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Elemental analysis of some Seasonal Plants of Maharashtra, India

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Abstract

The importance of seasonal plants, especially monsoon grown plants, as preventive and curative therapeutic agents are long known. Some of them are also known to give nutritional benefits. The current research aims at investigating elemental composition of some dietary significant elements from plants under study. A total of six plants were studied in which three are predominantly available during monsoon season (seasonal plants) and rests three are available throughout the year (sll season plants). Amongst the plant studied, Amorphophallus commutatus (Shevra) showed high amounts of Potassium and copper and was the only plant under investigation, in which Zinc was detected. Thus it can be used as a good source of these elements, offering dietary benefits. However, high amounts of lead found in Basellarubra (Mayalu) could lead to health hazards. It is therefore necessary to conduct further investigations on the elemental composition of these plants if they are to be recommended in human diet for dietary *benefits.*

Keywords: Seasonal plants, elemental composition, all season plants, dietary benefits.

Introduction

One often comes across an upsurge in the number of leafy vegetables during specific months of monsoon. These leafy plants are used in form of a juice or used in the cooked form. Since they are available only during a specific season and aren't keenly purchased by one and all, not many have grabbed the attention of the scientific world with respect to their dietary benefits. Even most of urban population is unaware of their ability to cure seasonal ailments, especially the gastro-intestinal and cardiac disorders, cough, fever, asthma, bronchitis, scabies, jaundice, leucoderma and leprosy; which has been mentioned in some of the literature of herbal medicine. Effect of extract of monsoon vegetable on mammalian tumor has been studied in India[1].

S^{+2}, P^{+3}, Ca^{+2}, Na^{+}, K^{+}, Cu^{+2}, Zn^{+2}, Fe^{+2} etc. are elements which are important for normal metabolism in human being. Most of the elements are quantified along with their effects. The current project includes results of elemental composition of some these important dietary elements from seasonal (monsoon) and all season plants.

The outcome of the research is promising enough to recommend these vegetables in human diet.

Out of these six plants, *Amorphophallus commutatus* (Shevra), *Amaranthusviridis* (Pandhara math), *Clerodendronindicum* (Bharangi) are mentioned as Seasonal (Monsoon) and *Portulacaoleracea* (Ghol), *Basellarubra* (Mayalu) and *Cassia tora* (Takla) are available throughout the year and are mentioned as All season plants in the present paper[2-6].

The main objectives of the research were: To collect and identify the edible plants under investigation, to study elemental composition of some dietary beneficial elements.

Material and Methods

Collection of plant species: The following plants were collected from various markets in and around Mumbai.

All Season plants: *Portulacaoleracea* (Ghol), *Basellarubra* (Mayalu)and *Cassia tora* (Takla)

Seasonal plants (Monsoon): *Amorphophallus commutatus* (Shevra), *Amaranthusviridis* (Pandhara math), *Clerodendron indicum* (Bharangi).

They were washed with distilled water and the morphological characters were studied for identifying the plant species.

Preparation of plant samples for Elemental analysis: After recording fresh weights of the plants, they were oven dried at 60°C till three consecutive constant dry weights were obtained. The dried plant samples were made into a fine powder using a grinder and the powders was stored in separate amber colored glass bottles with air-tight caps[7].

Elemental analysis: Acid digestion: The dried powdered plant samples were acid digested. Approximate 0.5gms of the sample was taken in different beakers. To this about 2-3ml of distilled water was added so as to make it to a paste and then was slightly heated by adding 5-7ml of conc. HCl to it. It was then filtered and the filtrate was used for further analysis[8].

Procedure: The acidified aqueous test sample was used for analysis. Care was taken that the acidity of the test portion matched with the acidity of calibration solutions.

The instrumental parameter of the ICP-AES system was adjusted in accordance with the manufacturer's manual. About 30 minutes prior to measurement, the instrument was adjusted to the working conditions. Wavelength for measurement was also selected.

Known amount of analyte was added to the know amount of the sample portion. Corresponding concentration change was calculated. The difference in concentration between the original and the spiked sample portion was measured. The ratio 'true spike concentration' versus 'measured spike concentration' was used as a correction factor for the initially measured concentration of the sample portion.

