

Elemental Analysis of Anti-Allergenic Indigenous Plants and their Possible Correlation with Therapeutic Activity

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ABSTRACT

Present study is mainly focused on elemental analysis of two selected antiallergenic indigenous plants (*Cynadon dactylon* (L.) Pers. and *Cymbopogon citratus* (DC.) Stapf., family Poaceae) with the help of ICP-MS and CHNS Analyser. They have many medicinal properties which are used to cure numerous diseases. Phytochemicals like primary and secondary metabolites are formed in various combinations of major, minor and trace elements. In all 25 elements have been measured which include major, minor, trace and some toxic elements. The concentrations of all elements have been found to vary in both the plants. The basic elements like Carbon, Hydrogen and Nitrogen were found maximum while trace, toxic and heavy metals have been found in minute concentrations and some were totally absent. The present data obtained can be useful to decide the dosage of the herbal or traditional drugs. The results are valuable for preparation of herbal medicines using various combinations of different medicinal plants and also discriminate nutritive value, helpful to improve pharmaceutical significance of both the antiallergenic medicinal plants.

Keywords: Phytochemicals, Trace Elements, Heavy Metals, Antiallergenic, ICP-MS, CHNS Analyser, *Cynadon dactylon* (L.) Pers., *Cymbopogon citratus* (DC.) Stapf.

INTRODUCTION

Medicinal plants are effective against various diseases because of their pharmacological efficacy which depends on their elemental concentrations. Phytochemicals like primary and secondary metabolites are formed in various combinations of major, minor and trace elements which play curative and preventive role in most of the dangerous diseases. Hence elemental profile and concentrations of medicinal plants are directly or indirectly related with the curative ability of medicinal plants, so the quantitative analysis of various elemental concentrations is essential for the determination of effectiveness and functioning of drugs prepared from medicinal plants which play vital role in curing various diseases. *Cynadon dactylon* (L.) Pers. and *Cymbopogon citratus* (DC.) Stapf. have been selected for this study (family Poaceae) as antiallergenic indigenous plants of India. *Cynadon dactylon* (L.) Pers. is reported as a sacred plant which has been used traditionally for worshipping of *Lord Ganesh*. It is fast growing everywhere and widely spread weed in crop field. *Cynadon dactylon* (L.) Pers. possesses immense medicinal properties presented by various scientists such as anti-arthritis¹, anti-cancer², anti-oxidant³, anti-ulcer⁴, anti-convulsant⁵, immunomodulatory⁶, hyperglycaemic and hyperlipidemic properties⁷ etc. It is applied externally on wounds, burns, haemorrhages and discoloration of skin. It is also reported to cure hysteria, epilepsy, piles, dysentery, epistaxis, diarrhea, raktpitta, urinary tract infection etc⁸. *Cymbopogon citratus* (DC.) Stapf. is also

one of the important medicinal plants. Traditionally prepared herbal beverages from *Cymbopogon citratus* (DC.) Stapf. leaves are nutritional due to presence of several minerals⁹. Decoction of leaves is useful in treatment of fever, urinary disorder, and cough & cold¹⁰. It is reported as digestive, anti-inflammatory and used to treat nervous conditions¹¹. Because of the fragrance it is used to prepare many cosmetic products¹². In biological system metals and minerals play significant role for activation of metabolic processes¹³. In Ayurveda certain disorders are treated using *bhasma*, which is prepared basically from minerals and metals. Awareness of side effects of synthetic drugs has created interest in the use of herbal products, as they are safe, secure and environmental friendly. But documentation about elemental content of medicinal plants in ancient literature is scarce. Therefore, it is necessary to do elaborate research in elemental analysis of most of the plant species for understanding their therapeutic ability in future and to expand knowledge in natural drug system. Therefore, two antiallergenic indigenous plants have been selected in present investigation.

