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Determination Of Nutritional Potential Of Cymbopogon Citratus (D.C.) Staph By Atomic Absorption Spectroscopy And Its Health Benefits

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Abstract: ***Lemon grass (Cymbopogon citratus) was processed for analyses. They were sorted and chopped into bits. They were sundried for 12hrs, oven dried for 24hrs at 60^{o}C and pulverized. Digestion was carried out according to AOAC 2000 and analysed for P, Mg, K, Na, Se, B, Co, Fe, Zn, Mn, Cu and Ca contents using Unicam 939/959 Atomic Absorption Spectrophotometer. Out of these twelve "botanical based minerals", the most abundant was potassium followed by magnesium, phosphorus and calcium the least being boron. Most nutritional problems in Nigeria experienced by the vulnerable groups - the children and the elderly are due to mineral deficiencies in unwholesome or processed foods. Minerals usually obtained from synthetic mineral supplements are inadequate for the rural population due to high cost of procurement and at times adulteration. Most of them are toxic to susceptible individuals. Lemon grass is very effective in 'Ajurvedic' medicine because of the "botanical based minerals" and bioactive compounds therefore taken in adequate quantities will help in the improvement of general health.***

Keywords: Lemon grass, botanical based minerals, bioactive compounds, and pharmaceutical properties.

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I. INTRODUCTION

Plants are known to contain botanically based minerals for therapeutic and nutritional provision for man because they contain minerals, vitamins and bioactive compounds. Plants are also rich in fibres, and phytochemicals (Vanisha and Hema, 2012). Lemon grass is known to provide minerals for adequate human nutrition Asaolu, (2009). Lemon grass is a tropical and subtropical plant (Figuevinaha *et al.*, (2008) with medicinal values for treating malaria, ophthalmia, pneumonia, vascular disorders, diarrhea and stomach ache (Vanisha and Hema, 2012). It has also been claimed to be anti-inflammatory, antibacterial, anti-fungal, antimycotic, (Inouye *et al.*, 2007) (Bansod and Rai 2008) vasorelaxing, diuretic, remedy in treating ringworm infestation, for nervous, gastrointestinal disturbances, fevers and hypertension (Leite *et al.*, 1986). Most nutritional problems in Nigeria especially among the vulnerable groups of children and the elderly are linked to lack of minerals in the common diets. Mineral from synthetic mineral supplements are rarely met by the rural population due to their high cost of procurement, besides most of them are toxic to susceptible individuals in the population. To avert the problems of synthetic minerals renewable, available and safe sources, many works have been done to identify plants with potential value for minerals. Mercel and Brevenu (2012) reported the presence of botanical based minerals at safe levels in *Urera trimenus* and *Hippoctatea. myriantha.*

According to Wood (2008) lemon grass acts on the connective tissues of the body lymphatic capillaries and vessels.

Carlin *et al.*, (1986) claimed that lemon grass is used in the treatment of digestive disorders, nervous disorders inflammation, and fever as well as other diseases.

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But considering, the role of 'botanical based minerals' a combination of lots of minerals and other useful bioactive compounds, it has helped in providing the needed minerals in replenishing the lost nutrients and boosting the general health of the individual and healing of the diseases.

Godwin *et al.*, (2014) in elemental analysis of phytochemical properties of lemon grass from different locations using Instrumental Neuron Activation Analysis (INAA) reported the presence of phenolic, antioxidant and flavonoid in lemon grass from five geographical regions.

This work is expected to contribute to the ongoing investigations of elemental profile of plants especially lemon grass using AAS and the work would provide additional data for future research work on the sample.

II. MATERIALS AND METHODS

PLANT MATERIALS

Lemon grass was obtained fresh from Abiakpo Ikot Essien, Ikot Ekpene Local Government Area of Akwa Ibom State in South Eastern Nigeria. The samples were identified in the Botanical Unit of the Department of Science Technology, Akwa Ibom State Polytechnic, Ikot Ekpene, Nigeria.

PREPARATION OF SAMPLES FOR ANALYSIS

The lemon grass sample was prepared for Unicam 939/959 AAS analysis according to the method adopted by (Jasha, 2014). Fresh samples were sorted of impurities and chopped into bits. The sample was sun dried for 12 hours to moisture content of 20g/100g and then oven dried for 24 hours at 60^{o}C to moisture content of about 12g/100g. The dry sample was pulverized and stored for analysis.

