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Comparative Studies and Elemental Analysis of Fertilizer Effected Medicinal Plant Samples Using Sem-Eds

SP Kiran Kumari [1], V Sridevi [*2], MVV Chandana Lakshmi [2] and M Manasa[1]

[1] M.Tech, Centre for Biotechnology, Department of Chemical Engineering, Andhra University, Visakhapatnam-03, Andhra Pradesh, India.
[2] Associate Professor, Centre for Biotechnology, Department of Chemical Engineering, Andhra University, Visakhapatnam-03, Andhra Pradesh, India.

ABSTRACT

Ayurveda and kabiraji are two important forms of alternative medicine that is widely available in India. India is one of the world's 12 biodiversity centers with the presence of over 45000 different medicinal plant species. According to World health Organization (WHO), medicinal plants are an accessible, affordable and culturally appropriate source of primary health care for more than 80% of Asia's population. This made our study to aim and explore the possibility of medicinal plant cultivation as a sustainable livelihood option. The present study includes the cultivation of four different medicinal plants under the influence of inorganic, organic and combined effect of both inorganic and organic fertilizer which may help us to choose the best fertilizer for the cultivation of large amount of these medicinal plants. This phenomenon was studied by using SEM –EDS, sophisticated equipment which helps to give morphological and elemental analysis data. By using the generated data comparative studies were done between all the four cases of study.

Keywords: Ayurveda, Medicinal plants, Fertilizers, Morphology, Elemental analysis, SEM-EDS.

Corresponding author

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INTRODUCTION

A medicinal plant [1] is defined as one, which contains substance that can be used for therapeutic purposes and its precursor for the synthesis of useful drugs. Medicinal plants are richest resources of drugs of traditional system of medicine, modern medicines, nutraceticals, food supplements, folk medicines, pharmaceuticals intermediates and chemical entities for the synthetic drugs [2]. The use of plants and plant products as medicines could be traced as far back as the beginning of human civilization [3]. Medicinal plants are a source of great economic value all over the world. Over three-quarters of the world population relies mainly on plants and plant extracts for health care. More than 30% of the entire plant species are used for medicinal purposes. It is estimated that world market for plant derived drugs may account for about Rs.2, 00,000 crores. It has been estimated that in developed countries such as United States, plant drugs constitute as much as 25% of the total drugs, while in fast developing countries such as china and India, the contribution is as much as 80%.

Because of these valuable properties medicinal plants became our main scope of investigation. All know that agriculture in India has a significant history. Today, India ranks second worldwide farm output. The economic contribution of agriculture to India's GDP is steadily declining with the country's broad-based economic growth. Still, agriculture is demographically the broadest economic sector and plays a significant role in overall socio-economic fabric of India. By the increase in cultivation of medicinal plants, there may be a hike in the economy levels of government and farmers, because day by day the dependence of international market on medicinal plants for treating various diseases is increasing.

Four different medicinal plants *Azadirachta indica*, *Cassia fistula*, *Catharanthus roseus*, *Aloe barbadensis*, *Ocimum sanctum* were selected for our research investigation due to the respective properties which are mentioned in Table 1. Besides these properties, there is various traditional applications of these plants from ancient times. Now a days these plants have a lot of significance in pharmacological applications and derivatives.

These four plants were grown for 60 days under the effect of fertilizers. Four plants of each variety were cultivated among these plants one plant act as a control and remaining three were grown under the effect of inorganic, organic and combinational effect of fertilizer. The main theme of the research work is to sort out the best suitable fertilizer for the growth of respective medicinal plants of our choice by using SEM- EDS.

MATERIALS AND METHODS

Plants cultivation

These plants were grown for 60 days under the specialized effect of fertilizers later the results were determined by the morphological study and elemental analysis.

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Table 1. Various uses of selected medicinal plants

