). It has resulted in an increase in fatal overdoses, strained healthcare systems, and broken up many families. Further illicit substance problems, aside from opioids, include the misuse of Amphetamine benzodiazepines, and synthetic cannabinoids(10).

Importance of Accurate and Reliable Analytical Techniques

The precision and dependability of the methods of analysis used determine the success of drug misuse testing(8). False benefits and drawbacks can have far-reaching implications, damaging people's lives and their livelihoods(11). As a result, it is critical to use cutting-edge analytical procedures such as immunoassays, chromatography, spectroscopy, and molecular biology approaches. To achieve precision and accuracy, these approaches go through extensive verification methods(12).



**Reshma et al.,****Types of Drug tested**

These classifications include an extensive variety of compounds, each with its own set of effects and hazards. In this component, we will look at the most common types of illicit substances that are examined on a regular basis, along with current developments that deserve our attention(13).

Categories of Abused Drugs

Opioids: In many areas of worldwide, opioid misuse has reached pandemic proportions. These medicines, which include conventional pain relievers like oxycodone as well as illegal ones like heroin, can cause addiction, overdose, and death. Analytical approaches are critical to tracking opioid usage and detecting cases of misuse(14).

Stimulants

Stimulant medications, such as amphetamines and cocaine, are well recognized for increasing energy, awareness, and happiness. Their overuse, on the other hand, can lead to addiction, cardiovascular problems, and psychological difficulties. Stimulant testing is essential in a variety of circumstances, including employment or athletics doping regulation(15).

Depressants

Sedative withdrawal symptoms of depressant medications, such as benzodiazepines and barbiturates, on the nervous system of the body. They are frequently recommended for anxiety and sleep difficulties, but their soothing effects can lead to misuse. Analytical procedures are used to identify drug abuse and overdose(16).

Hallucinogens

LSD and psilocybin (found in magical mushrooms) are hallucinogenic substances that change perception, thoughts, and feelings. Although they are normally less addictive, their overuse can result in psychological and behavioural disorders. In forensic and therapeutic contexts, testing these compounds is critical(17).

Cannabinoids

Cannabis, the most widely misused cannabinoid, is now legal in many areas for medicinal and recreational use. However, abuse remains a problem, particularly among teens. Cannabinoid screenings help reveal current usage but do not measure functionality(18).

Emerging Trends in Drug Abuse

Recent developments in drug usage continue to put testing for drug skills to the test. These developments involve the usage of innovative synthetic medications (such as artificial opioids and designed stimulants) along with new modes of consumption (such as vaping) that can mask detection. Furthermore, the legalization and increasing popularity of cannabis presents new issues, as existing methods for testing may not adequately indicate impaired levels(19).

Analytical Techniques for Drug Abuse Testing:**Immunoassays**

Enzyme-Linked Immunosorbent Assay (ELISA): Immunosorbent coupled to an enzyme Assay, often known as ELISA, is a typical immunoassay method used in drug misuse testing. The primary idea underlying ELISA is that antibodies attach to antigens, such as drug metabolites or proteins linked with drug use(20). ELISA kits are used in drug misuse testing to identify the amount or concentrations of drugs or their metabolites in biological samples such as urine or blood. This extremely sensitive technology relies on colorimetric or fluorescent signals generated by enzyme reactions to provide a dependable way of drug misuse screening(21).

Radioimmunoassay (RIA)

Radioimmunoassay (RIA) is a critical method in drug misuse testing that relies on binding competition between a radiolabelled drug or its metabolite and a specific antibody(20). This approach provides highly accurate quantitative



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measurement of drug levels in biological specimens. Because of competition, fewer radio-labeled medicines bind to the antibodies as the amount of medication in the sample increases. RIA may precisely assess the presence and level of a medicine by measuring the residual bound radioactivity. This precise and targeted method has proven beneficial in healthcare and forensic contexts, assisting in the identification and tracking of illicit drug use while assuring accuracy and dependability(22).

Chromatographic Techniques

Gas Chromatography-Mass Spectrometry (GC-MS): GC-MS is a strong analytical technology that is commonly used in drug testing. It works by sorting drug molecules in a sample based on their chemical characteristics and then identifying them using mass spectrometry. GC-MS has outstanding specificity and sensitivity, making it excellent for identifying a wide variety of medicines, metabolites, and even low amounts in biological materials(23). Its precision and dependability aid in the accurate determination and measurement of substances, which is critical for establishing substance abuse in clinical, forensic, and occupational situations(24).

Liquid chromatography-mass spectrometry (LC-MS)

LC-MS is an important analytical method used in testing for drugs. It allows for the accurate determination and quantification of drugs and their by-products in biological samples like urine and blood(25). The specificity, as well as sensitivity of LC-MS, of LC-MS, are unrivalled, allowing for the identification of a wide range of misused compounds such as opioids, stimulants, and cannabis(26). Its capacity to offer quantifiable data assists in evaluating drug concentrations, verifying usage, and tracking progress with therapy, making LC-MS a critical tool in the battle against substance addiction and the health hazards that come with it(27).

Spectroscopy-Based Methods

UV-Vis Spectroscopy:UV-Visible spectroscopy is a flexible analytical method used to identify and quantify drugs or their metabolites in drug abuse testing. It is based on molecules' absorption of ultraviolet (UV) and visible (Vis) light, which gives information about their electrical structure. UV-Vis spectroscopy is useful in drug analysis for identifying and measuring chemicals with distinct absorption patterns, which aids in the identification of unlawful drugs and the evaluation of drug purity(28).

Infrared (IR) Spectroscopy

In illicit drug testing, infrared spectroscopy is used to study the molecular structure of drugs. It quantifies the absorption of infrared rays by chemical bonds in molecules, revealing functional groups and overall composition. By comparing spectra to reference databases, IR spectroscopy is used to identify medicines and related substances. It assists forensic and analytical chemists in determining the presence of certain drugs and determining the purity of seized substances, hence aiding enforcement operations to curb drug misuse(29).

Molecular Biology Techniques

Polymerase Chain Reaction (PCR) in Drug Abuse Testing

Polymerase Chain Reaction (PCR) is a basic molecular biology method that is widely used in drug screenings. The basic idea behind it is to amplify certain DNA sequences. In this context, PCR aids in the identification of genetic markers or variants linked to drug metabolism, addiction sensitivity, or drug responsiveness(30). PCR allows for the controlled replication of DNA sections, making it possible to discover drug-related genetic features in a person's genome. This information can be extremely useful in predicting a person's proclivity for drug usage, examining pharmacogenetics variables, and designing treatment options. The precision and receptivity of PCR have transformed personalized healthcare and pharmacogenomics, making substantial contributions to the field of drug misuse as well as treatment(31).

Next-Generation Sequencing (NGS) for Designer Drugs

Next-Generation Sequencing (NGS) is a cutting-edge genetic technique that has found innovative uses in the fight against drug addiction, notably with synthetic substances. The key reason for employing NGS in this situation is its



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capacity to quickly sequence and determine the genetic makeup of new and upcoming designer medicines(32). NGS allows forensic and criminal justice organizations to more easily categorize and monitor these compounds by analyzing their genomic information, assisting in the discovery and prevention of new psychoactive chemicals. This technology aids in staying ahead of the ever-changing world of synthetic drugs, improving the effectiveness of law enforcement operations and public safety(33).

