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NUTRITIONAL ASSESSMENT OF JUICE EXTRACT FROM *Hibiscus sabdariffa*

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ABSTRACT

The juice extract from *Hibiscus sabdariffa* calyx was analyzed using standard methods to ascertain its nutritional qualities. The calyx of *Hibiscus sabdariffa* was found to contain 89.26±0.16% dry matter with 10.74±0.02% moisture content. The calyx was also found to contain 8.21±0.10% crude fat, 7.24±0.10% ash, 6.78±0.02% crude fibre, 11.26±0.16% crude protein, and carbohydrate was found to be 55.75±0.05%. The juice extract was found to contain both micro and macro-elements that are beneficial to human nutrition. The value ranged from 280mg/100g (calcium) to 2.44mg/100g (copper). The ascorbic acid and sugar contents of the juice were found to be 31.34±0.48mg/100g and 11.29±0.08mg/100g respectively, while the pH was determined to be 3.80±0.01. The phytochemical screening revealed the presence of alkaloids, tannins, flavonoids, cardiac glycosides, anthraquinones and saponins. The presence of these nutritive elements and the plant metabolites in moderate quantities in the juice extract justify the nutritional potential of the plant calyx.

**Keywords: *Hibiscus sabdariffa*, Proximate Composition, Mineral Elements,
Physicochemical Properties, Plant Metabolites**

INTRODUCTION

Hibiscus sabdariffa belongs to the family of the plant called malvaceae. It is commonly called Roselle in Netherland, sorrel in Jamaica and India, Cranberry in USA and

'zobo' in most part of Nigeria. The calyx is used in jams, jellies, sauces and wines productions. The fleshy calyces are used fresh for making Roselle wine, jelly, syrup, gelatin

and dried Roselle is used for tea, jelly, ice cream, butter and other desert drinks [1]. The fruit of the plant is used in soup making and juice extract consumed by the people. The positive effects of the fruits and vegetables may be associated with their high amount of several secondary plant products [2]. Many fruits including juice from *H. sabdariffa* are rich in water soluble vitamin C.

The calyx of Roselle is reported to be diuretic, digestive, antiseptic, sedative, purgative, emollient, demulcent and astringent. It has many medicinal applications to cure kidney stone, pyrexia, liver damage, hypertension and leukemia [3]. It was authenticated by another researcher that extracted juice of *H. sabdariffa* is efficient in curing hypertension [4]. Nutritionally, the juice extracted from *H. sabdariffa* commonly called zobo could be used as potential source of vitamin C concentrate, a powerful response agent and important source in the response of body to stress. The juice is said to be rich in vitamin B6, calcium, potassium and other several elements that are yet to be isolated and characterized [5]. The author further reported that hypertension is a medical emergency and requires immediate therapy by drinking freshly prepared, low sugar and refrigerated zobo, which is a cheap and affordable therapy rather than depending on scarce and

expensive antihypertensive drugs which cost as much as \$10 (₦1500) per 12 tablets.

In order to derive more benefits from this plant of hidden health importance, it is therefore necessary to determine the chemical compositions of the calyx, vitamin C, total sugar, mineral elements and phytochemicals of the juice extract with a view to ascertaining its nutritive and medicinal values.

MATERIALS AND METHODS

The calyces of *H. sabdariffa* (purple type popularly cultivated in the northern part of Nigeria) used for this research was purchased from a local market in Osogbo, Osun State, Nigeria. The samples were sorted to remove dirt and stones. They were then sun-dried for three days after which a part was rinsed with distilled water and blanched in boiled water for about 30 minutes to extract the juice from the calyces. Filtration was carried out and the filtrate was filled into an air-tight container, stored in a refrigerator for further analysis.

The other part were ground into powder and sieved with mesh 0.5mm diameter, stores in an air-tight polythene bag and kept at 4°C prior to proximate analysis. The moisture content of the powder sample (dry weight) was determined by oven-drying to constant weight in an air-oven at 105°C [6]. Fat content was determined by soxhlet extraction, ash content by igniting the sample at 550°C in a

muffle furnace and protein content by Kjeldahl technique [7]. Crude fibre was determined as outlined by AOAC (1990) [8]. The mineral elements were determined by using Flame Photometer (Gallenkham) for sodium and potassium, and Atomic Absorption Spectrophotometer (Buck model) for iron, magnesium, calcium, phosphorus, zinc, copper and manganese. The ascorbic acid and total sugar contents of the juice extract were determined using spectrophotometric method (spectronic 20) to determine the concentrations of developed colour at 520nm and 490nm respectively. The pH of the juice extract was determined with the aid of Philip Harris pH meter and standard method of AOAC (1990) [8] was used to determine titratable acidity of the juice extract. The qualitative phytochemical constituents of the juice extract were determined by the method of Sofowora (1993) [9].

