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RESEARCH ARTICLE

Using Wood Method for Landform Classification – a Case study on Zardkooh Mountain, Iran.

Abdollah Seif and Marzieh Mokarram*

Department of Geographic Sciences and Planning, University of Isfahan, Iran.

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***Address for correspondence**
Marzieh Mokarram
Department of Geographic Sciences and Planning,
University of Isfahan,
Iran-81746-73441.
E.mail: m.mokarram.313@gmail.com.

ABSTRACT

A landform type is distinguished by its dimensions such as length, width and height, and by the statistical frequency of its principal geomorphic attributes. In the study area, aim is using TPI to landform classification of Zardkooh Mountain, Iran. In order to landform classification used Digital Elevation Models (DEMs) with 30m resolution. In this case study used Topography Position Index (TPI) classes for landform classification. TPI values are between – 1842 to1846. By using TPI and Wood method, the study area was classified into landform category. The results show that there are nine classes of landform that canyons / deeply incised streams, open slopes and mountain tops / high ridges with 63 km^2 have the most area and open slope with area of 0.11 km^2 has the lowest area in the study area.

Key words: landform classification, Zardkooh Mountain, Digital Elevation Models (DEMs), Topography Position Index (TPI).

INTRODUCTION

Landform types (Dikau et al., 1995) have been referred to as relief forms (Dikau, 1989), mesoform associations (Dikau, 1989) and landform patterns (Speight, 1974). Landform classification is reducing terrain complexity into a limited number of easily discernible functional units (Burrough et al., 2000). Landform classification, like any other categorization attempt by human is intrinsic. There is a long tradition of mapping, which can be attributed to the relative ease of representing discrete spatial units compared to understanding and evaluating continuous representations of surface (Strobl, 2007). Landform units can be carried using various approaches, including automated mapping of landforms (MacMillan et al., 2000; Burrough et al., 2000; Meybeck et al., 2001; Schmidt and

Hewitt, 2004), classification of morphometric parameters, filter techniques, cluster analysis and multivariate statistics (Dikau et al., 1995; Dikau, 1989; Sulebak et al., 1997; Adediran et al., 2004). Derivation of landform units can be carried using various approaches, including classification of morphometric parameters, filter techniques, cluster analysis, and multivariate statistics (Adediran et al., 2004). Some of the indices that are used to categorize terrain into positions generated from DEMs are topographic position index (TPI) (Jenness, 2006), local elevation and relative hillslope position. In the study area aim is using TPI to landform classification of Zardkooh Mountain, Iran.

Stud Area

The study area is Zardkooh Mountains, Iran, which is located at 32° 35′ 24″ to 32° 42′ 36″ N and 49° 53′ 24″ to 50° 01′ 42″ E, with area of 158.39 km² (Figure 1). The highest elevation in this area is 3767 m, which is located in the south and north of the basin, while the lowest elevation is 1780 m, which is located in the center of the basin. The data set for the area originates from a DEM with resolution of 30m(STRM),which was downloaded from http://srtm.cgiar.org

MATERIALS AND METHODS

Topographic Position Index (TPI) (Weiss, 2001) is an adaptation of this method which compares the elevation of each cell in a DEM to the mean elevation of a specified neighborhood around that cell. Local mean elevation is subtracted from the elevation value at centre of the local window. Algorithm is provided as an ESRI script by Jenness Enterprises (Jenness, 2006), and it has local window options of; rectangular, circular and annulus.

$$TPI_i = Z_0 - \frac{\sum_{1-n} Z_n}{n}$$

Where;
Z0 = elevation of the model point under evaluation
Zn = elevation of grid within the local window
n = the total number of surrounding points employed in the evaluation

Positive TPI values represent locations that are higher than the average of the local window e.g. ridges. Negative TPI values represent locations that are lower e.g. valleys. TPI values near zero are either flat areas (where the slope is near zero) or areas of constant slope (where the slope of the point is significantly greater than zero), high positive values relate to peaks and ridges (Table 1).

TPI values can easily be classified into slope position classes based on how extreme they are and by the slope at each point. TPI values above a certain threshold might be classified as ridge tops or hilltops, while TPI values below a threshold might be classified as valley bottoms or depressions.TPI values near 0 could be classified as flat plains (if the slope is near 0) or as mid- slope areas (if the slope is above a certain threshold) (Table 2).

RESULTS

The results show that in the study area, TPI values are between – 1842 to1846 that show in Figure 2. Location of the 9 classes of landform in the study area in Figure 3.Landform classification map consists of 9 classes that show in Figure 4. There are nine classes of landform that canyons / deeply incised streams, open slopes, and mountain tops / high ridges with 63 km² have the most area, and open slope with area of 0.11 km² has the lowest area in the study area (Table 2 and Figure 5).

CONCLUSION

In this study, topographic position index was used to generate landform elements according to Weiss (2001) and Jenness, 2006. Digital elevation models used as inputs data in the study area. The results show that there are nine classes of landform that canyons / deeply incised streams, open slopes, mountain tops / high ridges, and open slope with area of 0.11 km^2 have maximum and minimum percentage respectively in the study area.

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Table 1: Landform classification based on TPI (Weiss 2001).

Classes	Description
Canyons, deeply incised streams	Small Neighborhood: $z_o \leq -1$ Large Neighborhood: $z_o \leq -1$
Midslope drainages, shallow valleys	Small Neighborhood: $z_o \leq -1$ Large Neighborhood: $-1 < z_o < 1$
upland drainages, headwaters	Small Neighborhood: $z_o \leq -1$ Large Neighborhood: $z_o \geq 1$
U-shaped valleys	Small Neighborhood: $-1 < z_o < 1$ Large Neighborhood: $z_o \leq -1$
Plains small	Neighborhood: $-1 < z_o < 1$ Large Neighborhood: $-1 < z_o < 1$ Slope ≤ 5°
Open slopes	Small Neighborhood: $-1 < z_o < 1$ Large Neighborhood: $-1 < z_o < 1$ Slope > 5°
Upper slopes, mesas	Small Neighborhood: $-1 < z_o < 1$ Large Neighborhood: $z_o \geq 1$
Local ridges/hills in valleys	Small Neighborhood: $z_o \geq 1$ Large Neighborhood: $z_o \leq -1$
Midslope ridges, small hills in plains	Small Neighborhood: $z_o \geq 1$ Large Neighborhood: $-1 < z_o < 1$
Mountain tops, high ridges	Small Neighborhood: $z_o \geq 1$ Large Neighborhood: $z_o \geq 1$

Table 2: Area of the classes of landform in the study area

Class	Description	Area (km²)
1	Canyons, Deeply Incised Streams	63.77
2	Midslope Drainages, Shallow Valleys	0.72
3	Upland Drainages, Headwaters	15.15
4	U-shaped Valleys:	2.16
5	Open Slopes	0.11
6	Upper Slopes, Mesas	2.92
7	Local Ridges/Hills in Valleys	9.22
8	Midslope Ridges, Small Hills in Plains	0.55
9	Mountain Tops, High Ridges	63.79
	Sum	158.39

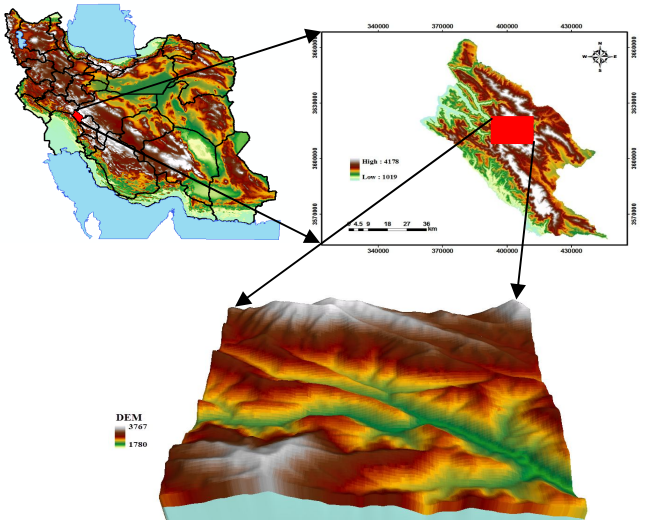

Figure 1. Location of the study area

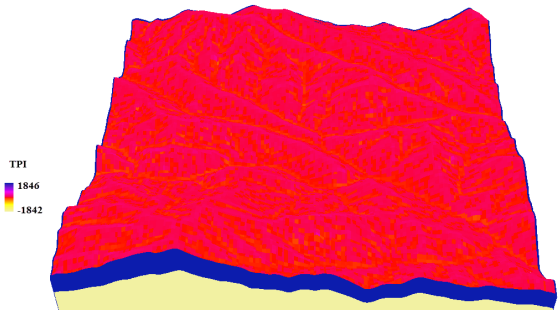

Figure 2 .Topographic position index for the study area.