Point-of-Care Testing (POCT)

Rapid Immunoassays

Because of their speed, simplicity, and efficacy, rapid immunoassays are an important component of point-of-care drug misuse testing. These tests use immune reactivity principles to identify particular drug metabolites or antigens in a biological sample, often urine or saliva. The urinary dipstick test, for example, exploits antibody-antigen interaction to deliver quick findings. Those assays, when used in drug misuse testing, provide rapid detection of common drug classes such as opioids, amphetamines, and cannabinoids. While they are useful for preliminary screening, they may lack the sensitivity and specificity required for conclusive confirmation, necessitating subsequent laboratory-based investigation(34).

Handheld Mass Spectrometers

Handheld mass spectrometers are a game changer in point-of-care drug misuse testing, providing on-the-spot analysis with remarkable precision. These portable gadgets work on the mass spectrometry concept, ionizing and analysing chemicals inside a sample to provide very precise and quantitative findings. Handheld mass spectrometers (MS) provide real-time detection of several substances and their metabolites in diverse matrices including urine and saliva, in drug abuse screening(35). Because of their capacity to identify compounds at low concentrations, they are invaluable for confirmatory testing, avoiding the need for costly and labour-intensive laboratory analysis. As a result, these technologies are revolutionizing the efficiency and accuracy of point-of-care drug testing, especially in emergencies and medical centres when quick choices are required(36).

Hair and urine analysis

Hair and urine testing are important procedures for identifying drug addiction. Drug residues are absorbed into hair strands over time in hair analysis, providing a historical record for drug usage. Because urine testing reveals current drug metabolites, it is a popular option for employment and clinical examinations(37).

Saliva Testing

Saliva testing is a non-invasive technique for detecting recent drug usage. It detects metabolites of drugs in oral fluids, indicating recent ingestion and the possibility for impairment. This method is very useful for roadside drug inspection and rapid on-site tests(38).

Sweat Patch Testing

Sweat patch testing is applying a patch to the skin for a lengthy period of time to collect perspiration. It has the ability to identify drug usage over a period of days to weeks, making it valuable for tracking abstinence in recovery programs and parole circumstances(39).

Emerging Technologies and Trends

Microfluidic Devices

Microfluidic devices are a game-changing tool in the field of drug misuse testing. These innovative technologies excel at downsizing and automating complex analytical operations. They function in minuscule channels, enabling the exact modification of fluids on a microscale, allowing for rapid and accurate sample handling. What makes microfluidics so intriguing in drug testing is their capacity to dramatically reduce sample sizes, accelerate analysis procedures, and improve mobility, making them ideal for testing at the point of care settings. These devices have demonstrated their worth in detecting a wide range of compounds, especially drugs of violence, and have consistently provided dependable and accurate findings in a variety of testing scenarios(40).



**Reshma et al.,****Nanotechnology in Drug Testing**

Nanotechnology has brought about a paradigm change in the field of drug misuse testing, particularly by increasing sensitivity and specificity to previously unheard-of levels. This game-changing discipline makes use of nanomaterials such as nanoparticles and nanosensors, which are painstakingly designed to detect even trace amounts of pharmaceuticals within biological specimens. Their exceptional surface area-to-volume ratio allows for rapid and efficient binding while also allowing for considerable signal amplification, resulting in exceptionally sensitive tests. Beyond diagnostics, nanotechnology has pioneered medication delivery technologies, allowing for controlled-release formulations and the possibility of precisely targeted therapy to address problems with substance abuse. As a result, it promises pioneering and imaginative solutions to the complicated problems faced by drug usage(41).

Artificial Intelligence for Data Analysis

Artificial intelligence (AI) is now recognized as a key factor in drug misuse testing, revolutionizing how we interpret and analyze data. AI algorithms are now capable of filtering through large datasets created by diverse analytical approaches, recognizing subtle patterns, identifying abnormalities, and revealing significant trends in the consumption of drugs thanks to their remarkable data-crunching skills. The use of machine learning algorithms improves the accuracy and efficiency of drug testing by significantly lowering false positives and improving prediction accuracy. Furthermore, AI-driven solutions provide vital aid in decoding complex test findings, assisting clinicians and forensic investigators in making well-informed choices linked to the diagnosis and administration of drug usage(42).

Method Validation and Regulatory Considerations**Importance of Method Validation**

To assure the accuracy, precision, and reliability of analytical procedures, validation of methods is critical in drug abuse testing. It ensures that the approach adopted is appropriate for the task at hand, reducing erroneous findings and maintaining the reliability of testing programs(43).

Regulatory Guidelines and Requirements (e.g., FDA, WHO)

The FDA and WHO, for example, have strict criteria and procedures for drug misuse testing. These principles serve to assure the quality and integrity of testing methods by ensuring uniformity, standardization, and conformity with defined standards(44).

Quality Control and Assurance

Quality control and assurance measures are fundamental to drug abuse testing. They involve the implementation of rigorous processes and standards to monitor and maintain the accuracy and reliability of analytical methods, preventing errors and ensuring consistent results(45).

Accreditation and Certification of Laboratories

Drug abuse testing requires accreditation and certification programs. Laboratories that follow recognized certification criteria exhibit expertise and dependability, creating trust in the accuracy and validity of their testing methods and outcomes(46).

Challenges and Limitations in Drug Abuse Testing(47)**False Positives and False Negatives**

False positives occur when a test wrongly detects drug usage, perhaps leading to unintended consequences. False negatives, on the other hand, lead to missed identification, allowing drug usage to go undetected while diminishing faith in testing systems.



**Reshma et al.,****Detection Windows and Half-Life of Drugs**

Because of the varied half-lives of the medications, their detection window differs. Short-acting medicines may be overlooked if tests are performed too late, but long-lasting drugs may provide incorrect results if tests are performed too early.

Cross-Reactivity and Specificity

Cross-reactivity refers to a test's reaction to substances that are structurally identical to the target medication, which might result in negative results. The specificity in screening is critical for reducing such mistakes.

Matrix Effects and Sample Preparation

Complex matrices in biological samples (urine, blood, saliva) can interfere with drug testing. Adequate the collection of samples is critical for removing impurities and guaranteeing reliable findings.

Evolving Drug Formulations

Tests must adjust as medication compositions vary. New formulations, like as extended-release versions or innovative drug delivery mechanisms, may necessitate changes to testing methodologies to correctly identify misuse.

Ethical and Legal Issues

Testing for drug misuse presents ethical and legal considerations, such as privacy, consent, and possible prejudice. Balancing the necessity for testing with the fundamental liberties and dignity of persons is a continuing concern in drug misuse prevention.

Applications of Drug Abuse Testing**Clinical Drug Testing**

The application of analytical methods in clinical drug testing entails monitoring patients' compliance with prescribed prescriptions, detecting illegal drug usage, and managing substance misuse problems. Reliable measurement of medicines and metabolites in biological fluids assists healthcare practitioners in making educated treatment decisions and maintains patient safety(48).

