

## Quantitative Mineral Ion Content of a Nigerian Local Refreshing Drink-Zobo-(Water Extract of Hibiscus Sabdariffa Calyx)

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**Abstract:** Zobo, a local Nigerian drink suddenly became a household and commercial drink for all classes of people within the past two years, without recourse to possible health implication. A quantitative mineral element content of the water extract of the calyx (Zobo) was carried out. The two major varieties of *Hibiscus sabdariffa* var rubber-light red calyx (sample 1) and var *sabdariffa*-dark red calyx (sample 11), found in Nigeria, were used for the analysis, using AAS, flame emission spectroscopy and classical titrimetric methods for the determination of the minerals. Mineral ions assayed are Potassium (K), Sodium (Na), Calcium (Ca), Magnesium (Mg), Zinc (Zn), Iron (Fe), Manganese (Mn), Cadmium (Cd), Lead (Pb), Bicarbonate (HCO) and Chloride (Cl). The mineral element content of the drink was found to be K, 324.52-400.19 mg L<sup>-1</sup>; Na 2.58-8.52 mg L<sup>-1</sup>; Ca, 140.09-164.01 mg L<sup>-1</sup>; Mg 37.52-69 mg L<sup>-1</sup>; Mn 2.4-11.6 mg L<sup>-1</sup>; Fe, 0.44-4.58 mg L<sup>-1</sup>; Zn, 0.39-0.9 mg L<sup>-1</sup>; Pb, 0.00-0.73 mg L<sup>-1</sup>; Cd, 0.00-0.05 mg L<sup>-1</sup> and anions, Cl<sup>-</sup>, 0.001-0.9 mg L<sup>-1</sup> and HCO<sup>-</sup>, 6.67.0 mg L<sup>-1</sup>. The extract from sample 11 on the average has a higher mineral element content, than sample 1, however the difference were not statistically significant (p>0.05). The claimed diuretic and antihypertensive effects of the drink might be linked with the high level of K and low level of Na and Cl<sup>-</sup>.

**Key words:** Zobo, mineral, ion, hibiscus species, drink

### INTRODUCTION

The Hibiscus species, (*Hibiscus sabdariffa* Linn, *Roselle*) are tropical herbs and shrubs. The genus *Hibiscus sabdariffa* belongs to dicotyledons family called Malvaceae, class of Archichiamydae, order Malvales. Generally Roselle is a very nutritious crop with the fruits containing approximately, 84.5% water, 1.7% protein, 1.0% fat and 12% carbohydrate (Morton, 1987). The calyces contain about (41%) citric acid, both fruits and flowers contains ascorbic acid 6.14 mg 100 g<sup>-1</sup> edible portion (Guthrie, 1989). The major Roselle growing areas in Nigeria are the northern and middle belt states of the country. Both the edible and inedible calyces producing sp. are cultivated in Nigeria. The inedible green, red-streaked inedible calyces are widely exploited jute-like fibre source. The attractive wine coloured aqueous extract (cold or hot), of the calyx of the Hibiscus spp had been taken as beverage after sweetening and flavouring (zobo drink) and possible spicing with ginger. It (zobo drink) has indeed taken the place of bottled and canned beverages in many homes. The beverage is however claimed to possess anti hypertensive effect. The calyces and leaves of Roselles have been reported to possess anti-scorbutic and diuretic

activity (Dalziel, 1955). In East of Chad an infusion of the calyces (called sudan tea) is taken to relieve symptoms of plethora, for bronchitis and cough and is also used as a vehicle for various native medicines, (Dalziel, 1955).

Recently it was reported that over 100 people were killed in Kenya due to ingestion of poisonous locally brewed beer (Akoh, 2001). In view of the magnitude of consumption of this beverage without recourse to its possible medicinal or toxic effect, we thought it worthwhile to investigate the presence and concentration of the various mineral elements present in Zobo drink and the possible health implications.