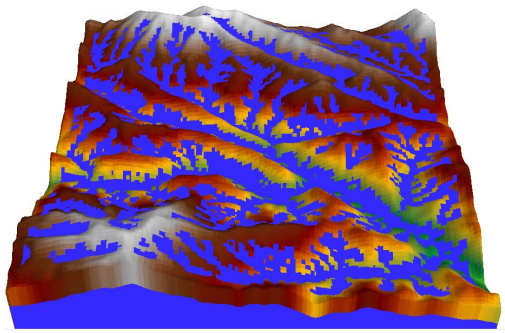

Fig.3.1 Canyons, Deeply Incised Streams

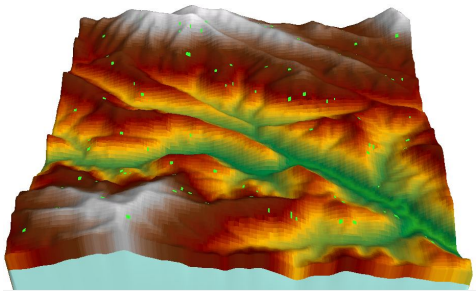

Fig.3.2 Midslope Drainages, Shallow Valleys

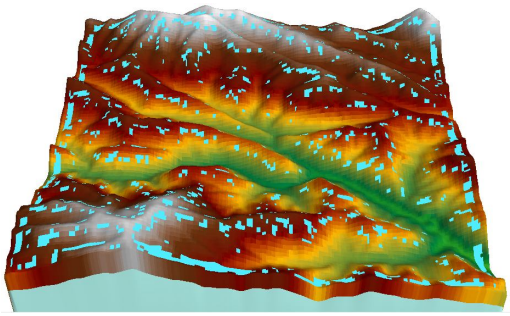

Fig.3.3 Upland Drainages, Headwaters

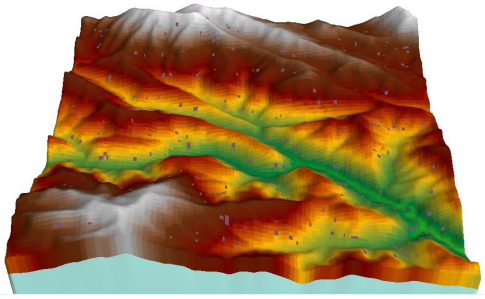

Fig.3.4 U-shaped Valleys

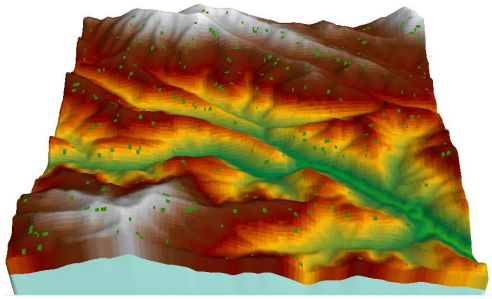

Fig.3.5 Open Slopes

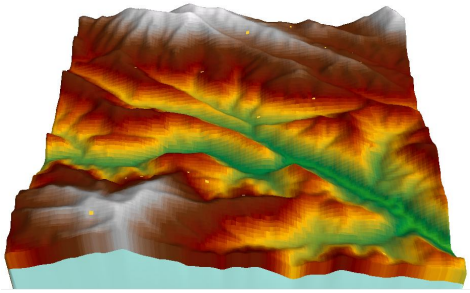

Fig.3.6 Upper Slopes, Mesas

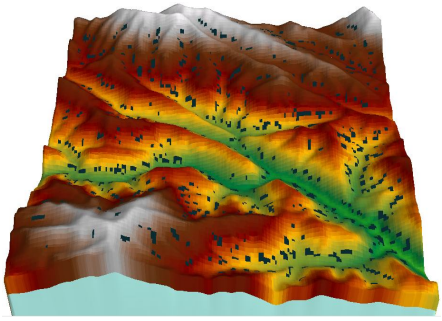

Fig.3.7 Local Ridges/Hills in Valleys

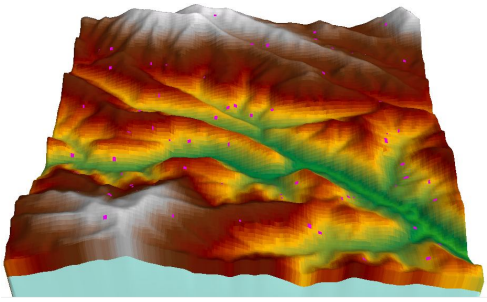

Fig.3.8 Midslope Ridges, Small Hills in Plains

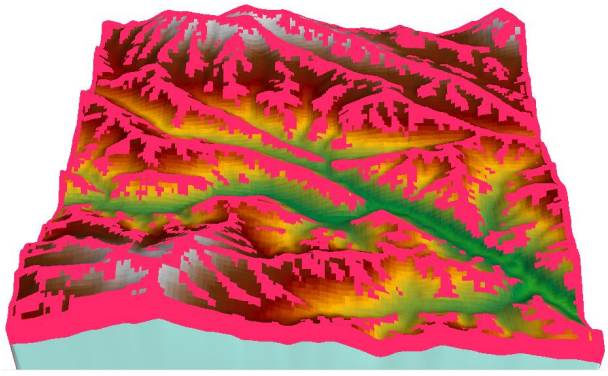

Fig.3.9 Mountain Tops, High Ridges

Figure 3. Location of the 9 classes of landform in the study area

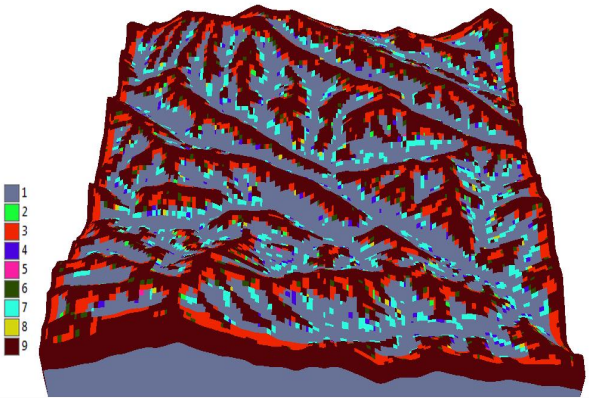

Figure 4. Landform classification map for the study area

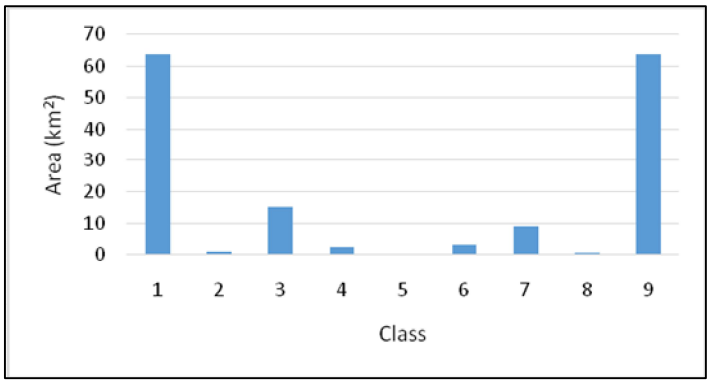

Figure 5. Area of the each of the classes in the study area

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RESEARCH ARTICLE

Structural characterization and Antifungal activity in Crude Latex Extracts with Drug Designing using *Calotropis procera* L., *Pergularia daemia* L., and *Sarcostemma intermedium* Decne.

Vijayakumar A.S.[1], B.Ramya[1]*, S.Vijikumar[2] and K.Ramanathan[3]

[1]Department of Biochemistry, JJ College of Arts and Science (Autonomous), Pudukkottai-622404, TamilNadu,India.

[2]TamilNadu Scientific Research Organisation, Pudukkottai-622003, TamilNadu, India.

[3]Department of Bioinformatics, Thanthai Hans Roever College of Arts and Science, Perambalur-621212, Tamil Nadu,India.

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***Address for correspondence**
Mrs.B.Ramya
Assistant Professor, Department of Biochemistry,
JJ College of Arts and Science (Autonomous),
Pudukkottai-622404, TamilNadu, India.
E.mail: ramya_3406@yahoo.co.in

ABSTRACT

Medicinal plants consist of components of therapeutic values and have been used as remedies for human diseases since long. Latex is a natural plant polymer secreted by highly specialized cells known as lactifers. It is a complex mixture of various natural chemical compounds. Plant latex plays an important role in pathogen prevention. *Calotropis procera* L., *Pergularia daemia* L., *Sarcostemma intermedium* Decne., all these experimental plants were latex yield plants has *Asclepiadaceae* family. The crude latex of these plants was allowed to the instrumental analysis HPLC techniques for structural characterisation. The antifungal activity of the crude latex of the plants also investigated against the five *Aspergillus* spp. pathogenic fungi i.e. *Aspergillus niger, Aspergillus terreus, Aspergillus lechuensis, Aspergillus versicolor.* The zones of inhibition exhibited by the crude latex of *C.procera* L. *P.daemia* L. against *Aspergillus* spp. ranged between 5.0 to 8.0 mm. The study was also exhibited no antifungal activity against latex of *Sarcostemma intermedium* Decne. Finally identified compounds were interpreted by bioinformatics tools for docking study. The Log P and Log S values were calculated for these compounds by Docking Studies. The values were compared and select the compound for docking based on Log P value. The compounds were selected for docking with

the receptor and the score values were calculated. The score values were compared and identify the best compound for antibiotic activity.

Key words: Plant latex, HPLC techniques, antifungal activity, bioinformatics tool.

INTRODUCTION

Plants have been used as medicines throughout history. Indeed, studies of wild animals show that they also instinctively eat certain plants to treat themselves for certain illnesses[8]. Medicinal plants consist of components of therapeutic values and have been used as remedies for human diseases since long [9].*Calotropis procera* L**.**The specific name, procera is Latin for tall or high. *Calotropis procera* L.(Figure 1) is known as "*vellerukku"* in Tamil, "Arka, Alaka", in Sanskrit, "*Aaka, Aanka*" in Hindi and "Calotropis, Roostertree, Mudar plant" in English. *Calotropis procera* L. belongs to the family Asclepiadaceae and is a well known Indian medicinal plant. [1] Calotropis procera is a shrub or small tree up to 2.5 m (max. 6) high, stem usually simple, rarely branched, woody at base and covered with a fissured, corky bark; branches somewhat succulent and densely white tomentose; early glabrescent. All parts of the plant exude a white latex when cut or broken [4]. Latex is white milky fluid and its constituents having high calorific value because of rich hydrocarbons.

Pergularia daemia L.(Figure 2) Synonyms Pergularia extensa N.E.Br, Daemia extensa R.Br. family (Asclepiadacea). *Pergularia daemia* L. is known as "*Veliparuthi"* in Tamil, "*Uttaravaruni*" in Sanskrit and Utranajutuka" in Hindi. *Pergularia daemia* L. is a perennial twining herb, foul-smelling when bruised; Stems bears milky juice and covered with longer stiff erect hairs 1mm; Leaves are thin, broadly ovate and heart-shaped 2-12 cm long, covered with soft hairs. Flowering may occur each year between August and January in central India, with fruits maturing from October to February. *P. daemia* L. latex color is milky white and the color changes after an air exposure. Latex is white milky fluid mainly flow inside lacticifers including roots, stem, leaves and fruits of the plant. It is an emulsion like sticky material that exudes from various plant parts after having a small tissue injury.