Workplace Drug Testing

Workplace drug testing uses analytical techniques to screen personnel and maintain a drug-free atmosphere in the workplace. Urine and saliva testing, chain of custody methods, cut-off levels, and confirmation tests employing techniques such as GC-MS and LC-MS to validate positive results are all key aspects of ensuring workplace safety and integrity(49).

Sports Doping Control

Analytical methods are critical in sports doping control because they detect illegal drugs (e.g., anabolic steroids, and stimulants) in athletic samples. Rigid testing protocols, anti-doping rules, target, and non-target analysis employing GC-MS and LC-MS, and the need to collect collecting samples integrity to ensure equal competition are all discussed(50).

Forensic and Legal Drug Testing

In legal contexts, forensic and legal drug testing utilizes analytical procedures to offer proof of drug usage or impairment. The chain of control, adherence to legal norms, the use of particular and sensitive assays, and expert testimony to support investigations into crimes, probationary monitoring, and court processes are all key themes(51).

Epidemiological Studies

Analytic tools are used in epidemiological research to acquire population-level data on drug misuse trends and patterns. Selection at random, survey layout, specimen collection, and the use of quantitative tests are all concepts.



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This data is used to support public health policies, and preventative efforts, and develop policies in the fight against substance misuse(52).

Drug Rehabilitation Programs

Analytical testing is used in drug recovery programs to measure patients' progress in eliminating substance misuse. Frequent urine or saliva tests to assess prohibition, adherence to treatment, and relapse identification are key principles. These findings drive therapy modifications and help people get back on track(47).

Future Directions and Innovations**Advances in Analytical Techniques**

Analytical methods advancements are revolutionizing drug misuse testing. Techniques such as liquid chromatography-mass spectrometry (LC-MS) and high-resolution mass spectrometry allow for more exact drug and metabolite identification. This improves sensitivity, specificity, and detection of novel psychoactive drugs, placing testing for drugs at the cutting edge of substance addiction control(53).

Integration of Artificial Intelligence and Machine Learning

The combination of machine learning with artificial intelligence is improving the evaluation of drug misuse testing data. These methods can handle large datasets quickly, which improves result comprehension, pattern identification, and anomaly detection. They improve the precision of detecting drug usage and forecasting developing patterns, providing testing for drugs more proactive and effective(54).

Portable and Wearable Drug Testing Devices

Drug testing technologies that are portable and portable are becoming more widely available. These instruments, which frequently include microfluidics and biosensors, enable immediate testing in a variety of scenarios, ranging from roadside drug tests to remote healthcare. They provide continuous tracking capabilities, which improve convenience and allow for immediate intervention in drug misuse instances(55).

Emerging Drug Trends and Challenges

It is critical to keep up with evolving pharmacological trends and issues. Analytical procedures must adapt to identify these compounds properly when new medications and consumption methods emerge. To address the evolving environment of drug usage and its related consequences, researchers and developers must remain watchful and proactive(56).

CONCLUSION

Finally, drug misuse testing is critical to protecting public health and improving safety in a variety of industries. The ongoing advancement of analytical techniques, bolstered by the incorporation of artificial intelligence and the introduction of portable screening devices, represents a watershed moment in our ability to identify and manage substance abuse. These advancements enable us to not only precisely identify a greater range of compounds but also to do so quickly and efficiently. These breakthroughs present a ray of optimism in a world befuddled by the intricacies of growing drug trends and shifting behaviors regarding consumption. They envision a future in which proactive identification and intervention may help reduce the devastation caused by substance misuse, building a healthier and safer society for all.

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CONFLICT OF INTEREST

The authors do not have any conflict.

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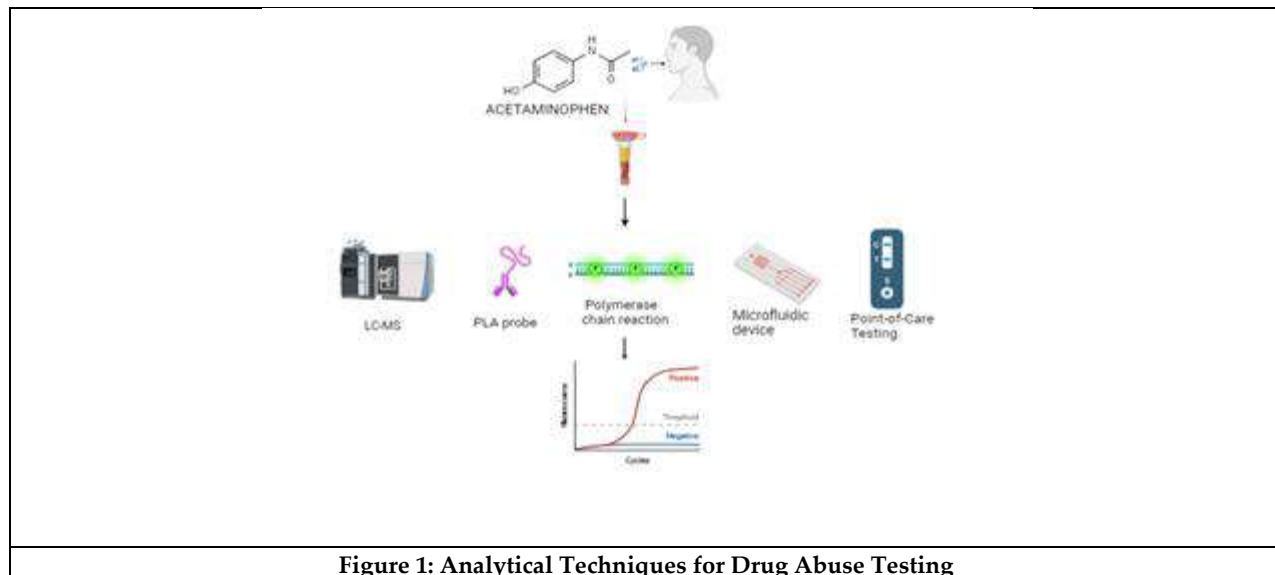


Figure 1: Analytical Techniques for Drug Abuse Testing





An Investigation into Surface Logistics Procedures at a Subset of Chennai's Automobile Companies

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ABSTRACT

Logistics could have been more present in the past when it came to storage and transporting materials by truck or train. Global industrial networks have expanded due to the swift developments in information technology and international transportation across all nations. These days, information transmission is crucial for proper logistics concerning payments, customs paperwork, and the location and status of moving merchandise. Transportation of goods, information, and money across international borders is known as logistics, and it necessitates a highly developed national infrastructure, including ports, airports, the Internet, and other facilities connected to finance and IT.

Keywords: Storage, Augmentation, Recently, Infrastructure

INTRODUCTION

Logistics seeks to achieve more differentiation in their service offerings in addition to cost reduction. The success of today's top players in the market, such as Cisco, Dell, Wal-Mart, and Toyota, is primarily due to their better operational and logistical capabilities. Additionally, a few of the winning nations have built top-notch physical infrastructure, like ports and airports, as well as top-notch IT infrastructure. India is aggressively luring investments by adopting the Supply Chain Cluster Paradigm, which considers all supply chain participants, including manufacturers, financial institutions, logistics providers, etc.