DIGESTION AND ANALYSIS OF PLANT SAMPLES

The digestion of the samples was carried out according to the method of AOAC, (2000). The aliquot of the samples were analyzed for Ca, Fe, Cu, Mg, and Zn. Other minerals were Na, K, P, Se, B and Co using their individual elemental lamps.

III. RESULTS AND DISCUSSION

Analysis of P, Mg, K, Na, Se, B, Co, Fe, Zn, Mn, Cu, and Ca was done in triplicate of the samples. Result of mineral content of plant material is shown in Table 1. The concentrations of the elements are expressed in mean ± SD mg/100g alongside values from previous work. The mineral elements isolated in our samples are as shown in the table below:

Element	Conc. mg/100g Current Experiment	Fagbohun *et al.*, 2010 (mg/100g)	Recommended Nutrient intake RNI, (mg/d) FAO/WHO, 2004	Dietary ref. intake: recommended dietary allowance (mg/d) (RDA), USA	Recommended dietary allowance (mg/d) (RDA), ICMR, 2009
Ca	47.13±0.014	39.5	750.0-800.0	1000.0*/**	600.0
P	48.83± 0.015	89.3	-	700*/**	-
Na	8.27± 0.021	54.8	-	1.5g/d	-
Fe	4.538± 0.006	0.024	9.1*/ 26.0**	8.0*/18.0**	17.0*/ 21.0**
Cu	0.232± 0.002	ND	-	900.0	1.35
Co	1.229± 0.007	ND	-	-	-
K	216.44±0.461	59.5	-	4.7g/d*/*	-
Mg	56.09± 0.179	70.0	220.0	420.0*/310**	310 */ 340.0**
Zn	3.150±0.001			11*/8**	
Mn	1.882±0.021			2.3*/1.8**	
B	0.016± 0.00	ND	-	-	-
Se	0.061±0.003			55ug*/**	

Table 1: Table of mineral elements from experiment literature and standards

Column 4: Vitamin and mineral requirements in human nutrition: report of a joint FAO/WHO expert consultation, World Health Organization, and Food and Agriculture Organization of the United Nations, 2004. HealthSupplementNutritionalGuide.Com

Column 5: Dietary reference intakes (DRIs): recommended dietary and adequate intakes, elements Foods and Nutrition Board, Institute of Medicine, National Academies (Jasha, 2014).

Column 6: Nutrient requirement and recommended dietary allowances for Indians

A report of the expert group of the Indian Council of Medical Research (ICMR), 2009

*For male, ** for female, ND not determined.

Figure 1 shows that potassium is the most abundant element followed by magnesium, phosphorus, calcium while the least is Boron.

From the table, the most abundant mineral in the samples show the following trend potassium 216.0.46mg/100g > Magnesium 56.09±0.179mg/100g > phosphorus 48.83±0.015mg/100g >calcium 47.171±0.014mg/100g > Iron 4.538±0.006mg/100g > Zn3.150 ±0.001mg/100g> Mn 1.882±0.021mg/100g > Cu 0.232±0.002mg/100g > Boron0.016±0.00mg/100g which are lower than RDA per day. But when taken in appropriate doses could make up the required amount.

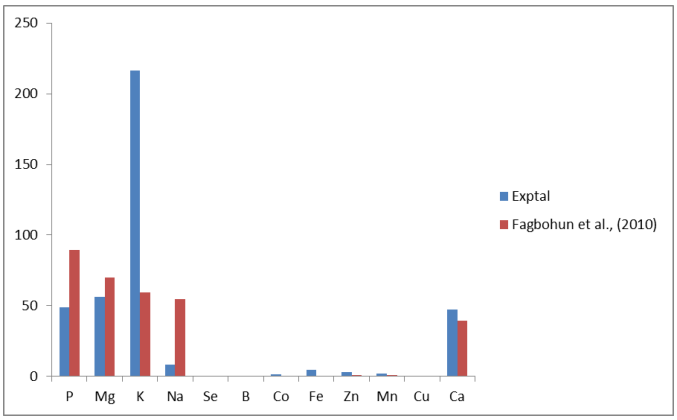

Figure 1: Mineral elements from Lemon grass according to Umoh and Fagbohum et al., (2010)