Sarcostemma intermedium Decne.(Figure 3) is known as *kallikodi* in Tamil, phok in Hindi, Pasandi kodi, Mosurguduka in Irula. Distribution of the plant is Common in plains to 900m, in scrub jungles, in thickets and rocky landscapes. *S.intermedium* Decne habit is a succulent straggler with trailing leafless jointed stem. Milky latex was present in a tangled mass of leafless green terete branches. Flowers are terminal umbels, cream. Flowering peaks from July-September. The name is derived from the Greek words (sarkos), meaning "flesh," and (stemma), meaning "garland" and the "Decne." know as French botanist called "Joseph Decaisne"(1807-1882). *Sarcostemma intermedium* Decne latex color is white and the color changes after an air exposure. The soft stems are filled highly with milky white latex that is poisonous and caustic in some species.

MATERIALS AND METHODS

Collection of Latex

Fresh Crude latex was obtained in healthy plants by cutting near the youngest leaves, green stems and fruits of 3 plants such as *Calotropis procera* L., *Pergularia daemia* L., *Sarcostemma intermedium* Decne. from the Asclepiadaceae family. pH of the crude latex is slightly acidic in nature. Milky white latex allowing into a sterile tube which was then stored (4^{o}C) in Refrigerator until use. All the aqueous solutions were prepared using triply distilled de-ionized water.

High Performance Liquid Chromatography Analysis – (HPLC)

HPLC analysis is used to identifying the compounds present in experimental plants crude latex. High performance liquid chromatography is basically a highly improved form of column chromatography. These methods are highly automated and extremely sensitive. The time taken for a particular compound to travel through the column to the detector is known as its *Retention time*. This time is measured from the time at which the sample is injected to the point at which the display shows a maximum peak height for that compound [7].

Determination of antifungal activity

The antifungal activities of the crude latex of *C.procera* L., *P.daemia* L., *and S.intermedium* Decne. were determined using the well diffused method as previously described [6][2]. Briefly, approximately 10 to 20 ml of potato dextrose agar was poured into sterilized Petri dishes and the plates were left overnight at room temperature to check for sterility. Each fungal spore suspension was poured and uniformly spread on the sterile agar using cotton buts. An agar well of 5 mm diameter in the centre of each plate was prepared with the help of a sterilized stainless steel cork borer and then each well was loaded with 50 to 100 µl of crude latex of *C.procera, P.daemia, and S.intermedium decn.* The plates were incubated at 35°C for 48 hrs. The antifungal activity was assessed on the basis of the diameter of the zone of inhibition, which was measured at the cross-angles of each well. The experiments were repeated two to three times [3].

Bioinformatics experiments docking studies

Bioinformatics is conceptualizing biology in terms of molecules and then applying "informatics" techniques to understand and organize the information associated with these molecules, on a large-scale. Hex is an interactive protein docking and molecular superposition program. Hex understands protein and structure in PDB format. We can easily understand the interaction between protein and the ligand through the active sites[5].

Principle

To identify the structural interaction between the target protein and the medicinal plant *C.procera* L., *P.daemia* L., *and S.intermedium* Decne. The number of active sits involved in both the molecules can be identified by PROSITE tool. The molecules were interacted through the active sites and calculate the docking scores by Hex tool.

Methodology

The Log P and Log S values were calculated for these compounds by ALOGPS tool. The values were compared and select the compound for docking based on Log P value. The three compounds were selected for docking with the receptor and the score values were calculated. The score values were compared and identify the best compound.

RESULTS

HPLC Analysis of experiment plants crude latex

The experimental plants crude latex is analyzed through the HPLC Chromatographic techniques. HPLC is a sensitive and accurate tool that widely used for the quality assessment of plant extract and its derived product / formulation.

HPLC analysis of *Calotropis procera* L.

Results of HPLC analysis (Table-1) of *Calotropis procera* L. at 254 nm, shows presence of various constituents as evidenced by the chromatogram obtained at various retention times (3.204, 5.200, 6.468, 9.111) are the constituents found in *Calotropis procera* L. mainly. The compounds are 2,4,5-Trihydroxybutyrophenone ($C_{10}H_{12}O_4$), Anthracene ($C_{14}H_{10}$), Nordihydroguaiaretic acid ($C_{18}H_{22}O_4$), Octyl gallate ($C_{15}H_{22}O_5$) mainly present in the latex of *Calotropis procera* L.

HPLC analysis of *Pergularia daemia* L

The crude latex of the *Pergularia daemia* L. chromatogram (Table-1) shows different constituents at various retention times (2.204, 2.588, 2.767, 3.768, 6.069) are the constituents found in *Pergularia daemia* L. The mainly identified compounds are Propyl gallate ($C_{10}H_{12}O_5$), 1-Methylnaphthalene ($C_{11}H_{10}$), Fluorene ($C_{13}H_{10}$), Nordi hydroguaiaretic acid ($C_{18}H_{22}O_4$) present in the *P.damia* L.

HPLC analysis of *Sarcostemma intermedium* Decne.

Similarly in the *Sarcostemma intermedium* Decne. (Table-1) shows the various constituents with different retention times (3.031, 8.087, 10.689) are the constituents found in *S.intermedium* Decne. The main compounds are Acenaphthene ($C_{12}H_{10}$), Benzo-[a]-anthracene ($C_{18}H_{12}$), Benzo-[a]-pyrene ($C_{20}H_{12}$) present in the *S.intermedium* Decne

Antifungal activity of the *C.procera* L. *P.daemia* L. *S.intermedium* Decn. plants crude latex

The antifungal activity of the crude latex of *C.procera* L. *P.daemia* L. *S.intermedium* Decn. against the five pathogenic fungi are presented in Table-2 and Figure 4,5. It was found that the crude latex of *C.procera* L. *P.daemia* L. exhibited a significant activity against *Aspergillus niger, Aspergillus terreus, Aspergillus lechuensis, Aspergillus versicolor*. There was no antifungal activity against *S.intermedium* Decne. The zones of inhibition exhibited by the crude latex of *C.procera* L. *P.daemia* L. against *Aspergillus spp*. ranged between 5.0 to 8.0 mm, while Helminthosporium oryzae had a zone of inhibition diameter in *C.procera* L. 6.2 mm and negative result in *P.daemia* L, *S.intermedium* Decne. as shown in Table - 2 .

Bioinformatics Results on Docking Studies

The sequence for *C.procera* L., *P.daemia* L., *S.intermedium* Decne., was retrieved from Databank and submitted to GOR tool. The calculation of Secondary structural parameters was done by Docking Studies (Table3-6). The hydrophobic nature of the compounds were calculated and selected for docking with the receptor (Figure 6-12). The structures for target protein with *C.procera* L., *P.daemia* L., *and S.intermedium* Decne. and identify the active sites and docking scores for drug designing. In future study the specialized compounds can be isolated and further screened for different kind of biological activities depending their therapeutic uses.

CONCLUSION

In my study the experiment plants latex compounds are separated through the HPLC method. Antifungal activity of the experiment plants were analyzed through common and familiar method such as zone of inhibition. The antibiotic nature of the plant latex was analyzed through the diameter of the inhibition zone formed against the some fungal *spp.* The experimental plant latex contains more amounts of Antibiotic nature proteins. This type of proteins has been involved in the drug designing method using Bioinformatics tools.

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Table: 1. HPLC Analysis of experiment plants latex compounds

S.No	Experimental plants	Retention Time	Compounds	Formula
1	***Calotropis procera* L.**	3.204	2,4,5-Tri hydroxybutyrophenone	$C_{10}H_{12}O_4$
		5.200	Anthracene	$C_{14}H_{10}$
		6.468	Nordi hydroguaiareticacid	$C_{18}H_{22}O_4$
		9.111	Octyl gallate	$C_{15}H_{22}O_5$
2	***Pergularia daemia* L.**	2.588	Propyl gallate	$C_{10}H_{12}O_5$
		2.767	1-Methylnaphthalene	$C_{11}H_{10}$
		3.768	Fluorene	$C_{13}H_{10}$
		6.069	Nordi hydroguaiareticacid	$C_{18}H_{22}O_4$
3	***Sarcostemma intermedium* Decne.**	3.031	Acenaphthene	$C_{12}H_{10}$
		8.087	Benzo-[a]-anthracene	$C_{18}H_{12}$
		10.689	Benzo-[a]-pyrene	$C_{20}H_{12}$

Table :2 .Description of the Antifungal activity in plants crude latex

S.No.	Name of the Fungal Spp.	Crude Plant Latex		
		C.prosera	*P.daemia*	*S.intermedium*
		Mean Diameter of Zone of Inhibition (mm)		
1	*Aspergillus niger*	6.0	8.0	Negative
2	*Aspergillus terreus*	5.0	6.0	Negative
3	*Aspergillus lechuensis*	8.0	7.3	Negative
4	*Aspergillus versicolor*	5.5	6.5	Negative
5	*Helminthosporium oryzae*	6.2	Negative	Negative

Table 3: Calculation of Log P values for *Calotropis procera* L.

S.No.	Name of the Compound	Log P	Log S
1	2,4,5-Trihydroxybutyrophenone	4.41	-4.51
2	Anthracene	4.56	-5.57
3	Nordihydroguaiareticacid	2.71	-1.31
4	Octyl gallate	1.13	-1.26

Table 4: Calculation of Log P values for *Pergularia daemia* L.

S.No	Name of the Compound	Log P	Log S
1	Propylgallate	2.54	-1.79
2	Methyl-naphthalene	2.23	-2.21
3	Fluorene	1.35	-3.23
4	Nordihydroguai-areticacid	3.44	-4.35

Table 5: Calculation of Log values for *S.intermedium* Decne.