REVIEW OF LITERATURE

Fowkes et al. (2017) performed study in the UK and discovered many additional reasons why delays in freight transit might lead to irregular travel times, apart from traffic. Forty respondents—who may be shippers, truckers, or operators of third-party logistics—were asked questions. Route timings varied as a result of three distinct kinds of delays to freight transit: (1) longer journey times with fixed departure times; (2) a wider range (or spread) of arrival times with fixed departure hours; and (3) a delayed schedule with effectively pushed-back departure dates. A cross-sectional assessment of companies in three industries—freight forwarding, third-party logistics service providers, and air and sea transportation—was carried out by Lai et al. (2004). The main finding of their article was that "...cost-related performance criteria are "non-integrated" and neglect chances for chain-wide performance enhancement." A systems approach should be considered when establishing criteria for measuring supply chain effectiveness, claims Holmberg (1994). Rather, several aspects such as time, speed, agility, flexibility, quality, and productivity should be included in the evaluation of supply chain performance. In this work, Aaronson et al. (2000) claim to have created a blueprint for a course on logistics education. The functional, process, and supply chain demands are explained clearly in this template. Currently, a prototype of the template is being developed using the "gestalt" idea. It explains why the whole is more than the sum of its parts. American Railroads (2001) said that taxes have to be modified as they disproportionately punish trains over vehicles. compares taxes according on the sector of transportation. The research states that although railroads must depreciate their infrastructure maintenance and repairs for tax considerations, fuel taxes paid by trucking companies are immediately deductible and utilised for upkeep. In his 2001 study, David Jorckenbrock computed the external costs associated with four distinct types of freight trains and compared them to the private expenditures that railroads incur. These personal and external expenditures are not the same as the comparable costs in the transportation sector. He found that the non-market costs of freight rail include noise, pollution, and accidents. Rail external expenses vary from 0.24 to 0.25 cents per ton-mile.

STATEMENT OF THE PROBLEM

Automobiles with advanced driver assistance systems (ADAS) need exact sensors with minimal false positive and negative rates. These requirements are typically not met by a single type of sensor; instead, a combination of several types of sensors must be utilized, considering cost as well. Using a sensor fusion system to combine the sensor outputs is a challenge; moreover, the relatively few solutions on the market typically need to be revised to connect the sensor streams in a way that considers the various sensors' advantages and disadvantages.

OBJECTIVES OF THE STUDY

1. To research the relative significance of characteristics for the product's supply chain in the automotive industry.
2. To determine the elements that drive surface logistics use for corporate operations in automakers.
3. To research how well logistics services work for automakers
4. To ascertain whether clients are satisfied with surface logistics
5. To research the difficulties the Indian logistics sector faces

SCOPE OF THE STUDY

This study focuses on Chennai-based automakers that rely on logistics service providers to run their supply chains effectively. The information or data relates to different surface logistics-related problems or procedures in this sector. The informants are those who work in a specific industry's supply chain. The study only examines surface logistics in India; multimodal logistics or other modes should be covered. Chennai-based automakers will also be considered for data collection and analysis.



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RESEARCH METHODOLOGY

UNIVERSE

The term "universe" describes the study's population. Since the research is focused on logistics firms, the population of the study will consist of all logistics companies together. The study's universe will include all of Chennai's logistics firms. Big, medium, and small industries are all included.

SAMPLE SIZE

In this research, a sample size of fifteen logistics businesses is taken into account.

SAMPLING METHODS

A practical sample technique was used for the research, and data from the experts of the specific logistics firm in Chennai was gathered.

DATA ANALYSIS AND INTERPRETATION

Of surface logistics firms, around 6% have been in business for more than 10 years. They are further separated into three age groups: 26% are over 30 years old, 34% are between the ages of 11 and 20, and 34% are between the ages of 21 and 30. For more than a decade, premier surface logistics firms have been established in this manner. The majority of surface logistics firms that took part in the study are between the ages of 11 and 30. Furthermore, relatively few businesses have lately launched. In this field, it's hard for new businesses to thrive because of the established players. Table 2 shows that most companies (20 percent) are in courier services. Twenty percent of the companies are involved in transport. Almost 16 percent of companies deal with logistics solutions and 16 percent with packaging. Other services in which logistics companies participate are transport (8%) and warehouse (8%). Therefore, most companies engage in logistics services and courier services. Table 3 demonstrates that the majority of the chosen surface logistics businesses had an average yearly turnover of less than \$10 million. Given that the firms are tiny with fewer workers and offices, previous outcomes also support this.

MULTIPLE COMPARISON

Quality and reliability

Tukey HSD

MAJOR FINDINGS AND SUGGESTIONS

It has been discovered that 32% of logistics companies employ more than 300 people. Roughly 40% of logistics companies employ fewer than 100 people. Eighteen percent of the enterprises have between one hundred and two hundred employees. The remaining 10% of logistics companies employ 200–400 people. According to our data analysis, 60–70% of logistics organisations think that "supply chain benchmarking, close interaction with customers, various suppliers, and just in time supply" are beneficial strategies for supply chain management. Of the "types of systems now in use in logistics firms to support surface logistical operations," over 80% of logistics organisations choose a "custom-made system in the theory of limitations, just in time, and electronic data exchange." For "warehouse management system and customer relationships management," it was found that 50% of firms use conventional packaging and 50% of organisations regularly use custom-made solutions. Research also indicates that 60–70% of the time, companies choose "standard packaging for supply chain management, bar coding, enterprise resource planning, and supplier relationships management as well as the advanced planning system." It is found that, when it comes to "logistics companies are improving or need to improve to manage its supply chain better," system upgrades are required in more than 80% of cases, and these upgrades must take into consideration "improvement in close partnership with suppliers and in holding safety stock."





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CONCLUSION

When inventory is arranged effectively to support sales, logistics creates value. Logistics costs for particular businesses usually vary from 5 to 35 percent of sales based on the company's nature, the region in which it operates, and the weight or value ratio of the inputs and goods. Usually, one of the most significant business expenses is logistics, which is only surpassed by the cost of manufacturing materials or the cost of goods sold in wholesale or retail sales. Achieving corporate objectives while striking a balance between cost expenditures and service expectations is a challenging task. The development of customer value is a universal process that all businesses must accomplish. Providing such value is crucial to attracting and keeping a devoted clientele. As a result, the current study was designed with the significance of surface logistics in the automotive industry of Chennai.