MATERIAL AND METHOD

The plant materials have been identified and authenticated from Botanical Survey of India (BSI), Pune. The specimen *Cynadon dactylon* (L.) Pers. (VMK- 12) and *Cymbopogon citratus* (DC.) Stapf. (VMK- 11) have been deposited in the herbarium of Botanical Survey of India, Pune,

Table 1: Programme settings for the Mars digester instrument Parameters.

Parameters	First step	Second step	Third step
Ramp	5°	10°	10°
Temperature	60°	150°	190°
Power	800	1200	1600
Hold time (Min)	5	5	20

Table 2: Elemental Analysis of *Cynadon dactylon* L. and *Cymbopogon citratus* L. by CHNS Analyser

S. No	Elements	Concentrations (ppm)	
		<i>Cynadon dactylon</i> L. Leaves	<i>Cymbopogon citratus</i> L. Leaves
1.	Carbon	417300	400360
2.	Hydrogen	56500	57960
3.	Nitrogen	12080	5600
4.	Sulphur	0.00	0.00

Maharashtra (India). Dry powder samples (0.5g) of *Cynadon dactylon* (L.) Pers. and *Cymbopogon citratus* (DC.) Stapf. were digested (*Mars protein analyzer digester*). Plant samples and standard solutions were prepared and used for the ICP-MS analysis. The standard solution of 10 ppm was prepared from 1000 ppm multi element standard solution of *Fluka make*. The data analysis was done by using ICP-MS TOP Batch Analysis Software. The linearity of standard solution was kept as 0.1 ppb, 0.5 ppb, 1 ppb, 5 ppb, 10 ppb, 50 ppb and 100 ppb.

Estimation of Carbon, Hydrogen, Nitrogen and Sulphur by CHNS Analyzer

Quantification of Carbon, Hydrogen, Nitrogen, and Sulphur is most essential for physiological and pharmaceutical aspects. The CHNS Analyzer is used for quantification and analysis was carried out at Sophisticated Analytical Instrument Facility (SAIF), IIT Bombay.

RESULTS AND DISCUSSION

The present investigation is focused mainly on antiallergenic indigenous plants of India. *Cynadon dactylon* (L.) Pers. and *Cymbopogon citratus* (DC.) Stapf. have very less information about elemental profile. Elements are directly or indirectly concerned to decide pharmacological properties in medicinal plants. Concentration of Carbon and Hydrogen was found 417300 ppm and 56500 ppm in *Cynadon dactylon* (L.) Pers. leaves where as 400360 ppm and 57960 ppm in *Cymbopogon citratus* (DC.) Stapf. leaves. Concentration of Carbon was found maximum while Hydrogen was found minimum in *Cynadon dactylon* (L.) Pers. leaves than *Cymbopogon citratus* (DC.) Stapf. leaves. Nitrogen content has been detected higher in *Cynadon dactylon* (L.) Pers. leaves (12080 ppm) as compared to *Cymbopogon citratus* (DC.) Stapf. leaves (5600 ppm). Sulphur was not detected in these plants (Table No.2). Nitrogen is basic element in amino acids and nucleic acids such as DNA and RNA. Enzymes and proteins are produced from the amino acids and hence we may also calculate the crude protein content of plants via nitrogen content of plants. Total plant growth