### MATERIALS AND METHODS

**Collection/Preparation of sample:** Sampling was directed to the major producers of the plant in Nigeria. The two different species of the *Hibiscus Sabdariffa* (Calyx) used for the drink were collected from each of the five producing states (Kaduna State; Daura LGA (Sample A1 and A11), Benue State; Ankpa LGA (Sample B1 and B11), Plateau State; Langtang North LGA (C1 and C11), Jigawa State; Dutse LGA (Sample D1 and D11), Kano State: Kura LGA (Sample E1 and E11). The two different varieties of

the *Hibiscus Sabdariffa* Clayx, used for the zobo drink namely var. *ruber* and var. *Sabdariffa*, were duly authenticated (by prof. Huseini, Taxonomist of Botany Department, University of Jos).

New plastic bottle (1 litre) were purchased and Distilled/De-ionized water obtained from the department of pharmaceutical chemistry. Atomic Absorption Spectrophotometer (Solaar, 969). USA, were used.

**Preparation of samples:** The Roselle flower (*Hibiscus sabdariffa* Calyx) were carefully picked and twenty gram of the dry samples each were weighed into a clean plastic container and labeled. Boiled distilled/deionized water (400 mL) was added to each plastic bottle container (Containing 20 g each of the calyx), mixed thoroughly and allowed to stand for 30 min. The extracts were collected into a measuring cylinder, the calyx were washed with hot water and added to the extract. The extract aliquot was cooled and volume made up to 500 mL with washing from the marc. The 500 mL of the extract was transferred into a 1 L plastic bottle, which had previously been washed and rinsed with distilled/de-ionised water. Samples were kept at 5°C in the fridge prior to analysis.

**Determination of mineral elements:** Atomic absorption spectrophotometer and Flame photometer were used for the estimation of the mineral content of the Zobo drink, using distilled/de-ionised water same plastic bottle as blank. While chloride and bicarbonate ions were estimated by standard titrimetric methods (AOAC).

## RESULT AND DISCUSSION

The result of the element analysis of the two different varieties of *Hibiscus Sabdariffa* namely var. *Sabdariffa* and var. *rubra* found within the Northern region of Nigeria has the following range of mineral elements (Table 1).

The concentration of the mineral elements were found to range viz; potassium, 324.52-400.9 mg L<sup>-1</sup>; sodium, 2.58-8.52 mg L<sup>-1</sup>; calcium, 140.09-164.01 mg L<sup>-1</sup>; magnesium, 37.52-69 mg L<sup>-1</sup>; manganese, 2.4-11.6 mg L<sup>-1</sup>; iron, 0.44-4.58 mg L<sup>-1</sup>; m L<sup>-1</sup>; lead, 0.00-0.73 mg L<sup>-1</sup>; cadmium, 0.00-0.5 mg L<sup>-1</sup>; chloride, 0.001-0.9 mg L<sup>-1</sup> and bicarbonate 6.0-67.0 mg L<sup>-1</sup>. Generally, sample 11 has a slightly higher concentration of mineral element than those of sample 1. The result of Mineral analysis has shown that for the two different varieties considered in this research work the potassium was found to have the highest concentration (370.78±2.5 mg L<sup>-1</sup>), while the estimated safe and adequate daily dietary intake for potassium range for infants to adult is between 350-562 mg (Nat. Res. council-Nat. Aca. Sci, 1989. USA). Potassium is the principal intracellular cation of most body tissues. It participates in a number of essential physiological processes, such as transmission of nerve impulse, contraction of cardiac, skeletal and smooth muscles. And maintenance of normal renal function. Normal potassium serum levels range from 3.8 to 5 mEq L<sup>-1</sup>. Potassium rich diets is used therapeutically in patients with uncomplicated essential hypertension, also in cases of hypokalemia, natural potassium sources such as food and drinks rich in potassium are used for the treatment or supplement. (Drugs facts and Comparisons, 1991). Zobo drink may therefore found therapeutic use in this area of medicine. However possible toxicity could also result from consuming very high concentration of potassium from either drugs, food or drinks sources, which could result to cardiac arrest and small bowel ulcers.