S.No	Medicinal uses of plants under investigation			
	Botanical Name	**Family**	**Traditionally use**	**Modern uses**
1	*Azadirachta indica*	Meliaceae	Anti-desertification properties.	Used as anthelmintic, antifungal, anti-diabetic, antibacterial, antiviral, contraceptive and sedative
2	*Cassia fistula*	Fabaceae	In Ayurvedic medicine, golden shower tree is known as *aragvadha*, meaning "disease killer".	Derivatives of 1,8-dihydroxyanthraquinone is found .Fabaceae are a source of potent entheogens and other psychoactive compounds
3	*Catharanthus roseus*	Apocynaceae	Decoction of young leaves used for stomach cramps.	Used for deriving anti-cancer drugs, vincristine and vinblastine.
4	*Aloe barbadensis*	Xanthorrhoeaceae	It also improves human immune system and digestive system.	Aloe vera works as Anti-septic, Antibacterial, and Anti infla-mmatory. It cures Eczema, Diabetes,Arthritis and Prevent infections.
5	*Ocimum sanctum*	Lamiaceae	The leaves are a nerve tonic and also sharpen memory. Chewing tulsi leaves relieves cold and flu. Basil juice is beneficial in the treatment of ringworm and other skin diseases.	Tulasi promotes optimum respiratory support. It has anti-microbial, anti-inflammatory, expectorant properties and is useful in respiratory tract infections. It also helps during respiratory stress.

Figure 1. Various fertilizers used in the investigation work

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Processing of plant samples

The leaves of the experimental subjected plants were collected and properly washed under tap water. Later these samples again washed with distilled water. The rinsed leaves are dried in oven at a temperature of 40-45°C for 72 hrs. The dried leaves of each plant are pulverized using a mortar and pestle, to obtain a powdered form. The powdered form of these plants is stored in airtight glass containers, protected from sunlight until required for analysis [4]. These samples are used for the SEM-EDS (Scanning Electron Microscope-Energy dispersive spectrometer) analysis [5].

SEM-EDS

The scanning electron microscope (SEM) uses a focused beam of high-energy electrons to generate a variety of signals at the surface of solid specimens. The signals that derive from electron-sample interactions reveal information about the sample including external morphology (texture), chemical composition, and crystalline structure and orientation of materials making up the sample. The SEM is also capable of performing analyses of selected point's locations on the sample, this approach is especially useful in qualitatively or semi-qualitatively determining chemical compositions using EDS.

Energy dispersive X-ray spectrometry is a popular method for the determination of trace elements in geological and environmental samples. With the morphological characters obtained from SEM are supported by Energy dispersive X-ray (EDS) micro analysis device, which makes possible to identify many elements present in it [5].

Procedure of SEM-EDS

The microphotographs were recorded using SEM- JEOL model, JSM-6610LV and EDS-Oxford INCA with an accelerating voltage of 20 KeV, at high vaccum (HV) mode. This is technique is being used in numerous applications for the environmental science and technology [6]. By loading the samples on the loading disk both the morphological and elemental analysis can be done simultaneously by using SEM-EDS. The weight percentage of the elements in all sample locations with respect to their control samples were recorded and noted down.

Figure 2. SEM-EDS equipment used in this research work

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RESULTS AND DISCUSSION

SEM samples photographs of all the five medicinal plants were recorded and compared with the control plant sample. From the investigation work it was found that control and the organic. Fertilizer effected medicinal plants morphological appearance was similar when compared to other fertilizers effect.

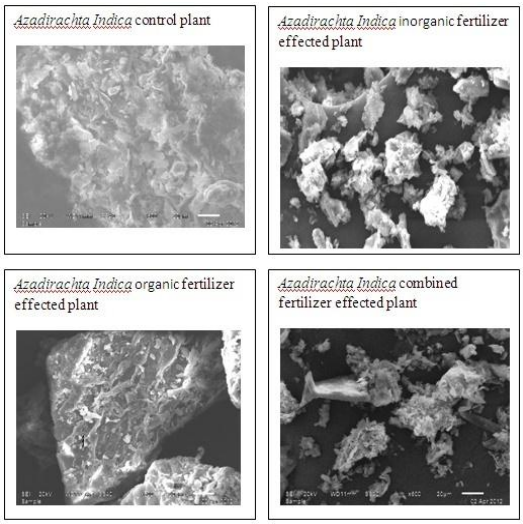

Figure 3. SEM image of *Azadirachta indica* in four different conditions of Control, Inorganic, Organic, Combined fertilizers effect.