RESULTS AND DISCUSSION

Table 1 shows the result of proximate analysis of the powdery sample of *H. sabdariffa* calyx. The moisture content of the powdery calyx of *H. sabdariffa* was found to be $10.74\pm 0.02\%$ which compared with values obtained for other leafy vegetables [10]. The low value reduces the tendency of microbial attack on the calyx [11] since water is a good

medium for microbial growth. The fat content of the calyx was $8.2\pm 0.10\%$; this percentage is acceptable since the tendency of having obesity and arteriosclerosis in human being is reduced [12]. These abnormalities are ascribed to high fat content in food samples. The fat content is higher than 4.9% obtained for *Ipomea batatas* leaf [13]. The result also confirmed that the calyx contained oil than common cereals [14]. The ash content of the sample was $7.24\pm 0.01\%$ and this is an indication of the level of inorganic materials present in the sample [14]. The ash content was on high side when compared to the one recorded for shoyu desalted mash residue [15] and compared favourably with 7.0% reported for *Lentinus edode* mushroom [16]. The crude protein content of *H. sabdariffa* was found to be $11.26\pm 0.16\%$, which was lower than 28.5% recorded for peanuts [17] but closer to 12.50% recorded for *Letinus edode* mushroom [18]. The crude fiber content of the sample was $6.78\pm 0.02\%$ and since fiber determines the degree of digestibility of food in animals, this value would help in human digestion [19]. The carbohydrate content was found to be $55.75\pm 0.05\%$ by difference. This was higher than 35.30% to 42.90% for 25 varieties of soybeans harvested in United State and Canada [20]. This value fell within

the range of the contents of *Pleurotus* mushrooms of 46.6% to 61.8% [21].

The mineral elements compositions of the sample were shown in **Table 2**. Calcium recorded the highest value (280.00mg/100g) widely followed by magnesium with a value of 195.40 195.40mg/100g, while the least value of 2.44mg/100g was associated with copper. This reveals that *H. sabdariffa* could easily serve as a good source of both micro and macro elements that are required in man's diet. The elements are present in appreciable quantities needed by the body. The concentration of phosphorus in the sample was 34.50mg/100g. It is vitally concerns with many metabolic processes, including those involving the buffers in body fluids [22]. It functions as a constituent of bones and teeth, adenosine triphosphate (ATP), phosphorylated metabolic intermediates and nucleic acids. Calcium had a value of 280mg/100g. It functions as a constituent of bone and teeth, regulation of nerve and muscle. The value obtained in this study was high enough to activate the conversion of prothrombin to thrombin (in blood coagulation) and also takes part in milk clotting [23]. The concentration of sodium was determined to be 80.70mg/100g. This metal regulates plasma volume and acid-base balance, involves in the maintenance of

osmotic pressure of the body fluids, preserves normal irritability of muscles and cell permeability, activates nerve and muscle [23]. The value obtained for potassium (160.50mg/100g) was moderate. This mineral element balances acid-base content of the body, regulates osmotic pressure and conducts nerve impulse, muscle contraction particularly, the cardiac muscle, and cell membrane [23]. Magnesium is an active component of several enzyme systems in which thymine pyrophosphate is a cofactor. Oxidative phosphorylation is greatly reduced in the absence of magnesium [24]. 195.40mg /100g obtained for magnesium in this study is also moderate. Copper is an essential micro-nutrient necessary for the haematologic and neurologic systems [25]. This trace metal had the least value among the metals investigated. It is necessary for the growth and formation of bone, formation of myelin sheaths in the nervous systems, helps in the incorporation of iron in haemoglobin, assists in the absorption of iron from the gastrointestinal tract (GIT) and in the transfer of iron from tissues to the plasma [24]. Iron was determined to be 58.80mg/100g. It functions as haemoglobin in the transport of oxygen. Manganese had a value of 33.80mg/100g. It is a cofactor of hydrolase, decarboxylase, and transferase enzymes [24].

The results of ascorbic acid, total sugar, titratable acidity and pH of the juice extract were shown in **Table 3**. The ascorbic acid (vitamin C) content of the juice extract was found to be $31.24 \pm 0.48 \text{mg}/100\text{g}$, which is high enough compared to vitamin C content of pasteurized straw berry which was found to be $36.0 \pm 1.9 \text{mg}/100\text{g}$ and lower compared with that of orange with a value of $45.0 \text{mg}/100\text{g}$ [26]. The vitamin C content of this juice was higher than $15.20 \pm 0.02 \text{mg}/100\text{g}$ obtained for sweet potato leaf [13] and $9.8 \pm 1.2 \text{mg}/100\text{g}$ for *Strolilanthos crispus* leaf [27]. The value was in consonance with $31.33 \text{mg}/100\text{g}$ reported for the same calyx by Fasoyiro et al [3]. It was also greater than $3.30 \text{mg}/100\text{g}$ to $31.33 \text{mg}/100\text{g}$ obtained for some common south eastern local fruits in Nigeria [28] and $11.50 \text{mg}/100\text{g}$ for orange juice by Onuorah [29]. The vitamin C content was in agreement with those obtained for avocado ($30.00 \text{mg}/100\text{g}$, $28.24 \text{mg}/100\text{g}$), lower than guava ($51.02 \text{mg}/100\text{g}$, $50.30 \text{mg}/100\text{g}$) and greater than apple ($11.73 \text{mg}/100\text{g}$, $6.00 \text{mg}/100\text{g}$) by voltametric and titrimetric methods respectively [30]. It is known to be essential in prevention of scurvy in infants. The extract also serves as one of the cheap and rich source of vitamin C, which could easily be afforded by local people instead of wasting their hard earn