Sodium concentration was found to be 5.90 + 0.76 mg L<sup>-1</sup>, while the estimated safe and adequate daily dietary intake for sodium from infants to adult range between 115-3300 mg (Nat. Res. Council-Nat. Aca. Sci., 1989, USA). Sodium is considered the backbone of body fluid, because the quantity of water in the extracellular

Table 1: Concentration of mineral ions present in extract of the calyx of *Hibiscus Sabdariffa*, (Zobo drink) Unit; mg L<sup>-1</sup>

Area	Sample code	K	Na	Ca	Mg	Mn	Fe	Zn	Pb	Cd	HCO <sub>3</sub>	Cl
Katsina	AI	388.78	5.39	150.23	67.94	7.40	0.49	0.58	0.00	0.00	6.00	9.93
	AII	373.97	4.79	157.60	69.76	5.50	0.84	0.66	0.18	0.02	6.10	19.85
Benue	BI	364.45	4.18	142.98	63.33	4.80	1.08	0.81	0.30	0.03	7.20	4.96
	BII	359.91	4.26	146.41	60.66	5.10	0.91	0.78	0.44	0.03	6.10	14.89
Plateau	CI	337.45	2.58	141.91	44.09	2.35	0.44	0.39	0.43	0.04	6.10	24.82
	CII	324.52	8.52	144.65	37.52	7.10	0.60	0.60	0.73	0.05	67.10	9.93
Jigawa	DI	354.28	5.85	140.69	45.58	9.30	0.74	0.90	0.45	0.00	6.20	24.82
	DII	400.19	6.39	145.51	46.77	4.50	0.69	0.56	0.44	0.02	67.10	29.78
Kano	EI	354.63	4.10	164.01	54.21	4.70	0.55	0.78	0.59	0.02	67.10	19.85
	EII	395.32	5.54	148.35	60.69	11.60	4.58	0.87	0.61	0.01	6.00	14.89
SampleI	Mean±SD	359.92	4.42	147.84	55.03	5.72	0.66	0.69	0.35	0.02	18.54	16.88
		±8.50	±0.58	±4.40	±4.7	±4.7	±0.1	±0.09	±0.04	±0.0001	±2.7	±4.0
SampleII	Mean±SD	370.80	5.9	148.38	55.13	6.16	1.52	0.70	0.48	0.02	30.48	17.87
		±12.50	±0.76	±2.40	±5.7	±0.3	±0.8	±0.04	±0.09	±0.009	±3.3	±3.4

Sample I = light red calyx extract; Sample II = Dark red, calyx extract

fluid is regulated by the quantum of sodium in circulation, acid-base balance, nerve and Muscle function,  $\text{Na}^+/\text{K}^+$ -ATPase control of Na/K pump. The in-take of high concentration of potassium and low concentration of sodium in the Zobo drink, may activate the  $\text{Na}^+/\text{K}^+$  pump. This may cause influx of  $\text{K}^+$  into the intracellular fluids and efflux of  $\text{Na}^+$ , accompanied with  $\text{Cl}^-$  and water, thereby resulting in diuresis and possible reduction in blood pressure. This could account for the acclaimed diuretic effect and consequently the antihypertensive effect.

The result also indicated that calcium was the second highest in concentration with its highest mean value of  $148.38 \pm 12.4 \text{ mg L}^{-1}$ , while the estimated safe and adequate daily dietary intake for calcium range for infants to adults is between 400-1200 mg (Nat. Res. Council-Nat. Acad. Sci., 1989 USA). Calcium has been found to be the fifth most abundant element in the body; the major fraction is in bone. It is essential for the functional integrity of the nervous and muscular systems, for normal cardiac function, for cell permeability and for blood coagulation. The drink could therefore be a food supplement in hypocalcemia conditions.

Magnesium concentration in the drink average ( $55.13 \pm 5.7 \text{ mg L}^{-1}$ ), while the estimated safe and adequate daily dietary intake for magnesium range for infants adults is between 40-400  $\text{mg L}^{-1}$  (Nat. Res. Council-Nat. Acad. Sci., 1989, USA). Magnesium is a co-factor in a number of enzyme systems and is involved in neuro chemical transmission and Muscular excitability, along with calcium. The drink may help to maintain this vital function in the body.

The estimated Manganese was ( $6.76 \pm 1.3 \text{ mg L}^{-1}$ ), while the estimated safe and adequate daily dietary intake for manganese range for infants-Adults is between 0.3-5.0  $\text{mg L}^{-1}$  (Nat. Res. Council-Nat. Acad. Sci., 1989 USA) Manganese is a cofactor of several enzymes such as hydrolyase, decarboxylase and transfers also required for the synthesis of Glycoprotein and proteoglycans. (Mazor and Harrow, 1971). The level of manganese estimated in the samples shows a slightly higher level than the estimated safe and adequate daily intake, this might therefore result in manganese toxicity. Manganese toxicity by inhalation poisoning produces psychotic symptoms and parkinsonism.