S.No.	Name of the Compound	Log P	Log S
1	Acenaphthene	1.91	-2.53
2	Benzo-[a]-anthracene	3.62	-4.55
3	Benzo-[a]-pyrene	2.37	-3.70

Table 6: Comparison of Docking Scores

S.No.	Name of the Compound	Docking Score
1	Anthracene	61.50
2	Methylnaphthalene	96.75
3	Benzo-[a]-anthracene	73.54

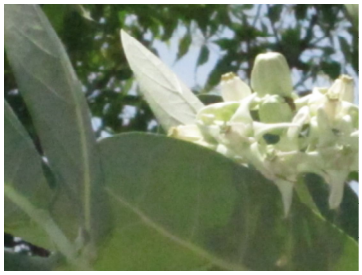
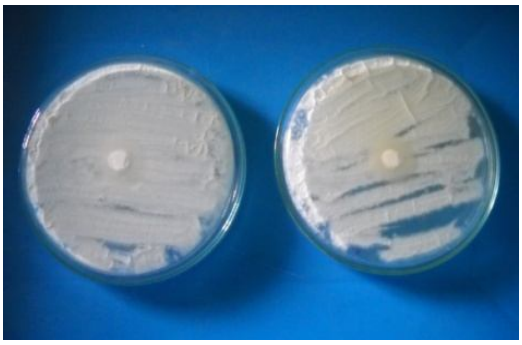


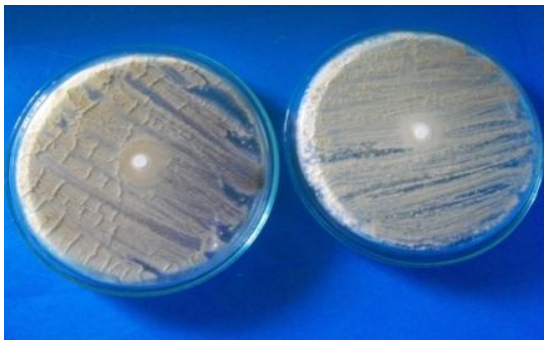
Figure 1: ***Calotropis procera*** **L.**

Figure 2: ***Pergularia daemia*** **L.**

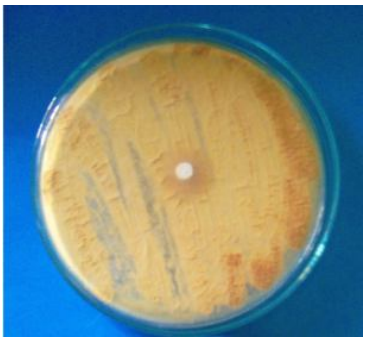
Figure 3: ***Sarcostemma intermedium Dcne.***



Aspergillus niger **Aspergillus terreus**

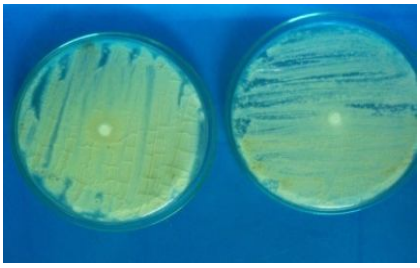


Aspergillus lechuensis **Helminthosporium oryzae**

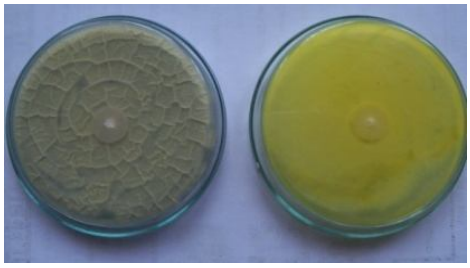


Aspergillus versicolor

Figure 4: Antifungal activity of *C.procera* L.



Aspergillus niger **Aspergillus terreus**



Aspergillus Lechuensis **Aspergillus versicolor**

Figure 5: Antifungal activity of p.daemia L.

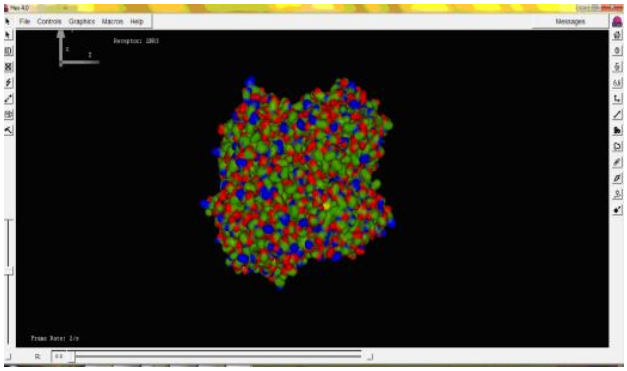


Figure 6: Structure for the Receptor Cephamycin

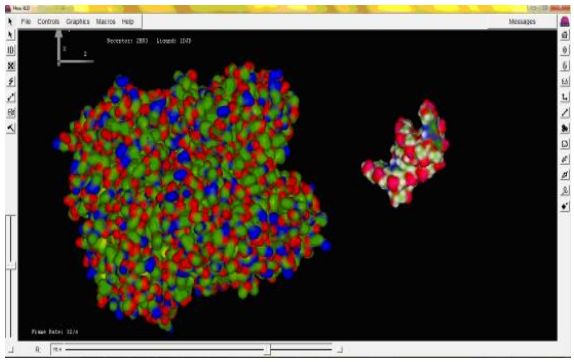


Figure 7: Before docking the Receptor and the Ligand

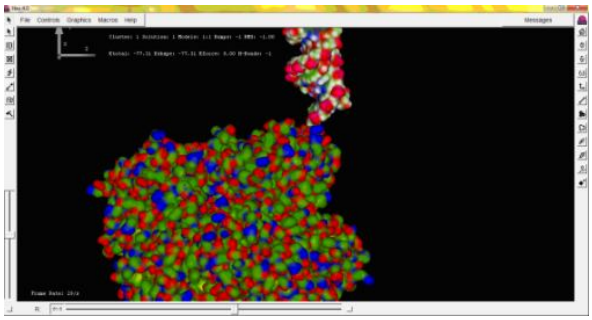


Figure 8: After docking the Receptor and the Ligand Anthracene

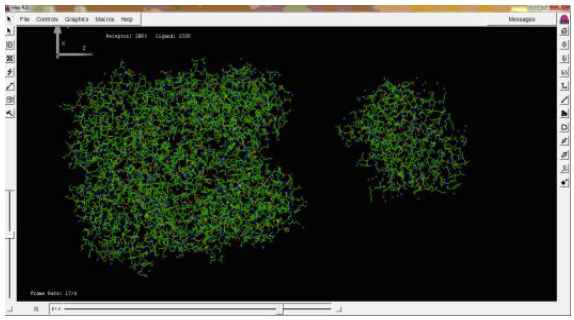


Figure 9: Receptor and the Ligand ready for docking

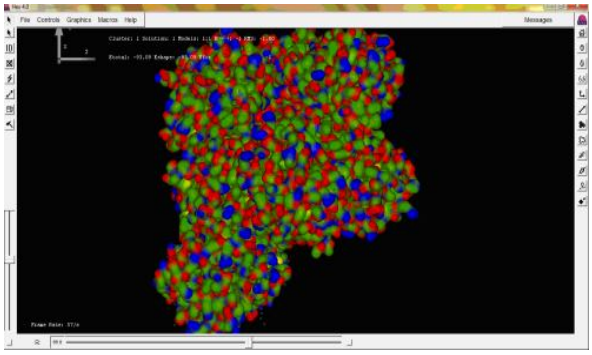


Figure 10: After docking the Receptor and the Ligand Methylnaphthalene

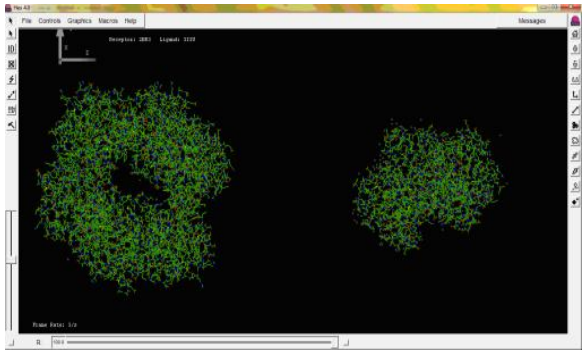


Figure 11: Before docking the Receptor and the Ligand Benzo-[a]-anthracene

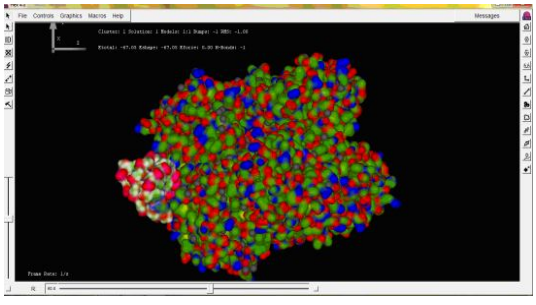


Figure 12: After docking the Receptor and the Ligand Benzo-[a]-anthracene

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SPECIAL ARTICLE

Information and Knowledge System through Village Resource Centre and Village Knowledge Centres in TamilNadu and Puducherry, India.

Jegan Karuppiah*and R.Rajakumar

M.S.Swaminathan Research Foundation, Taramani, Chennai, TamilNadu, India.

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***Address for correspondence**
Jegan Karuppiah
Scientist,IEC Division,
M.S.Swaminathan Research Foundation,
Taramani, Chennai,TamilNadu,India.
Email: jegan@mssrf.res.in.

ABSTRACT

Information is becoming increasingly important factor in the era of globalization. Access to information is uneven due to rapid development of technologies, poor awareness, social and economic conditions and a range of other factors. Increasing information divide among people, over a period of time, is likely to bring about economic and social divides and hence a potential source of tension in society. The M.S.Swaminathan Research Foundation (MSSRF) based in Chennai had undertaken pioneering work in this area by addressing the need for bridging the information divide among rural and urban areas and among various sections of rural society through a network of Village Knowledge Centres (VKCs). Each VKC is located in a village and mostly consist of a few computers, electronic display boards and other information and communication equipment strategically housed to enable easy access to large sections of rural society.The model developed by MSSRF has been quite successful and the idea has impressed policy makers in India and several developing countries. The Common Service Centres (CSCs) promoted by the Government of India is a well known example of adoption of the template developed by MSSRF. Several institutions and corporate houses have also made use of these models for pursuing some of their strategic and commercial objectives.