Correction was performed by analyzing one or more interfering check solutions, determining the ratio of supplied interfering concentration versus detected analyte concentration.

The result were expressed in as many significant figures as are acceptable according to the precision of the measuring values, but not more than three significant figures.

The test report contains the following information: A reference to this standard, a reference to the digestion method used a complete identification of the sample, the results of the determination, and deviation from the standard[9,10].

Results and Discussion

The elements under study have known to play various roles in plants and humans as described below and therefore considering the values obtained from elemental analysis, we can recommend their use in our diet. When the two plant groups (seasonal and all season plants) were compared for the content of their Macro elements, the seasonal plant group (monsoon) shown higher values of these elements, especially for Potassium. Potassium maintains Na+/ K+ - AT Pase pump, muscular activities and also maintains electrolyte balance in the body. Its deficiency results in formation of kidney stones and cardiac diseases whereas in excess it causes accumulation of calcium in bones.

No definite comparison could be made between the two plant groups with respect to other two important macro elements, calcium and Sodium, but the amount of calcium and sodium found to be present in all these plants is adequate, for them to be used as a source of dietary elements. In humans, calcium acts as neurotransmitter, maintains muscular functioning, helps in proper bone formation, promotes absorption of Ca^{+2} from intestines by calcitonin and also helps Na^{+}- k^{+} pump. In excess, it accumulates in the blood, called hypercalcemia and causes neurodegenerative diseases[11].

Sodium maintains homeostasis and influences the contraction and relaxation of muscles. In excess, it will raise blood pressure but will be excreted in the urine whereas in low concentration it causes hyponatremia which can bring about death from the brain swelling or the heart stopping[12].