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Table.1 Establishment of Surface Logistics Companies

Year of Establishment		frequency	per cent	Valid percent	Cumulative percent
valid	Less than10 yrs	4	16	16	100
	21to 20yrs	7	28	28	28
	21to 30yrs	10	40	40	68
	More than 30yrs	4	16	16	84
Total		2	100	100	

Table.2 Type of Surface Logistics Companies

Type of Sector		frequency	per cent	Valid percent	Cumulative percent
Valid	Shipping	2	8	8	8
	Logistics Services	4	16	16	24
	Packaging	4	16	16	40
	Logistics solution	3	12	12	52
	Warehouse	2	8	8	60
	Transportation	5	20	20	80
	Courier	5	20	20	100
Total		25	100	100	

Table 3 Turnover of the Selected Surface Logistics Companies

Yearly Turnover		frequency	per cent	Valid percent	cumulative per cent
Valid	Within 25 crores	4	16	16	16
	25-50crores	5	20	20	36
	50-100 crores	7	28	28	64
	100-200crores	3	12	12	76





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	200-300crores	4	16	16	92
	more than 300crores	2	8	8	100
	Total	50	100	100	

Table 4 Hemogenous Subsets for Quality and Reliability variables based on the Capacity of the Container

(I) Capacity of Container	(J) Capacity of Container	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Bulk Cargo	Piece Goods	-1.66705163*	0.343907	0	-2.66516	-0.8689471
	Half Container	-1.49079282	0.609683	0.075	-3.08296	0.1013763
	Full Container	-1.31393069*	0.343907	0.001	-2.21204	-0.4158262
Piece Goods	Bulk Cargo	1.76705163*	0.343907	0	0.868947	2.6651561
	Half Container	0.27625881	0.535941	0.955	-1.12334	1.6758536
	Full Container	0.45312094	0.183826	0.072	-0.02694	0.933178
Half Container	Bulk Cargo	1.49079282	0.609683	0.075	-0.10138	3.0829619
	Piece Goods	-0.27625881	0.535941	0.955	-1.67585	1.123336
	Full Container	0.17686212	0.535941	0.988	-1.22273	1.5764569
Full Container	Bulk Cargo	1.31393069*	0.343907	0.001	0.415826	2.2120352
	Piece Goods	-0.45312094	0.183826	0.072	-0.93318	0.0269361
	Half Container	-0.17686212	0.535941	0.988	-1.57646	1.2227327

The level of significance is 0.05 level.

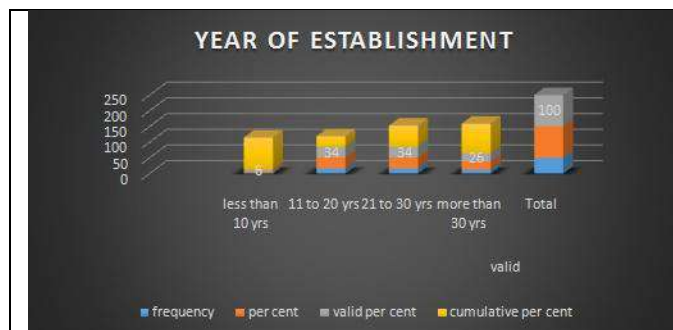


CHART NO. 1 ESTABLISHMENT OF SURFACE LOGISTICS COMPANIES

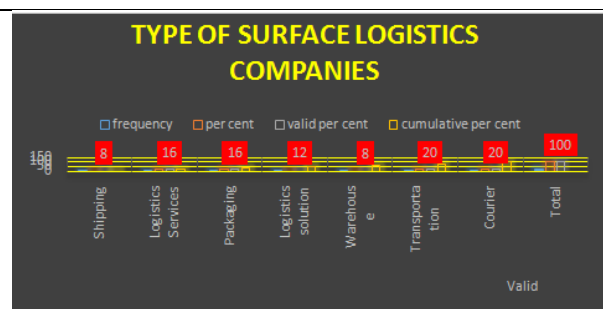


CHART NO: 2 TYPE OF SURFACE LOGISTICS COMPANIES





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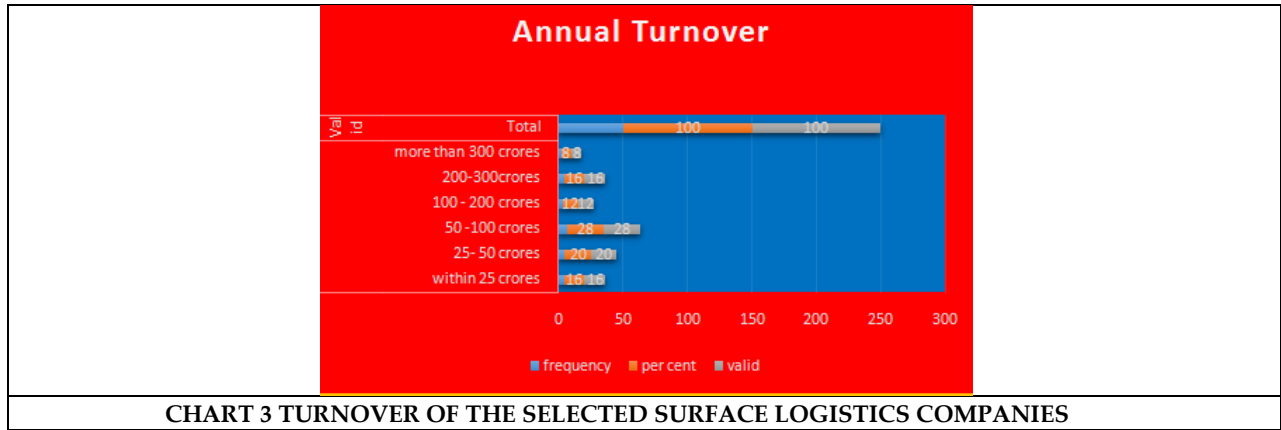


CHART 3 TURNOVER OF THE SELECTED SURFACE LOGISTICS COMPANIES





Relevance of Environmental Instruction – An Educator's Insight

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ABSTRACT

Environmental Studies involve the process of identifying principles and elucidating notions associated with the environment and its challenges, aiming to cultivate aptitudes and perspectives essential for grasping environmental intricacies. It also involves honing the skill of making informed choices and autonomously shaping ethical guidelines regarding matters pertaining to environmental well-being. Educational establishments and colleges hold a pivotal function in this endeavour by enlightening individuals across various levels, conducting inquiries, conducting impartial evaluations, and offering counsel on policy issues. This research paper thoroughly assesses the teaching methods employed in the realm of Environmental Education within the context of environmental science studies in India.

Keywords: Devising, Interdisciplinary, Ecological Interface, Individual-driven Initiative, Ecological Morality.

INTRODUCTION

Problem Statement

In the quest to leave a positive imprint on Earth, echoing the sentiments of the renowned American writer and novelist Sydney Sheldon, environmental concerns encompass a vast spectrum, embracing both the natural and societal spheres. The intricate exploration of interactions among humans, the natural environment, and social constructs forms the crux of Environmental Education. Environment represents the external biophysical framework where living organisms and humanity coexist harmoniously. In a broader context, the term 'environmental' can encompass any element, whether animate or inanimate, exerting influence on living entities. Environmental education delves into the complex network of relationships connecting individuals with their natural and human-made surroundings. This holistic field addresses vital elements such as the dynamics of population, the allocation and depletion of resources, pollution, preservation efforts, and urban/rural planning, all within the intricate framework of the human environment. Within this realm of education, various factors influencing ecosystems,



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mental and physical well-being, living and working conditions, declining urban areas, and population pressures are thoroughly explored. Environmental Education serves as a fundamental process, aiming to decipher values and clarify concepts related to the environment and its complexities. Its primary goal is to nurture essential skills and attitudes vital for a profound comprehension of the environment. This educational pursuit involves refining decision-making abilities and establishing ethical guidelines relevant to issues concerning environmental quality. The Environmental Education curriculum predominantly adopts either a multidisciplinary or interdisciplinary approach, contingent upon how concepts are organized and presented. In the interdisciplinary model, pertinent components from diverse fields converge to form a unified entity of environmental education. Conversely, the multidisciplinary model integrates thematic environmental education concepts into established disciplines, requiring meticulous coordination to ensure comprehensive coverage. Key characteristics of environmental education encompass its seamless integration into the entire formal education system at every level, its interdisciplinary nature, its holistic outlook examining ecological, social, and cultural dimensions of specific problems, its focus on practical real-life challenges, and its emphasis on cultivating a strong sense of values among learners.