Keywords: VRC, VKC, NVA, MSSRF, Common Service Centers, Youth Entrepreneurship, Eco-Jobs, Rural Technology.

INTRODUCTION

This paper shares the 12 years experiences of M S Swaminathan Research Foundation's Information systems with the help of ICT through Village Resource Centres (VRCs) and Village Knowledge Centres (VKCs). M S Swaminathan Research Foundation initiated the VKC concept in 1992 and tested the filed in 1997. In 2003-2004, this programme was upgraded by forming ISRO-Village Resource Centres and Jamsetji Tata National Virtual Academy (NVA).This paper captures the journey of information system through VRC/VKC and suggestions based on the field experiences.

Information through VRC / VKC

Under the general theme "New Technologies: Reaching the Unreached, the M S Swaminathan Research Foundation has been organizing a series of annual inter-disciplinary dialogues on technology enabled rural development activities since 1990. Under this generic title, MSSRF held an Interdisciplinary Dialogue on Information Technology: Reaching the Unreached in January 1992 with the support of International Development Research Centre [IDRC], United Nations Development Programme [UNDP], Department of Space, Government of India, International Tropical Timber Organisation [ITTO] and the Council for Advancement of People's Action and Rural Technology [CAPART]. The dialogue revealed that the future of food security in the developing world, especially South Asia, would be less dependent on resource intensive agriculture and more on knowledge intensity. The conceptualization of the Village Knowledge Centre could thus be traced to the dialogue in 1992.The participants in the said dialogue suggested that the generic content received from Universities,National Informatics Centres (NIC) and Remote Sensing Agencies need to be more locale-specific and demand-driven. With the help of experts, these contents are translated into the vernacular written in an understandable manner based on the specific needs of the rural communities. This locale-specific, demand-driven content is then transmitted to block level knowledge centre, later called Village Resource Centres (VRCs).The Village Knowledge Centre receives this locale-specific demand-driven knowledge from block level knowledge center. This locale-specific knowledge is disseminated to the rural communities through different technologies**.**

Information and Knowledge System

From 1993 to 1996, MSSRF conducted a series of studies in about 25 villages in the Union Territory of Pondicherry and the state of Tamil Nadu. One of the studies was on estimating the reach and impact of electronic media in the rural areas. This revealed that the reach of electronic media especially television, was reasonably high despite the prevalence of poverty in the villages surveyed.

Another study revealed that farmers gather most of the information they need from the local shopkeeper, the market place, and the suppliers. Considerable amount of information exchange takes place among the rural poor households making it the primary mode of information dissemination among the villagers. MSSRF is convinced that Information and communication technologies could play a major role in environmentally sustainable rural development, not only in taking knowledge to the poor but also in helping them achieve poverty reduction through on-farm and non-farm eco-enterprises for income-generation, gender and social equities and boosting their self-confidence.

Based on the outcome of these surveys, MSSRF developed the concept of Information System for translating knowledge into action. This involves spell out different components of the Information system for different eco-farming systems (soil health care, water harvesting management, crop and pest management, energy management, post harvest management, crop and animal components of farming systems and, information, skill, organization, management and marketing empowerment) and different databases (eco-jobs, household entitlement database, self-employment, related to women and children).

Village Knowledge Centres (VKCs)

To set up the Information and Knowledge System for Sustainability with the generous support of IDRC and CIDA, started the Village Knowledge Centre programme in January 1998 at the Union Territory of Pondicherry (now Pondicherry) located on the east coast of South India. Six Village Knowledge Centres (VKC) were established over a period of three years.The villages chosen include inland agricultural, fishing and socially underprivileged communities' predominant villages (dalit - the former Untouchable caste at the bottom of the Indian social caste structure). Each VKC is linked with the Hub (Resource Centre) through Motorola VHF Radio in a two-way communication hub-and- spokes model (Figure.1)

Based on the VKC experience, MSSRF organized a concept and operational plan consultation for the launch of Jamsetji Tata National Virtual Academy for Rural Prosperity (NVA) on May 8, 2003. In this consultation, aspects such as role of data generators and providers (Universities, Research Stations, ISRO, IMD, NGOs, Financial Institutions, IGNOU, IMD, AIR, Doordarshan, Corporate Sector, Policy Makers), role of data managers (managing both content and connectivity) and the dissemination of locale specific demand driven content to the rural communities were discussed. This consultation led to the development of a user-controlled, user-owned and user-managed network, helping to reach the unreached and include the excluded in terms of information, knowledge and skill empowerment. On 23 August 2003, NVA was officially launched with the generous support of Sir Dorabji Tata Trust and the Tata Education Trust.ICT-enabled development activities of MSSRF are carried out under the umbrella of NVA.

ISRO-MSSRF Village Resource Centres (VRC)

In 2003, MSSRF partnership with the Indian Space Research Organization (ISRO) in connecting the existing VRCs to be able to transfer knowledge/information from one location to another location. ISRO and MSSRF, after several discussions, developed a Village Resource Centre programme. A year later, in 2004 VRC in Thiruvaiyaru, Sempatti and Thangachimadam were connected through a satellite. The aim was to test this programme in three different agro-ecological conditions - Delta, Hill and Coast.The Honorable Prime Minister of India Dr.Manmohan Singh inaugurated this programme through video conferencing on 18th October 2004. Mr. Prithviraj Chawan, Minister of State in the PMO and Mr T K A Madhavan Nair, Chairman of ISRO also participated in the inauguration. A live demonstration showing the interaction between the VRCs located at Thiruvaiyuru in Tanjavur District, Thankatchimadam in Ramanathapuram District and Sempatti in Dindigul District, MSSRF and Sri Ramachandra Medical College and Research Centre at Chennai was organized during the inaugural function.

All the MSSRF VRCs are connected through the Indian Space Research Organization's (ISRO) uplink and downlink satellite facilities. The satellite based ISRO-VRCs aims at digitally connecting remote villages and provides them with services like tele-medicine, tele-education, interactive farm and fishery advisories, government schemes and entitlements, weather services and remote sensing applications through a single window. Users located at any one node of this network can fully interact with others located at another node through video and audio links. Each node can be further expanded using other means such as notice boards, pamphlets, public address system, community newspaper, press releases, cable TV, and audio/video conferencing through wireless telephone, meetings, mobile phone and intranet web site for dissemination of useful and necessary information.

Recognition

The VRCs and VKCs programme received several recognitions based on the programme's tireless innovations in the area of Information system and ICT-enabled development activities as well as grassroots partners support.

Reaching the Unreached

The programme embraced the technologies and basic Information and communication system to supply useful information in order to improve quality of life. In 1999 Motorola Gold Dispatch Solution Award was given to VRCs and VKCs programmes for innovatively combining the use of information and communication technologies (particularly using full duplex wireless link with villages using Motorola Systems, GM300 mobile radios to six-satellite hubs ranging from 10 to 15 kilometers away) to promote sustainable agriculture and rural development.

CONCLUSION

The existing information and knowledge system of M.S.Swaminathan Research Foundation (VRC/VKC) is very appropriate for the rural communities especially to uplift their life and livelihood through the timely information including weather and market because number of beneficiaries got benefit in terms of high yield in their crops, high profit in their enterprises and Job opportunity etc.

ACKNOWLEDGEMENTS

I would like to express my immense gratitude to Prof..M S Swaminathan for his encouragement. I sincerely thank to our Executive Director Dr.Ajay Parida , Mrs. Nancy J Anabel Director,IEC and Dr. N.Parasuraman. I wish to thank my research supervisor Dr.Seeni Natarajan and also thank to all of our IEC Staff Members.

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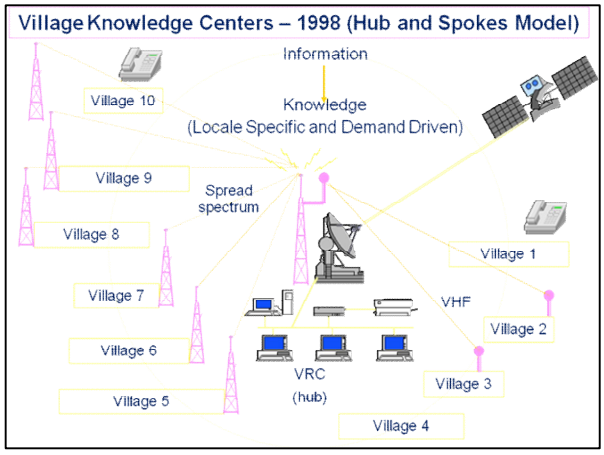

Figure1 : Hub and Spokes Model of VRC/VKC

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RESEARCH ARTICLE

Comparative Study on Effect of Inorganic, Organic and Inorganic with Organic Fertilizers on Anti-nutritional Content and Yield Parameters of Tapioca (*Manihot esculenta* Crantz.) and Soil Properties.

Manoharan. G, Krishna Moorthy.S and Malliga.P*

Department of Marine Biotechnology, National Facility for Marine Cyanobacteria, Bharathidasan University, Tiruchirappalli - 620 024, Tamilnadu, India.