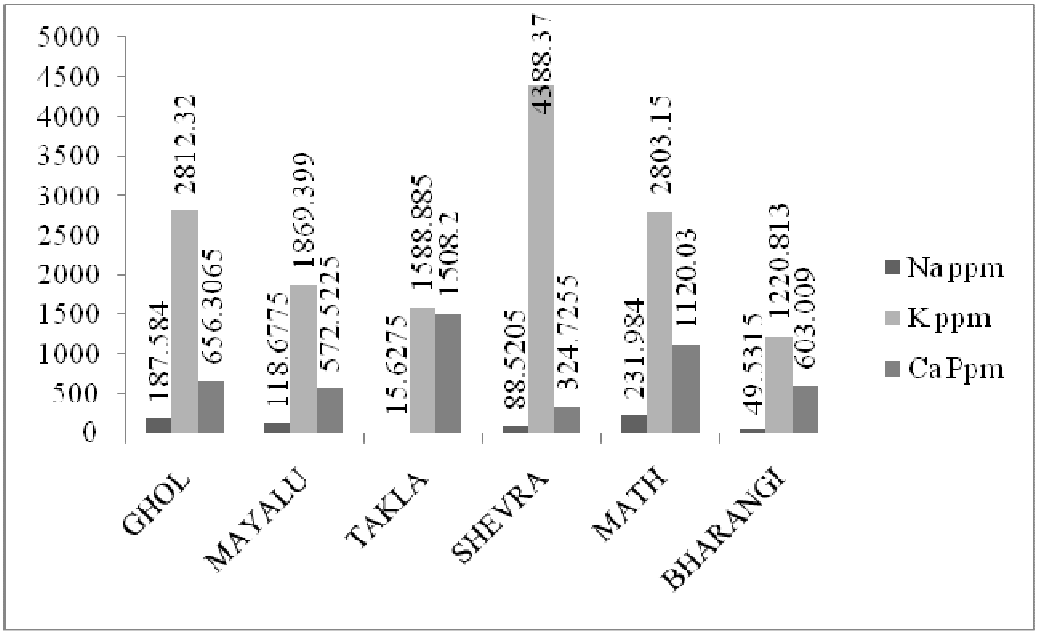

Figure-1
Elemental analysis of calcium, potassium and sodium

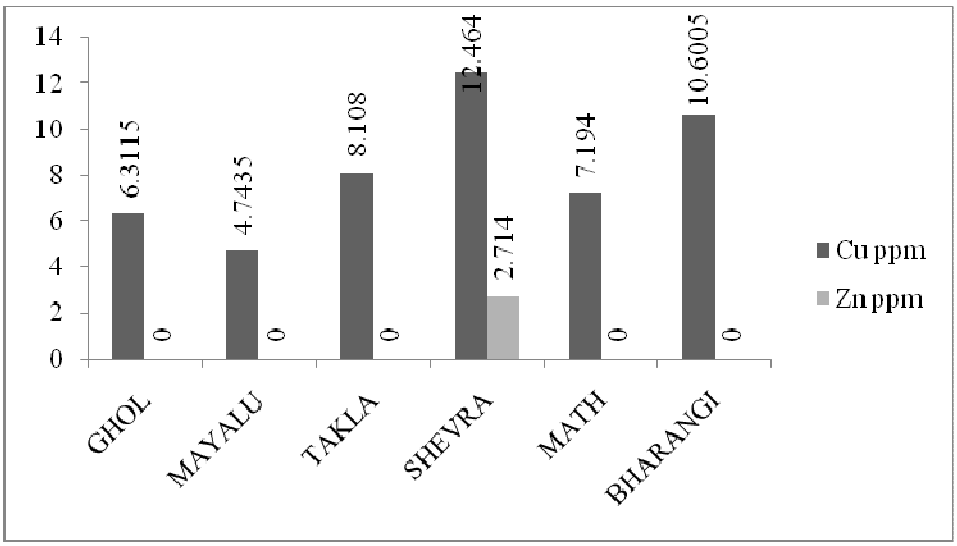

Figure-2
Elemental analysis of copper and zinc

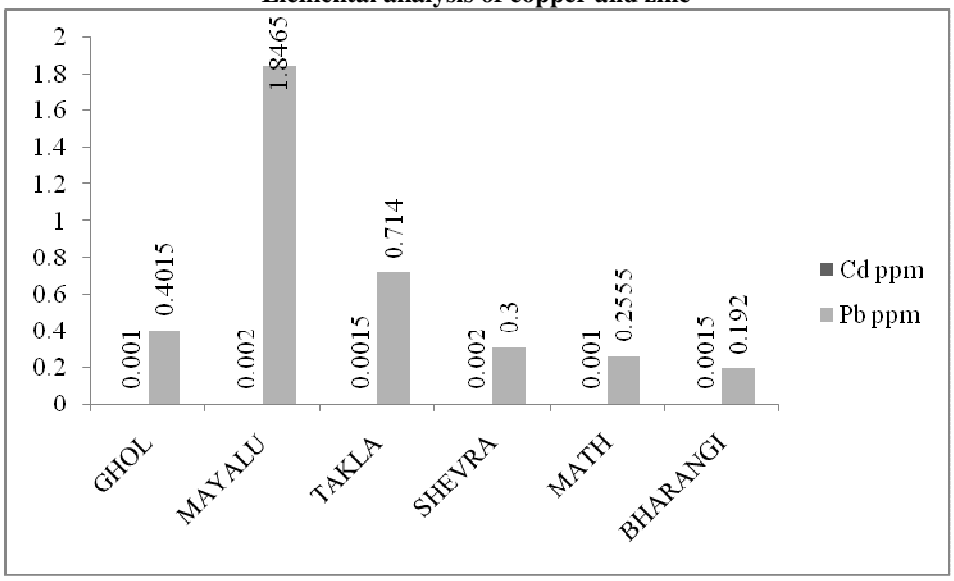

Figure-3
Elemental analysis of lead and cadmium

Table-1
Elemental analysis of calcium, potassium and sodium

Sr. No.	Samples	Sodium Na^+ ppm	Potassium K^+ ppm	Calcium Ca^{2+} Ppm
1. All Season	Ghol	187.584	2812.32	656.3065
2. All Season	Mayalu	118.6775	1869.399	572.5225
3. All Season	Takla	15.6275	1588.885	1508.2
4. Seasonal	Shevra	88.5205	4388.37	324.7255
5. Seasonal	Math	231.984	2803.15	1120.03
6. Seasonal	Bharangi	49.5315	1220.813	603.009

Table-2
Elemental analysis of copper and zinc

Sr. No.	Samples	Copper Cu^{+2} ppm	Zinc Zn^{+2} ppm
1. All Season	Ghol	6.3115	0
2. All Season	Mayalu	4.7435	0
3. All Season	Takla	8.108	0
4. Seasonal	Shevra	12.464	2.714
5. Seasonal	Math	7.194	0
6. Seasonal	Bharangi	10.6005	0