is reflected by the total nitrogen content of plants. Sometimes toxicity of plant species also depends on higher nitrate content¹⁴. Table No.3 reveals wide variation in elemental concentrations in these plants. The concentration of Phosphorus, Potassium, Calcium and Magnesium are major elements and have been found 5713.13 ppm, 3043.58 ppm, 435.63 ppm and 3495.82 ppm respectively in *Cynadon dactylon* (L.) Pers. while 43.69 ppm, 1160.19 ppm, 1920.30 ppm and 633.84 ppm respectively in *Cymbopogon citratus* (DC.) Stapf. Phosphorus, Potassium and Magnesium concentration has been reported maximum in *Cynadon dactylon* (L.) Pers. leaves than *Cymbopogon citratus* (DC.) Stapf. leaves where as Calcium concentration has been reported minimum in *Cynadon dactylon* (L.) Pers. leaves than *Cymbopogon citratus* (DC.) Stapf. leaves as mentioned above. Calcium and Phosphorus are most important elements in animal as well as plant metabolism. Phosphorus plays key role in maintenance and development of skeletal tissues, acid-base balance & osmotic pressure maintenance in animal body. Specific phosphate like ATP is essential in energy utilization and transfer. Phosphorus is also involved in protein synthesis, fatty acid transport, amino acid exchange, growth and cell differentiation, appetite control, efficiency of feed utilization and fertility¹⁵. Phosphorus is one of the major part of phosphoproteins, nucleic acids, phospholipids, sugar phosphate, enzymes etc. It is one of the important constituents for increasing plant growth¹⁶. Calcium is main constituents of bones, teeth, heart functions and muscular system¹⁷. It is mostly necessary in blood coagulation activity. Calcium, Potassium and Magnesium are together essential for red blood cell production and maintaining body mechanism¹⁸. Our findings indicated Chromium, Manganese, Ferrous, Cobalt, Nickel, Copper, Zinc, Molybdenum and Boron as minor elements and found to vary in concentrations in *Cynadon dactylon* (L.) Pers. and *Cymbopogon citratus* (DC.) Stapf. leaves. Concentration of chromium is found to be higher in *Cynadon dactylon* (L.) Pers. leaves (4.51 ppm) than the *Cymbopogon citratus* (DC.) Stapf. leaves (0.31 ppm). Chromium acts as an activator in most of the enzymes and helpful in lipoproteins, carbohydrate and nucleic acid metabolism¹⁹. Higher concentration of chromium causes damage of kidney, liver and lung²⁰ where as deficiency causes decreasing insulin activity which is responsible for increasing cholesterol and sugar level in the animal body. Higher concentration of Manganese was reported in *Cynadon dactylon* (L.) Pers. leaves (116.78 ppm) than *Cymbopogon citratus* (DC.) Stapf. leaves (15.58 ppm). Manganese is second most important minor element present in plant and animal body, required in various biochemical reactions. In animal body Manganese is stored in kidney and liver and it is essential for normal functioning of reproductive and central nervous system²¹. Manganese deficiency causes the reproduction failure in male and female²². Higher concentration of Iron was recorded in *Cynadon dactylon* (L.) Pers. leaves (158 ppm) as compared to *Cymbopogon citratus* (DC.) Stapf. leaves (26.68 ppm). Iron is most important minor element which

Table 3: Elemental Analysis of *Cynadon dactylon* L. and *Cymbopogon citratus* L. by ICP-MS technique.

S. No	Elements	Concentrations (ppm)	
		<i>Cynadon dactylon</i> Leaves	<i>Cymbopogon citratus</i> Leaves
Major Elements			
	P	5713.13	43.69
	K	3043.58	1160.19
	Ca	435.63	1920.30
	Mg	3495.82	633.84
Minor & trace Elements			
	Cr	4.51	0.31
	Mn	116.78	15.58
	Fe	158.00	26.68
	Co	111.48	9.09
	Ni	4.32	0.25
	Cu	11.89	0.59
	Zn	90.24	3.36
	Mo	0.00	0.00
	B	6.33	0.00
Ultra Trace Elements and Heavy Metals			
	As	12.33	0.00
	Se	15.62	0.08
	Sn	0.00	1.52
	Ba	33.85	0.49
	Li	17.98	0.00
	Be	0.88	0.00
	Ag	1.14	0.00
	Cd	1.74	0.00
	Al	983.41	31.33
	Pb	25.58	0.16
	Hg	0.89	0.00
	Bi	0.17	0.00