Estimated Zinc concentration was  $0.70 \pm 0.04 \text{ mg L}^{-1}$ , while the estimated safe and adequate early dietary intake for zinc range from infants-Adults in between 5-19 mg (Nat. Res. Council-Nat. Acad. Sci., 1989, USA).

Iron, mean concentration of  $1.52 \pm 0.8 \text{ mg L}^{-1}$  while the estimated safe and adequate daily dietary intake for Iron range from infants-Adults in between 6-30 mg (Nat. Res. Council-Nat. Acad. Sci., 1989, USA).

The estimated Lead concentration was ( $0.48 \pm 0.09 \text{ mg L}^{-1}$ ) this is considered very high, in view of the metabolism of lead. Generally  $0.40 \text{ mg L}^{-1}$  is considered the normal upper limit for blood lead, 99% of which is contained within erythrocytes. Humans are in a state of positive lead balance from day of birth, such that a slow accumulation occurs until a total body burden of 50-350 mg of lead exists by age 60. Over 90% of absorbed lead is deposited in bone, primarily dense bone, with only minor amounts excreted in hair, nails, urine (Barry, 1975; Beattie, 1974). The half life of lead in blood is approximately 25 days; in soft tissue, about 40 days and in the non labile portion of bone, more than 25 years. Thus blood lead level may decline significantly while the body's total burden of lead remains heavy. Drinking of large quantities of zobo may lead to short or long term Lead poisoning, which adversely affects many enzymes system, including gastrointestinal disturbances, anaemia, insomnia weight loss, motor weakness, muscle paralysis and Neuropathy. Cadmium was found to be  $0.02 + 0.009 \text{ mg L}^{-1}$ , the normal daily intake of cadmium through ingestion or inhalation is from 20 to 40 mg, with only 5 to 10% of this amount is absorbed.

Estimated chloride concentration was  $17.87 \pm 3.4 \text{ mg L}^{-1}$  while the estimated safe and adequate daily dietary intake for chloride from infants to Adults is between 275-5100 mg, it plays a role in the water balance, osmotic pressure and pH regulation and is necessary for the formation of HCl by the gastric mucosa (Mazor and Harrow, 1971). The low chloride content along with low sodium favours the potassium-sodium exchange and the subsequent loss of the desired sodium chloride and water in hypertensive patients.

Bicarbonate anion, with a very high mean concentration of  $30.48 + 3.3 \text{ mg L}^{-1}$  is a normal constituent of the body fluids and the normal plasma level ranges from 24-31 mEq  $\text{L}^{-1}$ .

## CONCLUSION

The extract of the calyx of Hibiscus Sabdariffa, Zobo drink, was found to be rich in mineral elements especially the macro mineral which include (potassium, calcium, chloride, magnesium and sodium). These minerals are required in amounts greater than 100 mg daily<sup>-1</sup> while the trace elements (Zinc, Manganese), usually required in amounts less than 100 mg daily<sup>-1</sup>, were found to be low in concentration in the calyx extract of zobo. While heavy metals such as cadmium and Lead were estimated in very low concentration or absent.

Considering the fact that the macro minerals constituents of Zobo were higher in concentration compared to micro mineral, makes the local beverage Zobo of a high nutritive value for promoting balance diet in the daily mineral requirement for good health and possible prevention of diseases along with its very high concentration of vitamin C.

This research work has further established the physiological importance of taking Zobo as a local beverage, since it was found that the local beverage is very rich in potassium and has a lower sodium-chloride concentration, it could be said that the drink Zobo has some therapeutic usefulness against diseases such as hypertension, cerebrovascular diseases.

The high concentration calcium and magnesium may found use in, preventing the following diseases, tetany of new born, acute and chronic hypoparathyroidism, pseudohypoparathyroidism, post menopausal and sterile osteoporosis; rickets and Osteomalacia. (Drugs facts and Comparisons, 1991).

However, excess intake of very high concentration of this local beverage Zobo in larger amount over a long period of time could result to mineral toxicity producing toxic symptoms such as non specific nausea, diarrhea and irritability.

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