Table-3
Elemental analysis of lead and cadmium

Sr. No.	Samples	Cadmium Cd ppm	Lead Pb ppm
1. All Season	Ghol	0.001	0.4015
2. All Season	Mayalu	0.002	1.8465
3. All Season	Takla	0.0015	0.714
4. Seasonal	Shevra	0.002	0.300
5. Seasonal	Math	0.001	0.2555
6. Seasonal	Bharangi	0.0015	0.192

The amount of micro element Copper was found to be higher in seasonal (monsoon) vegetables especially in Bharangi and Shevra as compared to their all season counterparts. In humans, copper plays role in biological electron and oxygen transport, and is bounded to albumin in liver. In excess, it is known to produce oxidative damage to biological systems, and also Alzheimer's disease[13]. The second micro element under investigation was Zinc which is one of the most important element in humans as it plays a vital role in synaptic plasticity, normal brain functioning. It is involved in the operations of central nervous system (CNS) and brings about the coordination of the amino acids. Its deficiency can adversely affect liver and kidney function, cause diseases such as sickle cell anemia and diabetes. Copper and iron absorption is suppressed in presence of higher concentrations of zinc[14]. In all the plants under study, zinc was detected only in Shevra but its amount was found to be in adequate quantity, according to WHO standard[15].

Thus from the above discussion we can strongly propose the consumption of these seasonal (monsoon) vegetables for dietary benefits. If an appropriate serving measures can be determined for the daily intake, these vegetables can be proved as a good supplementary source of these elements.

Sometimes these vegetables are grown in a urban habitat which is contaminated with metal pollutants; therefore it is essential to check for certain heavy metals which may act as toxins/poisons, when accumulated in higher amounts can cause metal toxicity. Therefore, in the current research, plants under investigation were also analyzed for their cadmium and ead contents, as these are the most common heavy metals found associated with leafy vegetables grown in urban polluted areas such as railway tracks. Except the Mayalu plant, which showed higher levels of lead, the level of lead and cadmium were below permissible limits in rest of the plants[16].

In humans, cadmium can cause reproductive failure and possibly even infertility. Its ill effects include causing a damage to CNS, lowering of immunity and lead to psychological disorders. Presence of cadmium is also linked with damaging DNA and leading to certain types of cancers [17]. Lead (Pb) plays no vital role in functioning of human body and its presence can trigger off harmful effects such as increased blood pressure, miscarriages and abortions. It can cause disruption in normal functioning of nervous system andbrain[18,19]. Since concentration of these heavy metals in plants is totally habitat dependent, care should be taken while procuring these vegetables from the vendors.

From the study of moisture content of these leafy vegetables, it can be observed that, as 1gm of dry sample is obtained from approximately 100gms of fresh vegetable, the recommended dietary requirements for the elements studied, can be obtained from the normal portion of these leafy vegetables consumed per meal. (As approximately 1gm of dry sample is obtained from 100gms of fresh vegetable).

Conclusion

From the above results it can be concluded that most of these plants have adequate quantities of essential elements such as sodium, potassium, calcium, zinc, copper that is required in every day diet of humans. It can also be noted that higher quantities of most of these elements are observed in Seasonal leafy vegetables than the all season plants. The study of macro and micro elements of all these edible plants is a useful tool not only to understand the plant composition but also in evaluating their usefulness in supplying these elements as nutrients to human diet. Although the elemental content of the plants depends on availability of the elements in the soil and capacity of plants to absorb and retain them; their average concentrations can be determined by analytical methods and quantified forthe recommended dietary dose for human consumption. However, sometimes, toxic metal pollution of soil, water and air, may lead to absorption of some heavy metals such as Cd^{+2} (cadmium), Pb^{+2} (lead), Hg^{+2} (mercury) etc by these plants, which when present in higher doses, can lead to health hazards. Therefore, good agricultural practices should be followed, during cultivation and distribution of these seasonal as well as the all season leafy vegetables. Also there is a need to increase awareness in the urban population regarding the dietary benefits conferred by these less explored seasonal leafy vegetables.

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