Fagbohun et al, (2010) lemon grass had a higher amount of phosphorus 89.3mg/100g, magnesium 70.0mg/100g and sodium 54.8mg/100g. According to Godwin et al (2014)

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lemon grass Phosphorus (P) Content grown from five different locations at a distance of about 160km apart on analysis for K = 24192mg/kg, Cl = 6946mg/kg, Ca = 5849mg/kg, Mg = 2327mg/kg, Na=117mg/kg, Al =58mg/kg, Mn = 39mg/kg and Cu = 9mg/kg. The first four elements were higher in concentrations than others with Cu having the lowest value. He argued that despite the location and the varied soil composition, the selective absorption of similar minerals of lemon grass was not affected by the soil and environmental factors.

The phosphorus content of the plant was 48.83±0.015mg/100g lower than that of Fagbohun *et al*, (2010) and RDA of 700mg/d. The differences between the experimental and Fagbohun *et al* (2010) may be attributed to geographical location, variety or soil factors. The element is an essential component of bones, teeth, cartilage, phospholipids, nucleic acids, ATP and several key enzymes. It also functions greatly in energy and cell metabolism. The deficiency of phosphorus leads to osteopenia and if not treated may lead to osteoporosis thus increasing the risk of bone fractures in older adults. Therefore, taking lemon grass extracts would help in facilitating these functions.

MAGNESIUM (Mg)

The concentration of magnesium in the plant material was 56.09±0.179mg/100g less than Fagbohun *et al*, (2010) of 70.0mg/100g due to environmental factors and soil type and RDA of 420mg/d for adult males and 310mg/d for adult females. It is an activator of several enzyme systems involved in energy metabolism and protein synthesis. It also stimulates muscle and nerves contractions, regulate intracellular acid base balance and especially in carbohydrate, protein and lipid metabolism. It deficiency leads to numbness, muscle cramps, seizures and abnormal rhythms of the heart (Ma *et al*., 1995). The recommended daily allowance for men is 310mg/day while females are 340mg/day. Therefore deficiency of magnesium could be complemented by taking lemon grass in small doses. According to Dim et al., (2004) botanically based plants contain 0.14 – 0.23g/kg of magnesium of which lemon grass has in abundance.

SODIUM (Na) AND POTASSIUM (K) CONTENT

These are the elements found in the fluids and soft tissues of the body systems and were found to contain 8.27±0.021mg/100g and 216.44±0.461mg/100g respectively. The sodium content was lower and the potassium higher than Fagbohun *et al*, (2010) and RDA required per day. When they are taken in adequate amount, the required dosage could be augmented. They function optimally in controlling the osmotic pressures and water metabolism as well as maintenance of the acid base equilibrium of the body. Deficiency of sodium and potassium leads to dehydration of body fluids and body cramps. (Frassetto *et al.*, 2001).

IRON (Fe) CONTENT

Iron is known to contain respiratory pigments such as haemoglobin and myoglobin as well as other enzyme systems. It was present in 4.538±0.006mg/100g higher than Fagbohun *et al*, (20I0). It has been estimated by W.H.O that iron deficiency anaemia are suffered by 600-700 million people worldwide and those mostly affected are in developing countries especially women of fertile age and adolescence girls (Maeyer and Tegman 1985). The recommended dietary allowances for males are 17.0mg/day and females 21.0mg/day which lemon grass can augment for this adequacy having a higher concentration.

ZINC (Zn) CONTENT

Zinc serves as a vital component in the metabolism of some enzyme systems and in the maintenance of cell and the organs of the body. It is mostly needed in the defense of body systems. The amount present in the plant material was 3.150±0.001mg/100g lower than RDA per day. When taken in adequate quantities would reduce frequent infections, hypo-gonadism in males, loss of hair, poor appetite, skin sores and delayed healing of wounds. (medline plus.gov)(Shanker and Prasad 1998).

MANGANESE (Mn) CONTENT

Manganese content in the plant was 1.882±0.021mg/100g which met the RDA requirement for adult females and lower for adult men and in good proportion will make up for the insufficiency. Manganese is a vital micro element needed for normal growth, development and cellular homeostasis (Erikson *et al.*, 2005) and in curbing of neurodegerative diseases (Bowman *et al.*, 2011).