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***Address for correspondence**
Malliga.P
Professor, Department of Marine Biotechnology,
National Facility for Marine Cyanobacteria,
Bharathidasan University, Tiruchirappalli - 620 024,
TamilNadu, India.
E.mail: malli62@yahoo.com

ABSTRACT

Cyanobacteria are microorganims and it can be found in almost every terrestrial and aquatic habitat oceans, fresh water. They are gram negative, filamentous or unicellular and can manufacture their own food. Coir pith is a highly lignocellulosic waste, dumped in huge piles on roadside in an increasing proportion, considered creating environmental pollution problem because of its high lignin content, and slow degradation in natural environment. Cyanobacterium (*Oscillatoria annae*) acts unique for the fast degradation of coir pith. The solid portion of degraded products of coir pith by using cyanobacterium is called cyanopith and liquid portion obtained from the degradation process is called cyanospray.These fertilizers combined with *Azolla* and used as organic fertilizers for the growth of cassava. Azolla is freshwater fern which has symbiotic relationship with nitrogen fixing blue green algae *Anabaena azollae*. In inorganic farming of cassava cultivation, the recommended doses of Nitrogen (N), Phosphorus (P) and Potassium (K) were applied. This present study mainly focused on the effect of inorganic, organic fertilizers and combination both inorganic and organic fertilizers on anti-nutritional content such as phytate, tannin and toxic cyanide content of cassava tubers of three experimental fields such as Perambalur, Thuraiyur and Mannachanallur. This study also investigated the yield parameters such as number of tubers/plant and weight of tubers/100plants and analyzed the microbial populations (bacteria and fungi) of soil collected from the experimental fields. The anti-nutritional content such as phytate, tannin and toxic cyanogen were decreased in the cassava tubers treated with organic fertilizers in all

thethree experimental fields.The yield parameters and soil microbial populations were improved by organic fertilizers when compared to inorganic and combined farming of inorganic and organic fertilizers.

Keywords: Cyanobacterium , Organic fertilizer, cyanopith, cyanospray, cyanogens, cassava, *Azolla.*

INTRODUCTION

Cassava (*Manihot esculenta*) is the staple food of tropical and sub-tropical areas in India. It is a drought tolerant energy-storing root or tuber crop [1].Cassava (*Manihot esculenta* Crantz) had been introduced into India by Portuguese merchants in the 17th century, and has since become a popular root crop. It is commonly known as tapioca in India. The crop has historical and sentimental value in Kerala state and the King Visakham Thirunal, who was responsible for introducing the crop in India.Furthermore, this crop has saved many lives during an acute famine that gripped the state in the early part of the 20th century.The popularity of the crop later spread to neighboring states; however, not as a food crop but as a crop of industrial significance [18].

Soil fertility maintenance is very essential in achieving and maintaining high crop yields over a period of time. Mineral fertilizers often lead to a decrease in soil organic matter content and increased soil erosion [8]. It also results in soil physical degradation; increased soil acidity level and soil nutrient imbalance [20]. A reduced dependence on chemical fertilizer has been advocated [33]. Organic manure when efficiently and effectively used ensures sustainable crop productivity by immobilizing nutrients that are susceptible to leaching [1].Nutrients contained in organic manures are released more slowly and are stored for a longer time in the soil, thereby ensuring a long residual effect [35], supporting better root development, leading to higher crop yields [2].

Improvements of environmental conditions as well as the need to reduce costs of fertilizing crops are also important reasons for advocating increased use of organic materials [5]. They improve the soil fertility status by activating the soil microbial biomass [4]. They are required in rather large quantities to meet up with crops' nutrient supply. Application of organic manures sustains cropping system through better nutrient recycling [10]. They play a direct role in plant growth as available forms during mineralization, thereby improving both the physical and the biological properties of the soil [1].Organic manures decompose to give humus which plays an important role in the chemical behavior of several metals in soils through the flavonic and humic acid contents, which have the ability to retain the metals in complex and chelate forms [1].Organic manures also improve the water holding capacity of the soil; improve the soil structure and the soil aeration [6]. Hence, this study mainly focused on the effect of inorganic, organic fertilizers and combination both inorganic and organic fertilizers on anti-nutritional content such as phytate, tannin and toxic cyanide content of cassava plant tubers cultivated under three different experimental fields such as Perambalur, Thuraiyur and Mannachanallur.

MATERIALS AND METHODS

Preparation of organic fertilizers

The organic fertilizers such as cyanopith and cyanospray [26], and Azolla [19] was cultivated at mass level and applied to the fields in the ratio of 1:1.

Experimental Design

In this field experiment the experimental plant *Manihot esculenta* Crantz was cultivated using Inorganic fertilizers, organic fertilizers and inorganic with organic fertilizers under three totally different fields such as Perambalur, Thuraiyur and Mannachanallur in TamilNadu, India. The recommended doses of Nitrogen (N), Phosphorus (P) and Potassium (K) were as used as inorganic fertilizers. The fertilizers such as cyanopith with *Azolla* (1:1) as basal and cyanospray as foliar was applied as organic fertilizers.The filed plants were irrigated whenever necessary. In this field experiment the fertilizers were applied three times before harvesting. The amount of fertilizers were applied as follows, Inorganic fertilizers 300 kg/acre (NPK); organic fertilizers 1 tone/acre (cyanopith and Azolla fertilizer, 1:1) and combined fertilizers: inorganic 150 kg/acre (NPK) and organic 500kg/acre (organic manure).

Analysis on anti-nutrition and cyanogen content of cassava tubers

Phytate

Phytate content cassava tuber was determined based on the method of Latta and Eskin [24]

Tannin

Tannin content was determined by the method of Van Burden and Robinson [40].

Determination of cyanogen

Determination of cyanogen by Spectrophotometer [29]

Analysis on yield parameters

The tuber from the experimental plant of *M. esculenta* was harvested after 10 months of plantation and the yield parameters such as number of tubers/plant and weight of tubers/100plants was analyzed.

Soil microbial analysis

Inorganic, organic and inorganic with organic fertilizer applied field soil samples were collected the top 20 cm layer of the soil profile and around root systems of the experimental crop respectively. In each experimental field, three different soil samples soil samples from 10 locations randomly selected plants were collected, pooled together and mixed thoroughly. The soil samples of inorganic, organic and inorganic with organic fields were stored separately at 4^{o}C. The soils were sieved through a 2mm sieve, moistened to 60% of water holding capacity and incubated at 30^{o}C for 10 days to permit uniform rewetting and to allow microbial activity to equilibrate after the initial disturbances. Then soil samples were used for the analysis of bacterial and fungal populations using standard procedure [12].

Statistical analysis

One way analysis of variance (ANOVA) was used to assess the significance ($p = 0.01$) of the mean values of treatments and the differences were compared using SPSS, Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

In this field experiment, the treatment of inorganic fertilizers (N, P, K), Organic fertilizers (Cyanopith and *Azolla* (1:1), Cyanospray) and combined treatment of inorganic and organic fertilizers showed significant improvement in the reduction of anti-nutritional content and increased yield parameters of the experimental plant *M. esculenta* Crantz in all the experimental sites.

Anti-nutritional and cyanogen content of cassava tubers

The cyanogen and anti-nutritional content such as phytate and tannin showed decreased in the tubers of cassava (*Manihot esculenta* Crantz) plants treated with organic fertilizers such as cyanopith and *Azolla* in the ratio of 1:1 and cyanospray as foliar application in all the three experimental sites, while the other inorganic fertilizers (NPK 300 kg) and inorganic with organic fertilizers (NPK and organic manure) applied field plants tuber contained increased level (Table-1). The results are well supported by Susan *et al.* (2005) [39] who reported that application of crop residues decreased the cyanogen content of cassava tubers. Similarly phytate content decreased as nitrogen level increased from moderate to high [17].

Yield analysis

The application of inorganic fertilizers, organic fertilizers and combined application of inorganic fertilizers with organic manures on yield of *M. esculenta* were analyzed based on the number of tubers/plant and weight of tubers/100plants. Table - 2 showed the effect of inorganic fertilizers, organic fertilizers and combined application of inorganic fertilizers with organic manures on yield of *M. esculenta* under field conditions. The application of organic fertilizers such as cyanopith, cyanospray and *Azolla* significantly increased the number of tubers and weight of tubers yield of the experimental plants of *M. esculenta* in all the experimental sites (Perambalur, Thuraiyur and Mannachanallur) when compared to inorganic fertilizers and combined fertilizers applied field plants. The highest yield (6tubers/plant and 586kg/100plants) was obtained from the organic field of Permbalur followed by organic filed of Mannachanallur and Thuraiyur. Arshad Javaid [3] study in the combined fertilizers study have suggested that the two fertilizers such as Biopower and EM (Effective Microorganisms) and green manure clearly enhanced shoot biomass and grain yield in green manure amended soils. These results are in accordance with the results obtained by Ramamurthy *et al*. (1995)[31] and Mallikarjuna *et al*. (2000)[27] in sunflower.

The present results were also supported by the findings of Somasundaram *et al*. (2007) [36] who revealed that higher yield of sunflower was recorded under Biogas slurry with Panchagavya. The economic analysis showed that, BGS with Panchagavya was commercially viable since it registered the highest net return than recommended dose of fertilizers and foliar sprays over years. Similarly Subramniayan (2013)[38] and Krishna Moorthy (2013)[22] reported that the application of organic fertilizers such as cyanopith and cyanospray increased the yield of the experimental plants.

Soil analysis

Soil is the habitat of a diverse array of organisms which include both micro flora and fauna. Soil microorganisms and other fauna influence the availability of nutrients for crop growth by decomposing soil organic matter and releasing or immobilizing plant nutrients. Biological activity improves soil aggregation through the secretion of soil binding mucilage and hyphal growth. Improved aggregation, in turn increases water infiltration and the ease of plant root penetration. Soil biological activity is considered as an integral attribute of a healthy soil.

The field soil applied with organic fertilizers such as cyanopith, cyanospray and Azolla showed improved diversity and increased number of both bacterial and fungal colonies (Table. 3 and 4) when compared to that of inorganic

fertilizers and inorganic with organic manures applied field soil. This result revealed a remarkable diversity of microorganisms in organic fertilizer received soil. The reason might be that the soil nourished with organic matter provided an important habitat for microorganisms. Havlin *et al*. 2005 [15] reported that an increase in soil acidity could be attributed to the release of H during nitrification of any added ammonium fertilizer. Additions of organic matter (such as filter cake) to soil can reduce the effects of soil acidity and particularly, Al toxicity [14, 41].

Chellemi and George Lazarovits [7] reported that the application of organic manures like poultry manure, meat and bone meal not only increased the microbial biomass (both bacterial and fungal) in the soil but also inhibited the causative agent of Southern Blight (Sclerotium rolfsii) in tomato and reported that it might be due to the addition of N containing amendments which had stimulated the population of antibiotic producing organisms associated with the sclerotia.The field soil applied with organic biofertilizers such as jiwamrita, cyanospray and cyanopith showed increased number of both bacterial and fungal when compared to that of inorganic fertilizers applied field soil. This result revealed a remarkable diversity of microorganisms in organic fertilizer received soil. The reason might be that the soil nourished with organic matter (coir pith based cyanobacterial fertilizer) provided an important habitat for microorganisms [9].