is central atom of haemoglobin, hence it plays vital role in blood formation. Iron is also essential for the normal functioning of central nervous system^{23,24}. *Cynadon dactylon* (L.) Pers. leaves showed Cobalt concentration as 111.48 ppm and *Cymbopogon citratus* (DC.) Stapf. leaves as 9.09 ppm. Cobalt is main part of vitamin B-12 and help to make DNA and blood cells. Its deficiency causes serious problem in biological processes²⁵. In present study, trace elements like Nickel, Copper, Zinc and Boron are also detected but in various concentrations such as 4.32 ppm, 11.89 ppm, 90.24 ppm, 6.33 ppm in *Cynadon dactylon* (L.) Pers. leaves respectively and in *Cymbopogon citratus* (DC.) Stapf. leaves i.e. 0.25 ppm, 0.59 ppm, 3.36 ppm respectively but Boron has been not detected. Molybdenum was totally absent in these plants. Copper, Boron and Molybdenum are essential for the growth as well as health of the animals and plants. Copper deficiency may cause anemia, bone changes and neutropenia in animals²⁶. Nickel may act as a nucleic acid stabilizer as it is present in DNA and RNA in significant amount²⁷ where as Boron deficiency is responsible for alteration in brainwave activity because of the daily intake of Boron is less than 0.23 mg, similar effect is seen due to Magnesium deficiency also²⁸. Boron plays role in preserving neuronal

function and stabilize neuronal membrane²⁹. Zinc is important element in metabolism of several biochemical reactions in animals and plants. Heavy metals and ultra trace elements have been also determined and data showed noticeable results. Heavy metals and ultra trace elements like Arsenic, Beryllium, Lithium, Silver, Cadmium, Mercury and Bismuth were detected in appreciable amount in *Cynadon dactylon* (L.) Pers. leaves such as 12.33 ppm, 0.88 ppm, 17.98 ppm, 1.14 ppm, 1.74 ppm, 0.89 ppm and 0.17 ppm respectively and were not detected in *Cymbopogon citratus* (DC.) Stapf. leaves Some are heavy metals which cause serious health disorders when consumed by animals. According to World Health Organisation, skin cancer is induced because of the long term exposure of Arsenic. Beryllium causes pneumonia, lung disorders, cardiovascular damage and allergy³⁰. Lithium is a trace mineral most effective in mental health due to its neuroprotective potential, its deficiency influences common metal illness and social ills³¹. Bismuth is heavy metal but not much toxic, it is used in preparation of cosmetics and medicine to reduce acidity. Cadmium, Tin, Aluminium, Lead, Arsenic and Mercury are neurotoxic and show terrible effect on haematological system. Tin is used as a coating for food containers, it shows negative effect on human health like tumor formation³², infertility in man³³ and lung diseases³⁴. But in some countries Tin has been used to treat intestinal parasites³⁵. Tin was totally absent in *Cynadon dactylon* (L.) Pers. leaves but it detected in very minute amount i.e. 1.52 ppm in *Cymbopogon citratus* (DC.) Stapf. leaves. Selenium is most essential trace element act as an antioxidant which able to fight aging process and not only help to defend cancer but also boosts the immunity in animal. Selenium detected in trace amount in *Cynadon dactylon* L. leaves i.e. 15.62 ppm as well as in *Cymbopogon citratus* (DC.) Stapf. leaves i.e. 0.08 ppm. Heavy and toxic metals like Barium, Aluminium and Lead have been detected in *Cynadon dactylon* (L.) Pers. leaves i.e. 33.85 ppm, 983.41 ppm, 25.58 ppm respectively and in *Cymbopogon citratus* (DC.) Stapf. leaves they were reported as 0.49 ppm, 31.33 ppm and 0.16 ppm respectively. In present research, concentration of heavy and toxic metal like Mercury has been reported. Usually Mercury is not reported in any plants so far, but *Cynadon dactylon* L. leaves showed traces of Mercury. The heavy and toxic metals like Silver, Cadmium and Arsenic have also been detected in *Cynadon dactylon* (L.) Pers. leaves where as Tin was detected in *Cymbopogon citratus* (DC.) Stapf. leaves. Aluminium and Lead are toxic metals and have been detected in these plants. These might have entered and reported because of following reasons, *Cynadon dactylon* (L.) Pers. has ability to absorb and accumulate heavy metals from the soil^{36,37}, ICP-MS technique is useful in this study because of its capability to detect elements in very low concentration (ppb) and also pollution & environmental changes.