money to purchase manufactured source of vitamin C. The total sugar content of $11.29 \pm 0.01 \text{mg}/100\text{g}$ is low and therefore could be useful for diabetic patients in order not to increase their blood sugar. The lower pH of 3.80 ± 0.01 is in agreement with 3.10 to 3.90 reported by other researchers [3, 31] in their previous works. The pH of fresh orange obtained by Onuorah [29] was given as 3.7, this value is close to that obtained for Roselle juice in this study. The pH of the drink suggests that the drink may contain enough natural acids which may prevent it from fast degradation and thereby prevent the growth of some microorganisms and increase shelf life [32].

Table 4 depicts some secondary metabolites that are present in the juice extract. The presence of glycosides in the juice extract thus gives credence to its popular use in the treatment of hypertension. Saponins are glycosides of both triterpenes and steroids having hypertensive and cardiac depressant properties [33]. Saponins binds to cholesterol to form insoluble complexes, this prevents cholesterol re-absorption and results in a reduction of serum cholesterol. It has also been found out that saponins are potentially useful for the treatment of hypercholesterolemia, which suggests that they might be acting by interfering with

intestinal absorption of cholesterol [34]. Alkaloids comprised a large group of nitrogenous compounds which are widely used as cancer chemotherapeutic agents [35]. The presence of alkaloids in ample quantity proves its usefulness in folk medicine. Flavonoids are a group of phytochemicals found in varying amounts in foods and medicinal plants which have been shown to exert potent antioxidant activity against the superoxide radicals. Its consumption has been documented not to be associated with coronary heart disease mortality [36].

Epidemiologic studies indicate an inverse relationship between intake of dietary flavonoids and coronary atherosclerotic disease [37]. Therefore, the presence of flavonoids in this plant may give support to their therapeutic effects especially in the treatment of hypertension. Jonadet *et al* [38] has reported *in vivo* cardioprotective activities of *H. sabdariffa* protocatechuic acid (PCA), a phenolic compound, found in the dried flower of the plant. The presence of these metabolites probably explains the various uses of this plant in traditional medicine.

Table 1: Result of Proximate Compositions of *Hibiscus sabdariffa* Calyx (%).

Component	Mean value \pm SD
Moisture	10.74 \pm 0.02
Dry Matter	89.26 \pm 0.16
Crude Fat	8.21 \pm 0.10
Ash Content	7.24 \pm 0.10
Crude Fibre	6.78 \pm 0.02
Crude Protein	11.26 \pm 0.16
Carbohydrate	55.75 \pm 0.05

Note: Data are Means of Triplicate Determinations \pm Standard Deviation

Table 2: Result of Mineral Elements of the Juice Extract From *H. sabdariffa* (mg/100g)

Mineral element	Concentration
Sodium (Na)	80.70
Calcium (Ca)	280.00
Magnesium (Mg)	195.40
Iron (Fe)	58.80
Phosphorus (P)	34.50
Potassium (K)	160.50
Zinc (Zn)	81.40
Copper (Cu)	2.44
Manganese (Mn)	33.80

Table 3: Result of Physicochemical Properties of *H. sabdariffa* Juice Extract

Parameter	Mean \pm SD
Ascorbic Acid	31.24 \pm 0.48mg/100g
Total Sugar	11.29 \pm 0.08mg/100g
pH	3.80 \pm 0.01
Titrateable acidity	2.45 \pm 0.12%

Note: Data are Means of Triplicate Determinations \pm Standard Deviation

Table 4: Qualitative Phytochemical Constituents of the Juice Extract of *H. sabdariffa*

Metabolite	Inference
Saponins	+
Tannins	+
Phlobatannins	-
Anthraquinones	++
Flavonoids	++
Alkaloids	+++
Cardiac glycosides	+
Steroids	-

NOTE: Legend: - = Absent; + = Present in Trace; ++ = Moderately Present; +++ = Fully Present

CONCLUSION

The results obtained from this study revealed that *H. sabdariffa* is good for human consumption especially among local and less privilege people, who could not afford to buy meat and fish for their meals. The elements such as calcium and magnesium which are useful for normal development of teeth and bone are present in appreciable amount. The vitamin C, which helps the body in forming connective tissues, bone, teeth, blood vessels and play a major role as an antioxidant, that form part of the body defense mechanism against reactive oxygen species and free radicals by preventing tissue damage, is also found to be present in sufficient quantity. High amount of ascorbic acid and low sugar

content of the juice extract could make it a very good drink for diabetic patients. Caution should be taken in large consumption most especially in patient with ulcer history because of its slightly low pH, which is an indication of the juice acidity. It is therefore recommended that further studies should be carried out on the anti-nutritional components of this plant of hidden health benefits and other varieties of the same species should be analyzed in order to ascertaining their nutritional benefits.

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