Fouzia and Amir [11] isolated higher bacterial (554) and fungal (93) colonies from organic field nourished with cow dung, ashes, mulches in comparison with inorganic field (309 bacterial and 36 fungal colonies). Similarly, Krishna Moorthy, [22] reported that the application of organic biofertilizers such as cyanopith and cyanospray enhanced the microbial population of soil.Kannan *et al*. (2005)[21] reported the highest bacterial and fungal population associated with the application of vermicompost as N (75%) with Azospirillum which had been five times higher than 100 % urea received plots. This might be attributed to the organic biofertilizer containing higher amount of growth promoting substances, vitamins, and enzymes, which in turn increased the microbial population and increased the root biomass production, resulted in higher production of root exudates increasing the beneficial bacteria, fungi and actinomycetes population in rhizosphere region [13,28]

Xu and Zhang [42] studied the effect of insecticide methamidophos on soil microorganisms in cotton field soil ecosystem. They found that the insecticide exerted some effects on soil microbial activities such as the population of soil microorganisms, soil respiration, dehydrogenase activity and nitrogen fixation in cotton. They reported that soil microbial activity was slightly affected by single application at the dose of 5.0 μg/g and 10 μg/g and showed serious inhibition of dehydrogenase activity.

Lin *et al*. (2010)[25] reported that the application of poultry manure had a positive impact on yield of peanut, microbial biomass in the soil and physico-chemical texture of soil when compared to that of control and organic compound fertilizer of monosodium glutamate. Hole *et al*. (2005)[16] reviewed 76 surveys comparing the biodiversity impact of organic and conventional agricultural practices and concluded that the higher bacterial and fungal abundance and activity were found under organic system than conventional agricultural practices.

CONCLUSION

Based on the above findings, the present study concluded that the application of organic fertilizers such as cyanospray 0.3%, cyanopith and *Azolla* (1 : 1) showed very good results on the field cultivation of *M. esculenta* and also enhanced the soil microbial populations especially bacteria and fungi over inorganic fertilizers and combined fertilizers applications, and is therefore, the present study suggested that the application of organic fertilizers cyanospray, cyanopith and *Azolla* was the most effective method for the field cultivation of *M. esculenta* Crantz.

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Table-1.Effect of inorganic, organic and inorganic with organic fertilizers on Cyanogen and anti-nutritional content of *M. esculenta*

Parameters	Perambalur			Thuraiyur			Mannachanallur		
	I	O	I+O	I	O	I+O	I	O	I+O
Cyanogen (ppm)	**0.399** ± 0.005	**0.344** ± 0.005	**0.362** ± 0.005	**0.391** ± 0.005	**0.342** ± 0.005	**0.344** ± 0.005	**0.398** ± 0.005	**0.361** ± 0.005	**0.361** ± 0.005
Phytate (ppm)	**0.403** ± 0.010	**0.317** ± 0.002	**0.375** ± 0.003	**0.405** ± 0.010	**0.316** ± 0.002	**0.376** ± 0.005	**0.402** ± 0.011	**0.316** ± 0.002	**0.374** ± 0.005
Tannin (ppm)	**1.255** ± 0.005	**0.815**± 0.001	**0.855** ± 0.001	**1.252** ± 0.005	**0.813** ± 0.001	**0.858** ± 0.001	**1.254** ± 0.005	**0.813** ± 0.001	**0.859** ± 0.001

Values are the mean of three replicates ± SD.

Table- 2. Effect of inorganic, organic and inorganic with organic fertilizers on Yield analysis of *M. esculenta.*

Parameters	Perambalur			Thuraiyur			Mannachanallur		
	I	O	I+O	I	O	I+O	I	O	I+O
Number of tubers	4 ±1	6±1	5±1	5±1	6±1	5±1	3±1	5±1	4±1
Weight of tubers/100 plant (kg)	480±7	586±5	510±6	353±6	482±5	394±5	460±7	568±6	495±5

Values are the mean of three replicates ± SD.
I – Inorganic fertilizers; O – Organic fertilizers; I + O – Inorganic with Organic fertilizer

Table-3. Effect of inorganic, organic and inorganic with organic fertilizers on soil bacterial Populations

Samples	Total count (CFU) /g		
	Bacterial colonies		
	P	T	M
Inorganic field soil	229 x 10^4	174 x10^4	218 x 10^4
Organic field soil	360 x 10^4	406 x10^4	409 x 10^4
Inorganic with Organic field soil	260 x 10^4	246 x 10^4	305 x 10^4

Values are the mean of three replicates ± SD.

Table-4. Effect of inorganic, organic and inorganic with organic fertilizers on soil fungal Populations

Samples	Total count (CFU) /g		
	Fungal colonies		
	P	**T**	**M**
Inorganic oil	55 x10^3	56 x 10^3	59 x 10^3
Organic soil	91 x 10^3	63 x 10^3	72 x 10^3
Inorganic with Organic soil	66 x 10^3	58 x 10^3	62 x 10^3

Values are the mean of three replicates ± SD.

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RESEARCH ARTICLE

Phytochemical Screening , Functional Group and Elemental Analysis of *Crossandra infundibuliformis* (L.) Nees. Flower Extract.

Jency S[1*], Jeya Sundara Sharmila D[1] and Patrick Gomez M[2]

[1]Department of Bioinformatics, Karunya University, Coimbatore, TamilNadu-641114,India

[2]School of Biotechnology and Health Sciences,Karunya University,Coimbatore, TamilNadu-641114, India.

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***Address for correspondence**
Jency S,
Department of Bioinformatics,
Karunya University,
Coimbatore, TamilNadu-641114, India.
E.mail: jencysam22@gmail.com.

ABSTRACT

Plants are a great source for novel drug compounds and medicines derived from plants have made large contributions to human health and well being.*Crossandra infundibuliformis* belonging to the family Acanthaceae, is well known for its medicinal properties in various region of India and Srilanka. From the pharmacological screening of *C.infundibuliformis* leaf, it is understood to have the activities such as hepatoprotective, antibacterial, antifungal, anticandidal and larvicidal activity. Its flower part is used in various conditions like fever, headache, aperitif, pain and wound healing. Aim of this study is to evaluate the phytochemical constituents, minerals and the functional groups present in *Crossandra infundibuliformis* flower extract. A preliminary qualitative phytochemicals screening was performed and the presence of flavonoids, glycosides, terpenoids, Tannins was recorded. The minerals present in the plant sample were detected using SEM-EDX and minerals such as Al, Si, K,Cl were present. FTIR analysis indicated the presence of various functional groups such as alkyl halides, alcohol, phenol, carboxylic acid, aldehydes, ester and ether in *C.infundibuliformis* flower extract. In future, the bioactive principle could be isolated, purified from this plant, and its structure could be elucidated for drug development.

Keywords: *Crossandra infundibuliformis*, phytochemical analysis, flavonoids, minerals, EDX, functional group, FTIR.

INTRODUCTION

Plants are a great source for novel drug compounds and medicines derived from plants have made large contributions to human health and well being [4].Medicinal plants represent a rich source of antimicrobial agents and are serve as rich source of potent and powerful drugs [1].*Crossandra infundibuliformis* belonging to family Acanthaceae is a well known medicinal plant in various regions of India.This plant is one of the most chosen variety for folk medicine. Flower extract is used in various conditions like fever, headache, aperitif, pain and wound healing [3]. From the pharmacological screening of *C.infundibuliformis* leaf extract it was reported to have the antioxidant, antibacterial [6], hepatoprotective, antifungal, anticandidal activities and larvicidal activity [2].

MATERIALS AND METHODS

Plant Collection

The flowers of the plant were collected from local market, Salem District, Tamil Nadu, India. The plant sample was identified and authenticated as *Crossandra infundibuliformis* belonging to the family Acanthaceae at the Botanical Survey of India, Coimbatore, India (No: BSI/SC/5/23/2013-14/Tech./705).

Extraction

The flowers of *Crossandra infundibuliformis* were washed in clean water, shade-dried for 10 days, and finely powdered using grinding machine. 30 grams of the flower powder was extracted sequentially with 150ml (each) of the solvent in the order petroleum ether, chloroform, ethyl acetate, methanol and aqueous by cold percolation method.

Phytochemical analysis

Test for Saponins

1ml of extract was diluted with 5 ml of distilled water and it was agitated for 10 minutes. Formation of foam showed the presence of saponins.

Test for Tannins

To 2 ml of the extract, a few drops of 1% ferric chloride were added. Green color formationindicated the presence of tannins.

Test for Alkaloids

Drangendroff's test

2 ml of the extract was added to 2 ml of dilute HCl. To this solution, 1ml of Drangendroff's reagent was added. An orange or red precipitate produced immediately indicates the presence of alkaloids.

Mayer's test

A few drops of Mayer's reagent were added to 2ml of the extract. Formation of pale yellow precipitate indicated the presence of alkaloids.

Test for Flavonoids

To one ml of the extract, a few drops of dilute sodium hydroxide were added. An intense yellow colour was produced in the plant extract, which became colourless on addition of a few drops of dilute acid indicating the presence of flavonoids.

Test for Triterpenoids

Ten mg of the extract was dissolved in 1 ml of chloroform to which 1 ml of acetic anhydride was added following the addition of 2 ml of concentrated sulphuric acid. Formation of reddish violet colour indicated the presence of triterpenoids.

Test for Steroids (Salkowski reaction)

10 mg of the extract was dissolved in 2 ml of chloroform. Sulphuric acid was carefully added to form a low layer. A reddish brown colour at the interface indicated the presence of steroids.

Test for Anthraquinones

2 ml of the extract was hydrolyzed with concentrated sulphuric acid and 1ml of dilute ammonia was added. Appearance of rose pink colour was the positive response for the presence of anthraquinones.