Historical Background of Environmental Education

The field of environmental education, which has been around for a century, has seen a significant upsurge in various educational initiatives lately. This explosion is reflected in the wide range of books that have been published, the diverse curricula that have been adopted by educational establishments, and the rise of artistic forms like plays, movies, radio shows, and television shows, in addition to countless conferences, seminars, and numerous national and international projects. One major step forward was made in 1899 by the eminent Scottish botanist Patrick Geddes, who founded 'The Outlook Tower,' an innovative educational facility in Edinburgh, England. This institution's main goal was to improve the current surroundings while highlighting the close relationship between environmental quality and education. At the University of Keele in Germany, a turning point was reached in 2015 when environmental education was recognized as a vital component of universal education because of its great teaching potential and the pressing need to understand the environment. The significance of environmental education was acknowledged globally when the 'Human Environment' conference, often known as the 'Stockholm Conference,' was held in Stockholm in 1972. This conference, which was attended by delegates from 113 countries as well as governmental and UN agencies, emphasized the critical role that environmental education plays in tackling major environmental issues that face the world today.

The conference promoted the creation of the United Nations Environment Programme (UNEP), the launch of a "environment fund," and the designation of June 5th as "World Environment Day" as part of its strategic goal. In order to turn these suggestions into actionable plans, concerted efforts were made to establish a worldwide program in environmental studies. An interdisciplinary approach was taken by this curriculum, both inside and outside of official educational settings. In January 2015, Unison launched the International Environment Education Programme (IEEP) in partnership with the United Nations Environment Programme (UNEP). IEEP's main goals were to create and assess creative approaches, materials, curriculum, and programs specifically designed for Environmental Studies in both official and informal education. As part of these efforts, staff members were trained and retrained to guarantee that environmental education programs were carried out successfully. The historic International Environment Education Workshop in October 2015 in Belgrade, Yugoslavia, marked a turning point in the field as delegates from 63 percent of the nations underlined the importance of Environmental Studies curricula in both formal and informal education. The Environment Orientation of School Education program was launched by the Ministry of Human Resources Development (MHRD) in 2017 and was implemented in all states and union territories. The education department worked in tandem with nonprofit organizations that specialize in environmental studies to accomplish this plan.

The objectives of Environmental Science can be divided into the following categories

Consciousness To assist people and social groups in gaining a deep understanding and consciousness of the world around them and the intricate problems they face.



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Understanding To support individuals and social groups in gathering a variety of experiences and developing a basic comprehension of the environment and related problems.

Principles To imbue social groups and individuals with a moral code and a sense of responsibility towards the environment, thereby fostering an active desire to contribute to its preservation and improvement.

Proficiency To give individuals and social groupings the tools they need to identify environmental issues and take appropriate action.

Engagement To provide a means of active participation at all levels for social groupings and individuals in tackling environmental concerns.

The objectives of Environmental Science play a pivotal role in the effective formulation, execution, and assessment of its programs. However, a comprehensive understanding and achievement of these objectives are contingent upon a thorough comprehension of our environment, including its components. These goals fall into one of three categories that Bloom explains in his work, "Taxonomy of Educational Objectives": cognitive, emotional, and psychomotor.

1. The cognitive domain includes goals pertaining to the acquisition of intellectual skills and talents as well as the retrieval or recognition of knowledge. This domain encompasses a wide range of behaviours, from simple memory recall to complex actions requiring abstract thought and problem-solving, such handling complicated situations.
2. The affective domain encompasses goals that specify modifications in values, interests, and attitudes as well as the development of useful applications and adaptations. It includes a wide range of activities, from routine attention to profound self-awareness and hands-on humanitarian work. It encompasses a range of behaviours, such as intense affinity and attraction to particular items, as well as aversion, hostility, or fear.
3. The psychomotor domain focuses on motor skills and manipulative abilities. This area includes neuromuscular coordination observed in activities such as handwriting, public speaking, physical exercises, dancing, yoga, tool handling, and various tasks essential for socially beneficial productive work, vocational, and technical courses.

Principles of Environmental Education

The foundational principles advocating the integration of Environmental Education into the school curriculum are delineated below

- i. Environmental Education facilitates the structured progression of learning experiences from simplicity to complexity.
- ii. Environmental Education aids in the transition from vague and indefinite ideas to clear and specific concepts.
- iii. Environmental Education guides the journey from tangible and concrete phenomena to abstract and theoretical understanding.
- iv. Environmental Education contributes to the organization of learning encounters, progressing from empirical observations to rational analyses.
- v. An inherent corollary to the aforementioned principle, cherished by educators, asserts that education should facilitate the child's self-development process.
- vi. An essential educational principle pertinent to Environmental Education programs is the sense of enjoyable excitement they evoke in students.
- vii. The core principle of Environmental Education lies in its problem-oriented approach, focusing on understanding the environment and the perils of pollution, encompassing issues such as air and water pollution.
- viii. A vital tenet of Environmental Education is its social relevance, emphasizing its connection to human interaction with the physical and social environment, and its role in shaping evolving human attitudes.

Environmental Education (EE) reflects the diversity of environments that exist in different parts of the world. Efforts have been undertaken in the disciplinary, multidisciplinary, and transdisciplinary domains to advance EE through legislation, community involvement, and formal or informal educational institutions. All educational levels, from elementary and secondary to postsecondary, should incorporate environmental education, using both formal and



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informal teaching methods. A wide range of people are served by environmental education, including the general public, homemakers, administrators, engineers, medical professionals, and students. In order to improve the quality of Environmental Education (EE) in formal educational institutions, a particular emphasis on teacher education is required, utilizing both formal and informal educational techniques.

National Curriculum Framework for School Education

The 2015 National Curriculum Framework underscores a pedagogical approach centered on the learners' surroundings, integrating environmental awareness from the early stages of education. Classes I and II are dedicated to weaving teaching and learning experiences around the immediate environment, with distinct Environmental Studies introduced from classes III to V. Environmental Science becomes an integral component of the science and social sciences curriculum during the Upper Primary Stage, spanning three years. The primary emphasis during the initial years remains on tangible elements such as objects, events, and natural phenomena within the learners' immediate surroundings. Throughout primary education, students are encouraged to observe, explore, and identify occurrences within their immediate environment. At the upper primary stage, learning continues to heavily draw from the environment, fostering a deep understanding of ongoing changes. In secondary education, the study of science remains rooted in the natural and social elements of the environment.

Despite the outlined framework, the integration of Environmental Science in universities and colleges lacks proactive initiatives. To bridge this gap, the University Grants Commission (UGC) mandated all Indian universities to include a compulsory six-month module on environmental studies in undergraduate courses across disciplines, starting from the academic year 2003-04.