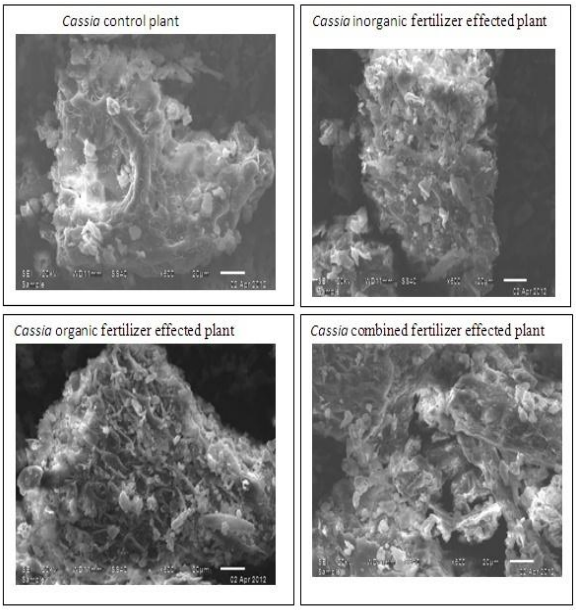

Figure 4. SEM image of *Cassia fistula* in four different conditions of Control, Inorganic, Organic, Combined fertilizers effect.

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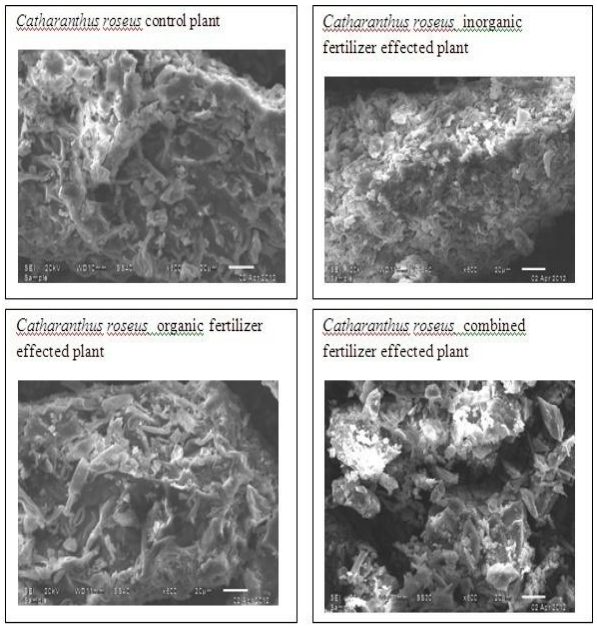

Figure 5. SEM image of *Catharanthus roseus* in four different conditions of Control, Inorganic, Organic, Combined fertilizers effect

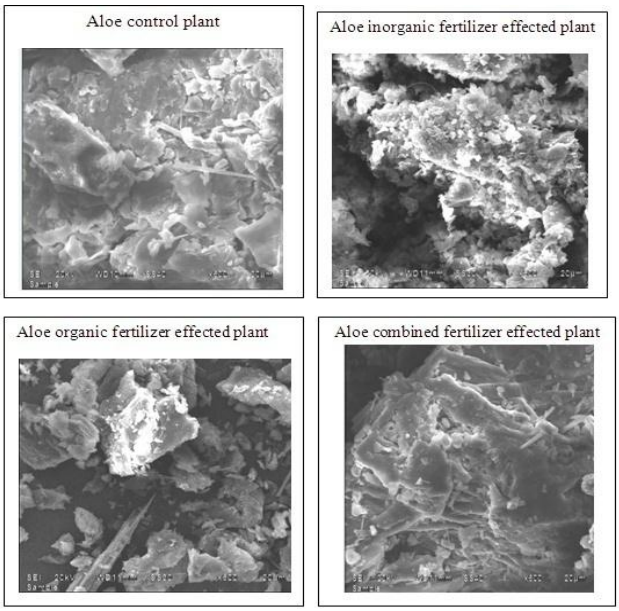

Figure 6. SEM image of *Aloe barbadensis* in four different conditions of Control, Inorganic, Organic, Combined fertilizers effect

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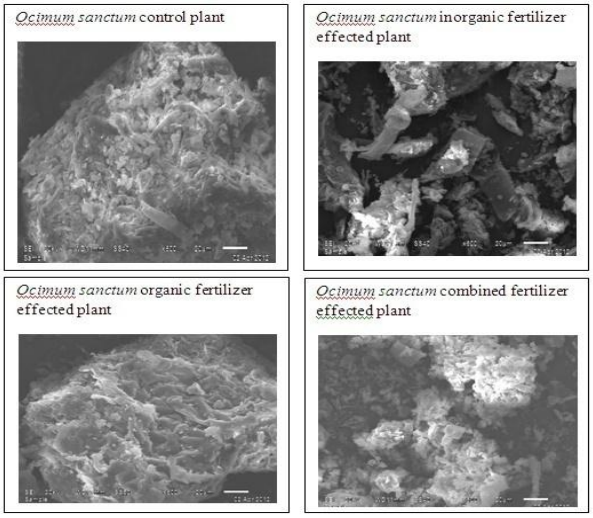

Figure 7. SEM image of *Ocimum sanctum* in four different conditions of Control, Inorganic, Organic, Combined fertilizers effect

The elements present in all the five different medicinal plants samples were detected by EDS and those were tabulated below. *Azadirachta indica* weight percentage of elements were detected and compared to with each other and represented in Table 2.