Test for Glycosides (Keller Killiani test)

10 mg of extract was dissolved in 1 ml of glacial acetic acid containing one drop of ferric chloride solution. This was under layered with 1 ml of concentrated sulphuric acid. A brown ring obtained indicated the presence of glycosides [5].

FTIR spectrum analysis

The sample was measured by Shimadzu 8400s spectrometer and using the spectral range of 4000-400 cm^{-1} with resolution of 4 cm^{-1}. The FTIR spectral analysis was performed to study the functional groups present in the sample.

EDX analysis

The flower powder was subjected to the elemental analysis using Scanning Electron Microscope (SEM) with an energy dispersive x-ray spectrometer (EDX).

RESULTS

Phytochemical Screening of Plant Extract

The results of the phytochemical analysis of *Crossandra infundibuliformis* flower extract is given in Table 1. The major phytoconstituents such as flavonoids, glycosides, alkaloid, saponins, steroids, terpenoids and tannins are present in the *C. Infundibuliformis* flower extract. Among the extracts used, methanolic extract had the presence of maximum number of phytocompounds.

FTIR spectral analysis

An FTIR spectrum of the sample was measured by Shimadzu 8400s spectrometer using the spectral range of 4000-400 cm^{-1} with resolution of 4 cm^{-1} with KBr pellets.The sample for FTIR was prepared similar to that of the diffraction studies and the spectral analysis helps to know about the functional groups present in the sample.Figure 1 represents the FTIR spectrum of the plant sample showing prominent absorption band at 3414cm^{-1},2926cm^{-1},1734cm^{-1},1625 cm^{-1}, 1047 cm^{-1}, 671 cm^{-1}. The peak at 3414cm^{-1} is characteristic representation of alcohol, phenol functional groups with O – H stretch. The peak value 2926cm^{-1} indicates the presence of CH stretch.The band between 3000 and 2800 cm^{-1} represent C-H stretch vibrations that are mainly generated by lipids. The spectral value 1734 cm^{-1} corresponds to carboxylic acid, aldehydes with C=H stretch. The peak at 1625 cm^{-1} represents C=C stretch belonging to alkenyl group. The band at 1047 cm^{-1} is assigned to C-O stretch and represents the functional groups esters and ether. Peak value 671 cm^{-1} indicates C-Br stretch and represents alkyl halides.

EDX results

Table 2 shows the results of elemental composition of *Crossandra infundibuliformis* flower powder using SEM-EDX technique. Peak representation of the sample is shown in figure2. SiO2, Al2O3, KCl, MAD-10 Feldspar were used as standards for this analysis. EDX spectra of the sample indicate the presence of elements such as Potassium, Chlorine, Silicon, Aluminium and Oxygen. Among the elements present Oxygen and Chlorine are in high concentration while K is present in moderate amount.Silicon and Aluminium are present in trace amount.

DISCUSSION

Plants have provided a source of inspiration for novel drug compounds.Phytochemical investigation of various solvent extracts of *C.infundibuliformis* flower revealed the presence of major phytochemicals such as flavonoids, glycosides, alkaloids, saponins, tannins, steriods and terpenoids. These phytocompounds display a remarkable spectrum of biological activities which are antiallergic, anti-inflammatory, antioxidant, antimutagenic and anticarcinogenic [7].The presence of glycosides is associated with their use in the treatment of cough, fever, cold and venereal diseases. Hence phytochemicals screening serve as the initial step in predicting the types of potential active compounds. FTIR is most widely used technique to identify the functional groups present in the sample. This technique allows detecting the whole range infrared spectrum in measuring of biological specimen. FTIR spectral analysis indicated the presence of functional groups aldehydes, carboxylic acids, esters, ethers, alkyl halide, alkane and amines in the *C.infundibuliformis* flower sample.

In the present study, EDX result showed the presence of minerals such as Si, Al, K along with Cl and O in the *C.infundibuliformis* flower powder. Minerals play both curative and preventive role in combating diseases. Over a period of years, scientists believe in the therapeutic role of metals in human health. Hence from this preliminary study it is evident that *C.infundibuliformis* would serve as an important medicinal plant in development of drugs for various ailments. Hence from this study it is very clear that the plant *C.infundibuliformis* flower part possess important phytoconstituents, minerals and major functional groups that make it possible to be used as medicinal plant for treating various diseases. Further, the bioactive principle could be isolated and purified from this plant; its structure could be elucidated and used in future drug development.

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Table 1: Phytochemical Screening of *Crossandra infundibuliformis* flower extract

Phytochemical tests	**Solvents**				
	PET ether	Chloroform	Ethyl acetate	Methanol	Aquous
Alkaloid-Mayer's	-	+	-	+	+
Alkaloid-Dragendroff's	-	+	-	+	+
Terpenoids	+	+	+	+	-
Anthraquinone	-	-	-	-	-
Cardiac glycosides	+	-	-	+	+
Flavonoids	-	+	+	+	+
Tannins	-	-	+	+	+
Saponins	-	-	-	+	+
Steroids	-	-	+	+	+

Table 2: Percentage of trace element present in *Crossandra infundibuliformis* flower powder

Element	**App Conc.**	**Intensity Corrn.**	**Weight %**	**Weight % Sigma**	**Atomic %**
O	21.13	0.9256	76.09	1.00	87.53
Al	0.48	0.7614	2.10	0.42	1.43
Si	0.87	0.8397	3.44	0.46	2.26
Cl	0.69	0.8235	2.79	0.43	1.45
K	4.89	1.0473	15.57	0.71	7.33
Total	100.00				

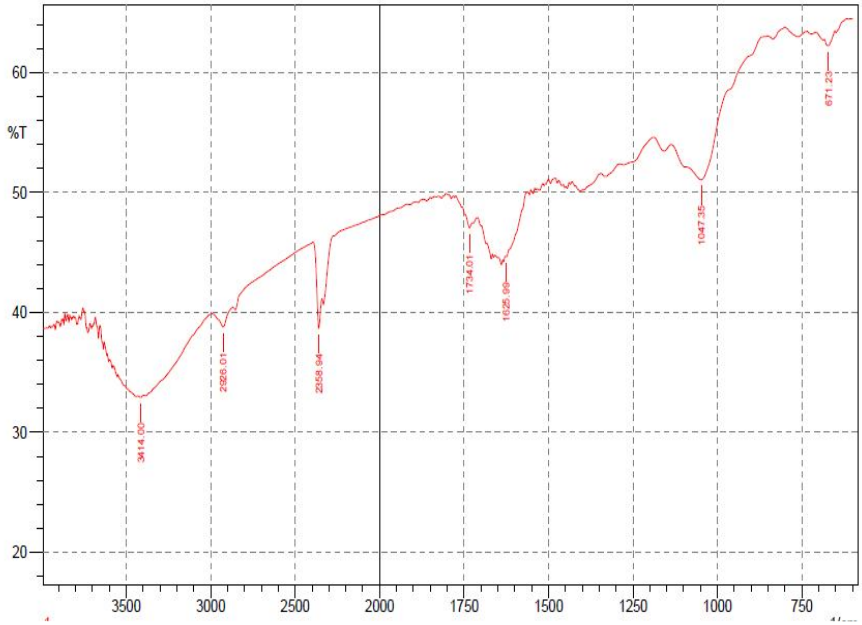

Figure 1 : FTIR Spectrum analysis of *Crossandra infundibuliformis* flower extract

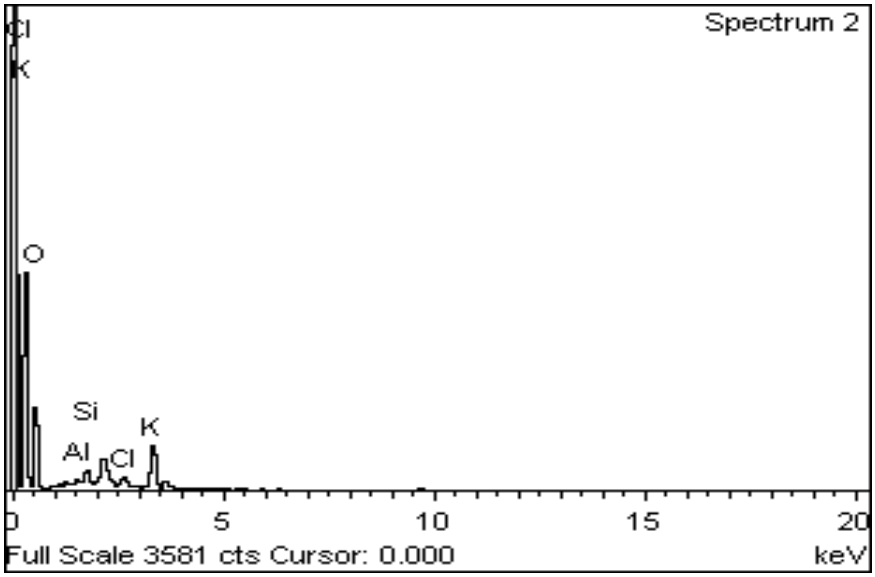

Figure 2: Elemental analysis of *Crossandra infundibuliformis* by EDAX

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2. Volume with supplement: Shen HM, Zhang QF. Risk assessment of nickel carcinogenicity and occupational lung cancer. Environ Health Perspect 1994; 102 Suppl 1:275-82.
3. Issue with supplement: Payne DK, Sullivan MD, Massie MJ. Women's psychological reactions to breast cancer. Semin Oncol 1996;23(1, Suppl 2):89-97.

Books and other Monographs

4. Personal author(s): Ringsven MK, Bond D. Gerontology and leadership skills for nurses. 2nd ed. Albany (NY): Delmar Publishers; 1996.
5. Editor(s), compiler(s) as author: Norman IJ, Redfern SJ, editors. Mental health care for elderly people. New York: Churchill Livingstone; 1996.
6. Chapter in a book: Phillips SJ, Whisnant JP. Hypertension and stroke. In: Laragh JH, Brenner BM, editors. Hypertension: pathophysiology, diagnosis, and management. 2nd ed. New York: Raven Press; 1995. p. 465-78.

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