COPPER (Cu) CONTENT

Copper was present in traces of 0.232±0.002mg/100g of dry sample. It helps in haemoglobin, red blood cell production and maintenance in cholesterol and glucose metabolism. The copper content was less compared with recommended dietary allowance of 1.35mg/day. However although it is low in lemon grass with its consumption this could be met for good health.

CALCIUM (Ca) CONTENT

The amount of Calcium was 47.131±0.014mg/100g in the plant sample. According to W.H.O. (2004) calcium helps in functioning of the nervous system, hearts and muscles and in blood clotting and formation of strong teeth and bones. Deficiencies in pregnant women lead to serious and fatal consequences such as natural death due to hypertension disorders, pre-eclampsia and eclampsia. (w.w.w. micronutrient initiative, 2017). The RDA per day is 600mg/day higher than that present in lemon grass preferred to being absent in it as the inadequacy could be curbed when consumed in the right amount.

SELENIUM (Se) CONTENT

Selenium was present in trace amount of 0.061±0.003mg/100g of sample. It is an important component

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of an enzyme glutathione peroxidase and in combination with tocopherols (Vit.E) protects cellular tissues and membranes against oxidative cell damage. (w.w.w.Fao.org). The RDA is higher than the amount present in the lemon grass. Deficiency leads to abnormalities of the heart muscle, joint and bone diseases (medlineplus.gov).

BORON (B) CONTENT

Boron content was 0.016±0.00mh/100g. The RDA requirement is not given. Boron is used for the formation of strong bones and in the treatment of osteoarthritis. When present in the body, it is used in the building of muscles and enhancement of testosterone and estrogen levels in post-menopausal women and healthy men and most especially in mental functioning of an individual (medline plus.gov).

COBALT (Co) CONTENT

Cobalt has a dorminant role in the formation of red blood cells and in the maintenance of nerve tissues. The cobalt content of 1.229±0.007mg/100g of dry weight is higher than the adult intake of 5-8mcg per day although a safe RDA for cobalt has not yet been set (Healthcare.utah.edu) and the average a It is an important component of cyano cobalamin (vit.B12) (Atkins & Jones, 2000).

A deficiency of cobalt is an indicator of vitamin B12 deficiency of which pernicious anemia. Other symptoms include numbness, fatigue and tingling in the hands and feet and if not treated can lead to decreased nerve function (Healthcare.utah.edu).

Equally, the ethanolic extract of lemon grass exhibits anti-mutagenic response in various models (pimsaeng, 1993) and delays the growth of fibrosarcoma cells transplanted in mice (Puatanachokchai, 1994).

According to Gumbel (1993), lemon grass is used in the treatment of muscular aches and pains, tired and sore muscles, sprains, weaken connective tissues, pains in joints, muscle cramps and spasms and sprains as shown in the function of magnesium (muscle cramps), iron for tiredness, zinc for skin sores and healing of wounds, muscle aches, pains and cramps for sodium and potassium and formation of connective tissues for copper.

Stehmann *et al*, 1995 reported that lemon grass tea has dieuiretic properties and can help in the treatment of water retention as shown in sodium and potassium functions.

Equally, according to Buckle, 2003 lemon grass (5% dilution in cool to warm compress) serves as a relieve for osteoarthritic pain which is noted for the presence of boron.

According to Nogueira *et al*, (1993) treatment of psychoneurological diseases by 201 out of 479 women volunteers in Sao Paulo showed good responses. Also, Ramirez *et al*, (1998) confirmed that use of lemon grass in the treatment of nervous disorders and inflammation.

IV. CONCLUSION

The botanical based composition of lemon grass – *Cymbopogon citratus* has shown that the most abundant mineral was potassium followed by magnesium, calcium and phosphorus while the least was boron. These botanically based mineral elements combine to enhance the potentials of pharmaceutical properties of the plant. However, with combination with the bioactive compounds inherent in the plant, the role of lemon grass in the improvement of human health cannot be ignored.

The composition of these 'botanically based minerals' with its attendant potentials show that lemon grass helps in boosting the general wellbeing of an individual.

Therefore, as an alternative to synthetic drugs with its attendant health implications, 'botanical based minerals' would serve as the best and safe method of therapeutic treatment of diseases.

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