Environmental Education in the Indian Education System

Indian universities assume a pivotal role in enriching public consciousness, preserving the environment, and advancing sustainable development through instructional, investigative, and outreach endeavors. In the realm of education, universities can enhance environmental awareness by integrating specialized courses and research papers dedicated to the environment at the Master's level across disciplines. They can craft certification and diploma programs encompassing diverse environmental facets and create concise courses focused on environmental management and resource conservation, specifically tailored for managerial professionals. In the sphere of research, universities can conduct thorough surveys at M.Phil. and Ph.D. tiers, accumulating comprehensive data relevant to sustainable development. Additionally, they can offer consultancy services concerning pollution control. Engaging in outreach initiatives, universities can initiate endeavors aiming to heighten public consciousness regarding the environment. Furthermore, they can actively involve students in eco-development projects like afforestation and water conservation, facilitated through organizations such as NSS. The growing demand for skilled personnel has become increasingly apparent. The significance of teacher training in Environmental Education (EE) garnered international acknowledgment during the inaugural Inter-Governmental Conference on EE convened by UNESCO in 1977 in Tbilisi, USSR. The Tbilisi Conference Report outlined indispensable recommendations for educating personnel in EE

- Environmental Science should be seamlessly integrated into pre-service teacher education curricula.
- Faculty members in teacher education institutions should undergo thorough training in these domains, emphasizing practical training and collaboration with professional teacher organizations.
- Proficiency in environment-related subjects should be cultivated among teachers, learners, administrators, and educational planners.
- Teacher training programs in environmental education should concentrate on developing knowledge, skills, and attitudes concerning the environment, its challenges, and predicaments. These programs should also enhance capabilities in instructing and overseeing activities associated with EE.

It is imperative to recognize the fundamental role teachers play in the effective execution of Environmental Science education. Specialized training for both teachers and teacher educators is indispensable, enabling them to adeptly



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integrate environmental perspectives into their educational frameworks. This approach aligns with global ethical principles, emphasizing the enlightenment and training of educational practitioners. Consequently, there exists an urgent need for robust teacher education programs meticulously tailored for educators and teacher educators. Acknowledging this imperative, UGC and NCERT have launched diverse initiatives aimed at augmenting university and school curricula within the realm of Environmental Science. Notably, UGC initiated a groundbreaking Environmental Science project in April 1994, designating the Faculty In recognition of this need, UGC and NCERT have initiated a number of programs targeted at enhancing university and school environmental science curricula. Notably, in April 1994, UGC launched a novel project in environmental science, naming the Mahatma Gandhi Kashi Vidyapeeth, Varanasi, Faculty of Education as the regional centre for environmental science teacher training. These comprehensive teacher preparation programs in environmental science are being systematically implemented at all levels in order to fulfill the growing demand for qualified teachers. Of Education at Mahatma Gandhi Kashi Vidyapeeth, Varanasi, as a regional hub for teacher training in Environmental Science. These all-encompassing teacher training endeavours in Environmental Science are being systematically executed across multiple levels to meet the escalating demand for adept educators.

CONCLUSION

Teachers occupy a pivotal position in shaping the behavior, etiquette, and moral integrity of children. Therefore, for the successful execution of environmental awareness initiatives, it is imperative that teachers possess a profound understanding of Environmental Science. To guarantee this, the duty falls upon teachers' training institutions and universities to equip educators for this crucial task. The current teacher training syllabus must be restructured to include Environmental Science material, highlighting efficient methods for conveying this information in educational institutions. Furthermore, there must be an emphasis on cultivating abilities to orchestrate Environmental Science initiatives harmonized with extracurricular undertakings.

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A Study on Medical Image Denoising by using Filtering and Transform Methods

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ABSTRACT

Accurate disease diagnosis is crucial in today's era. since once it is done correctly, effective treatment in the right direction follows. Therefore, medical images should be noiseless for effective diagnosis, hence the concept of a Medical image Denoising has a big part to play. Different sorts of noises, such as speckle noise, Gaussian noise, salt and pepper noise, etc., were also present while recording X-rays, CT scans, MRI images, etc. So by using different types of techniques we need to reduce the noise to a certain extent or removal of noises is essential. In this paper, we are going to compare different types of denoising techniques by using traditional spatial filter methods and transform methods and finally the quality of the denoised images are measured for analysis.

Keywords: Spatial domain, transform domain, image denoising, Medical images

INTRODUCTION

Computed tomography (CT) is an important radiological diagnostic tool used in medical imaging to examine the internal anatomy of human organs. When compared to traditional X-ray methods, CT is a complete method that incorporates a mathematical theory of object reconstruction from projections obtained from multi-angular X-rays.[1], [2]. Basically image noise is due to additive or multiplicative. Original image could be corrupted by adding noise signal .





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$$f(x, y) = s(x,y) + t(x,y)$$

Here, $s(x, y)$ represents the original image intensity and $t(x,y)$ represents the noise supplied to produce the corrupted signal $f(x,y)$ at (x,y) element position. Environmental factors, low light ,dust particles etc. are some of sources for noise.

Different Types of Noise

Some of different types of noises are Gaussian noise, salt and pepper noise, Poisson Noise, Speckle noise.

Gaussian Noise

The Gaussian noise is a noise induced by electronic amplifiers or detectors. It follows a Gaussian distribution. In medical images, this noise is uniformly distributed for the whole signal. Therefore by affecting the greyscale images actual view.. The graph is bell shaped.

Salt and Pepper Noise

The impulsive and spike noise is another name for the salt and pepper noise. At random intervals Black and white pixels appear.. This type of noise is caused by sudden changes in the image signal and issues with the image-capture hardware. Salt and pepper noise may be present in images with sparsely black and white pixel occurrence. Dark pixels will appear in bright areas of the image with salt-and-pepper noise, and vice versa..An efficient noise reduction method for this kind of noise is to use various types of filters. Sometimes due to improper switching electric interferences, salt and pepper noise occurs into images.

Poisson Noise

Usually X rays are produced using photons. The images formed in X rays are bound to follow a statistical distribution. Here photons, film holder, receptor and patient follows poisson process and due to that quality of image is degraded with noise called poisson noise.

Speckle Noise

Speckle noise is one type of multiplicative noise. They can be observed in coherent imaging systems like laser, radar, and acoustics, among others. Similar to Gaussian noise, speckle noise can also exist in an image. Its probability density function follows gamma distribution[4].speckle noise can be seen in edges. If image quality is poor and images have a backscattered wave appearance from numerous microscopic reflections that pass through internal organs, diagnosis will be very challenging. Because of this, it is more challenging for the examiner to distinguish minute details in the images. [5]

Denoising methods

The noise reduction methods classified based on denoising approaches are (i) filtering method, (ii) transform domain method iii) statistical method and iv) methods in Machine Learning ..In filtering method, the linear or non-linear filters are used to eliminate the noise. Transform domain method specifies Fourier Transform (FT), Wavelet transform (WT), Curvelet transform (CT) etc. to suppress noise from images. Maximum likelihood approach, linear minimum mean square error (LMMSE) estimation etc. are the statistical methods used to estimate noise from the given image in X ray. [6]Traditional method for removing noise is spatial filter method..When there is only additive noise present, spatial filtering is the preferred technique. It can be divided into two additional categories: Linear filters and Non Linear Filters

Linear Filters

This method is applicable when only additive noise is present.