CONCLUSION

In view of above fact, the anti-allergenic plants *Cynadon dactylon* (L.) Pers. and *Cymbopogon citratus* L. were studied for understanding the role of elements in

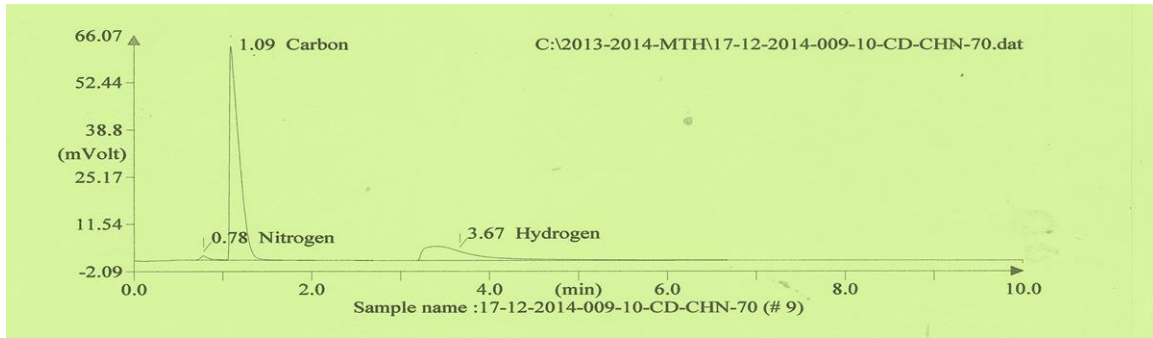


Figure 1: Chromatogram of *C. dactylon* Leaves by CHNS Analyser.

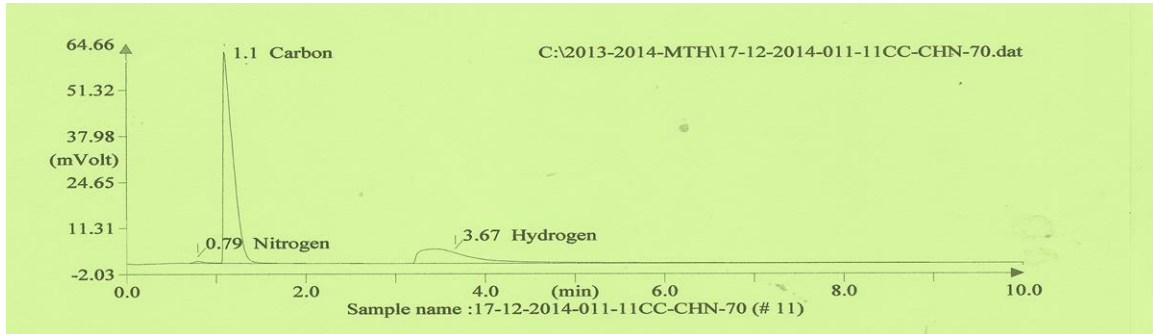


Figure 2: Chromatogram of *C. citratus* Leaves by CHNS Analyser.