Table 2. EDS results of *Azadirachta indica* in all four different conditions

S.No	Characteristics elements present in our samples	*Azadirachta indica* Weight % of the elements			
		C	I	O	Com
1	C	24.92	19.96	11.29	26.26
2	N	-	5.07	12.66	1.24
3	O	69.30	69.66	68.41	70.80
4	Mg	0.33	0.07	0.19	0.02
6	K	4.23	-	4.54	-
7	Ca	-	4.24	2.53	-
8	Zn	0.00	0.71	-	1.68

Cassia fistula weight percentage of elements were detected and compared to with each other.

Table 3.EDS results of *Cassia fistula* in all four different conditions

S.No	Characteristics elements present in our samples	*Cassia fistula*			
		C	I	O	Com
1	C	24.92	21.85	14.72	23.02
2	N	-	4.28	9.25	-
3	O	68.25	71.35	68.24	65.44
4	Mg	0.23	-	0.21	0.82
5	K	3.88	-	3.41	3.98
6	Ca	1.47	1.91	3.07	6.67
7	Zn	-	0.16	0.84	-
8	Cu	0.76	0.45	-	-

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Catharanthus roseus weight percentage of elements were detected and compared to with each other.

Table 4.EDS results of *Catharanthus roseus* in all four different conditions

S.No	Characteristics elements present in our samples	*Catharanthus roseus*			
		C	I	O	Com
1	C	12.86	10.67	12.36	15.86
2	N	8.80	11.62	9.25	7.43
3	O	63.51	65.48	63.49	67.28
4	Mg	0.39	-	0.49	0.07
5	K	8.49	6.61	8.55	-
6	Ca	4.09	5.36	3.48	6.73

Aloe barbadensis weight percentage of elements were detected and compared to with each other.

Table 5.EDS results of *Aloe barbadensis* in all four differrent conditions

S.No	Characteristics elements present in our samples	*Aloe barbadensis*			
		C	I	O	Com
1	C	9.12	19.83	21.48	-
2	N	7.38	6.32	3.11	16.40
3	O	52.90	71.38	67.45	55.84
4	Mg	1.66	-	0.30	-
5	K	4.58	-	8.55	10.62
6	Ca	13.22	0.27	-	17.14
7	Co	0.81	0.45	-	-

Ocimum sanctum weight percentage of elements were detected and compared to with each other.

Table 6.EDS results of *Ocimum sanctum* in all four different conditions

S.No	Characteristics elements present in our samples	*Ocimum sanctum*			
		C	I	O	Com
1	C	18.50	19.31	18.32	19.86
2	N	5.94	6.52	6.44	5.18
3	O	68.35	70.80	69.77	69.74
4	Mg	0.25	0.09	0.53	0.14
5	Ca	4.46	1.36	2.60	4.58
6	Zn	0.60	0.35	-	0.49
7	Cl	1.89	1.38	-	-

After observing all the values, the result varies from one plant to another, this is because some elements are found in some plants and absent in other plants. So there is no comparison of one medicinal plant to another but they are compared to the conditions of their growth, i.e., effect of fertilizers, finally by observation we can say that it can be found good results by using organic fertilizers and also inorganic fertilizers. Because the yield produced by both inorganic and organic fertilizer was high when compared to control plant. So the best has

to be chosen as this is the main agenda of the experimental work.

CONCLUSION

The elements present in the control plants are the basic elements which are generally present in those plants, which on effect of fertilizers may be degraded or some addition of elements may happen. The reduction of elements from it may cause a typical situation in the plants medicinal property as it may lost its activity. So this work seriously related with the elemental analysis of fertilizer affected medicinal plants. Probably there may be a change in results as the growth of plants depends upon various factors of biotic and abiotic conditions. But this work clearly represents the impact of fertilizers on the medicinal plants and adds some data to the research work.

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