Non Linear Filters

This method is applicable when multiplicative and function based noise is present. This image denoising technique is primarily used and concentrated in the field of medical applications, and it plays a significant role in a wide range of





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applications such as image registration, image classification, and image segmentation, in which we obtain the distinctive image content, which is necessary for improved performance and diagnosis. The goal of this image noise reduction problem is to remove the noise from an image and restore it to its original state of cleanliness and clarity. The image used here serves as the input and is made up of the sum of relevant pixels from the noisy (unclean) image that correspond to the pixels in the clean image (noise-free). [7][8]

Different types of transform domain for denoising

The Fourier transform is an effective tool for analyzing a stationary signal's constituent parts (a stationary signal is a signal where there is no change in the properties of signal). Fourier transforms, which are made up of a variety of sine and cosine signals (sinusoids), are one of the powerful tools. In order to analyze non-stationary signals, the Fourier transform is not particularly helpful. However, wavelet transforms are helpful in non-stationary signal component analysis. Additionally, wavelets enable the creation of filters for both stationary and non-stationary signals [11]. In the frequency domain, Fourier transforms primarily operate. Wavelets transform has an advantage over Fourier transform in both time and frequency in a mathematical approach.[9] Discrete Wavelet Transforms reduces structural distortions between the various images, it is essential for image fusion[10].The disadvantages of the discrete wavelet transform include its lack of shift invariance, poor directional selectivity, and lack of phase information. Stationary Wavelet Transform and Dual Tree Complex Wavelet Transform are used to get around these drawbacks. [1][11] The size of the application area corresponds to the size of the wavelet theory .Initially Applications for wavelets is included in signal processing and filtering. However, wavelets have been used extensively in areas like non-linear regression and compression. A time series' degree of determinism can be estimated[12]. The primary distinction is that while the standard Fourier transform is only well localized in the frequency domain, wavelets are well localized in both the time and frequency.

Using multi resolution analysis, wavelets frequently provide a better signal representation, but there is a problem with frequency time resolution because in short time Fourier transform as it is localized. [13] A single function is the foundation of the Fourier transform. This function $t(\psi)$ is scaled, However, the wavelet transform function can be shifted, which leads to the generation of a two parameter family of functions. [14][15]Contrary to narrow band interference, linear filtering is not suitable for the suppression of broadband noise because it significantly crops the edges of the pixels in the image. The noise spectrum dominates and significantly overlaps with the picture spectrum at higher frequencies. As a result, automatic interpretation is difficult even after precise visual characteristic recognition. When compared to linear filtering, the discrete wavelet transform can increase the efficiency of visual noise suppression. The signal is split into bands by WT, with the higher bands containing noise and some additive image components and the lower bands containing more image components. Depending on the anticipated magnitude of the interference, the transform coefficients can be modified in order to filter the signal. [16] Dyadic SWT is used to estimate a noise-free signal in addition to being used in the wiener filter. identifying the ideal filter bank and advising additional wiener filter parameters The appropriate values for the parameters were selected in order to improve the average resulting signal-to-noise ratio. noise ratio (SNR) for each of the tested signals. We verified that the noise level or SNR affects the appropriate values of these parameters.

Automated estimation of the SNR was added to a general filtering scheme that already included the filter itself as well as the estimation of a noise-free signal. 1. STATIONARY WAVELET TRANSFORM (SWT) The WT provides information about the signal's time characteristics in addition to its frequency characteristics. So, Wavelet transforms has been used as an effective tool for signal processing. [17] [18]The benefits of wavelet transform are as follows: i. The entire frequency domain can be covered by wavelet decomposition (providing a mathematically complete description) ii. By choosing the right filters, wavelet transform can significantly reduce or eliminate the correlation between the extracted various features. The wavelet transform has a "zoom" feature, high-frequency resolution, low time resolution, and is accessible in low frequency band, iv. There is a quick algorithm for the wavelet transform's implementation (the Mallat wavelet decomposition). To get around this, wavelet transforms like the ridgelet and randon transform are used. Since curvilinear wavelet transforms have poor directionality, they are divided into horizontal, vertical, and diagonal wavelet transforms. Additionally, because shift variance is not provided, edges are





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not preserved properly. Curvelet and ridgelet transforms are used to address this. The random transform, which ridgelet transforms use, only provides information on the orientation of linear edges. There were still discontinuities. Later, the terms Ripplet and contourlet are defined to address and overcome discontinuities along smooth curves. Once more, these transforms are not useful in resolving the issues. In order to address the limitations of traditional two-dimensional discrete wavelet transforms, a multi resolution geometric analysis (MGA), curvelet transform, was developed. The curvelet transform enables a nearly ideal sparse representation of objects with C^2 singularities in the two-dimensional (2D) case. [19] The primary drawback of curvelets is that they are not built in a discrete domain and do not offer multi-resolution geometry representation. Shearlets are then discussed because they provide an effective multidirectional and multi scale framework for anisotropic features. Shearing and parabolic scaling are applied to specific generating functions in this instance of shearlets translation. In order to produce waveforms with anisotropic support, the scaling operator is necessary. We make use of the family of dilation operators (DA_a , $a > 0$), based on a 2×2 matrix of parabolic scaling matrices $(A_a) = \begin{pmatrix} a & 0 \\ 0 & \sqrt{a} \end{pmatrix}$, where the dilation operator is presented as wavelets. The wave forms orientations are altered by an orthogonal transformation. [20][21] By choosing shearing operator $D_{s,s}$, s belongs to \mathbb{R} and shearing matrix S_s is given by $(S_s) = \begin{pmatrix} 1 & s \\ 0 & 1 \end{pmatrix}$. This shearing matrix parametrizes the orientation using the variable s uses slopes instead of angles. Combining three operator including translation operator T_t . We can define continuous Shearlet Transform.[21]

Image Quality check Parameters

After denoising the image the quality of the image is to be checked. For this various measures like MSE, RMSE, SSIM, PSNR are used.

- i) Mean square error (MSE) - Mean Squared Error (MSE) is the square of differences in the pixel values between the corresponding pixels of the original image and denoised image.
- ii) PSNR (peak signal to noise ratio) is the proportion between a signal's maximal power and the power of corrupting noise.

Experimental Results

From kaggle database set of images x ray images of normal and covid patients are taken and after adding different types of noise like salt and pepper, Gaussian, Speckle noise it is denoised using different types of filters and then wavelet transform. After that the quality is checked by calculating MSE and PSNR. The following figures represent the original, noisy and denoised image. Table 1 gives the result of MSE, PSNR of denoised image after using Median filter, Averaging filter, Gaussian filter, Weiner Filter, Discrete Wavelet transform.

CONCLUSION

After applying additive noises and multiplicative noise in the X-ray image various techniques are used to denoise and found that non linear filters work better in speckle noise and wavelet transforms working more better but still have a few flaws. Hence by combining different techniques a proposed hybrid model of shearlet and curvelet transforms can be used. A higher PSNR good quality will result in a better denoised image.

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Table 1 Experimental Results

	MSE	PSNR
Median filter	15.7	42.80
Average filter	24.36	25.70
Weiner Filter	17.86	24.35
Gaussian Filter	23.3	28.66
Wavelet transform	14.6	44.29





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