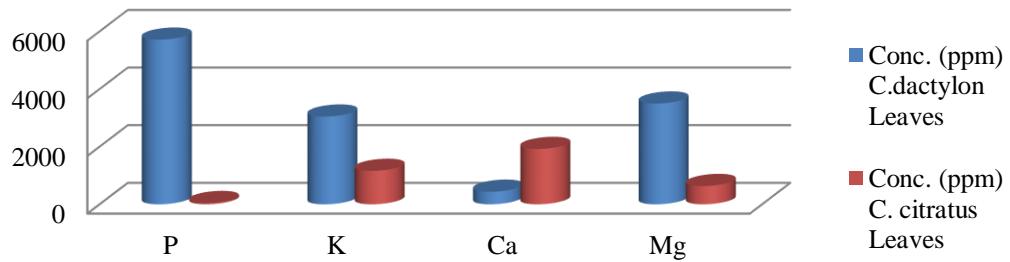


Figure 3: Major Elements Conc. (ppm).

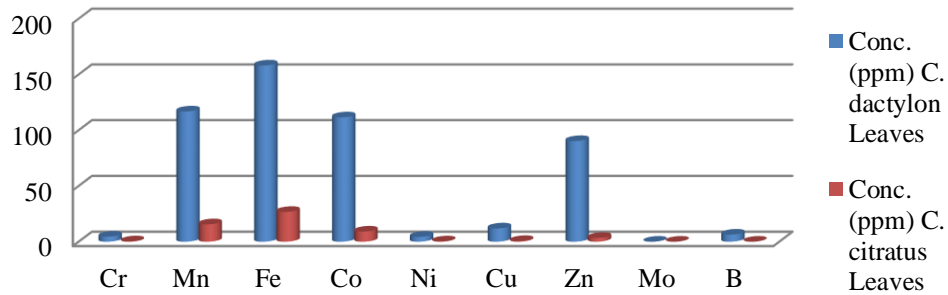


Figure 4: Minor & Trace Elements Conc. (ppm).

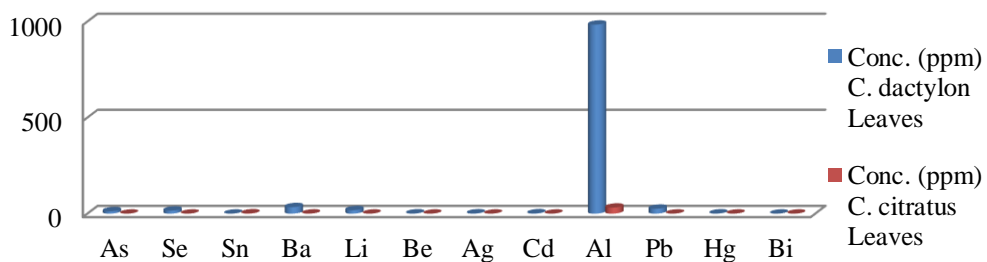


Figure 5: Ultra Trace & Heavy Metals Conc (ppm).

pharmacological properties. The results have been found important to correlate elemental concentration and therapeutic activity of these plants. The variation of elements and traces of some heavy and toxic metals have been detected in these plants because of the soil characteristics, selective element accumulating ability of plants and increased environmental pollution. Maximum variation and occurrence of elemental concentration have been shown in *Cynadon dactylon* (L.) Pers. leaves than *Cymbopogon citratus* L. leaves, this may be due to *Cynadon dactylon* (L.) Pers. have ability to absorb and accumulate heavy metals from the soil. Thus result of present investigation has shown that *Cynadon dactylon* (L.) Pers. is good absorbent of heavy and toxic metals; therefore it is used for removal of toxic and heavy metals from soil which consequently controls the soil pollution. These findings revealed concentrations of heavy and toxic metals below the permissible level as per World Health Organization therefore, it may not be hazardous to human health. The medicinally important trace elements have been detected in various concentrations which provide support to pharmacological properties of these plants. The present study shows elemental concentration in adequate amount, which is helpful to prove therapeutic activity and curative ability of these plants against diseases. The results will be helpful to design new herbal drugs which may be more effective to control and cure various newly emerged dangerous health problems in future. It could be important to discriminate nutritive values which are helpful for improving pharmaceutical significance of these plants.

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