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Mineral and Vitamin Composition of Plain and Turmeric Enriched *Hibiscus sabdariffa* Drink

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study aimed at producing and analyzing the micronutrient composition of plain and turmeric enriched *Hibiscus sabdariffa* drink. Plain *Hibiscus sabdariffa* drink (sample A) was produced using dried rosella calyces (125g) and water (1500ml) while turmeric enriched *Hibiscus sabdariffa* drink (sample B) was produced using dried rosella calyces (125g), water (1500ml) and turmeric (100g). The extracts were allowed to cool at ambient temperature (29^{o}C) for 2 hr in clean bowls. The filtrate was then used for the chemical analysis. The minerals were determined using wet-acid digestion method as described by AOAC and vitamins were determination using spectrophotometric and titration methods respectively. Means and standard deviation were calculated and means were compared using student-T test. Calcium (103.81mg/100g), phosphorus (190.59mg/100g), sodium (21.10mg/100g), iron (13.18mg/100g), zinc (3.35mg/100g) and copper (630µg/100g) were significantly higher in turmeric enriched *Hibiscus sabdariffa* drink, while phosphorus (105.79mg/100g) was significantly higher in plain *Hibiscus sabdariffa* drink. Thiamin content (0.16mg/100g) of turmeric enriched *Hibiscus sabdariffa* was not significantly different from thiamin value (0.15mg/100g) obtained for plain *Hibiscus sabdariffa* drink. Niacin (0.86mg/100g) and β-carotene (108.85µg100g) were however significantly ($p>0.05$) higher in turmeric enriched *Hibiscus sabdariffa* drink. Incorporating turmeric in *Hibiscus sabdariffa* drink production has been shown to

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increase the micronutrients composition of *Hibiscus sabdariffa* drink, particularly key nutrients such as iron, zinc and β-carotene (pro-vitamin A) that are critical for proper body functioning and development.

Keywords: Hibiscus sabdariffa; turmeric; mineral; vitamin; enriched.

1. INTRODUCTION

Hibiscus sabdariffa drink is a non-alcoholic beverage made from the calyces of *Hibiscus sabdariffa* [1,2]. *Hibiscus sabdariffa* drink is a preferred drink because it is indigenous to the people and has appreciable levels of carbohydrate, protein, minerals and vitamins compared to most carbonated drinks. Its acceptability among all age group has made it an important vehicle for the consumption of other indigenous spices with health benefit effects. Common indigenous spices used in the production of *Hibiscus sabdariffa* drink include ginger, black pepper, and cloves [3]. There are no to show that turmeric could be used as a spice in the preparation of *Hibiscus sabdariffa* drink.

Curcumalonga. Linn commonly referred to as turmeric belongs to the ginger family *Zingiberaceae* and it *is* native to the Indian subcontinent and South-East Asia [4,5]; it is a tropical perennial, rhizomatous, monocotyledonous, herbaceous plant [6]. Turmeric plant grows up to 3-5 ft. tall and produces dull yellow flowers with no seeds. The leaves are alternate and arranged in two rows and are divided into leaf sheath, petiole, and leaf blade [7]. Turmeric is primarily used as an additive for coloring products [8]. It is used in food industry in the amount of 5-500 mg / kg, depending on the food category [9,10]. Apart from its culinary uses, it has a wide spectrum of pharmacological properties [11,12]. In Nigeria like most other countries, the use of turmeric is limited to being that of a colourant or spice in some dishes [13]. Incorporating turmeric in *Hibiscus sabdariffa* drink production may increase its consumption in individuals; thus enhancing their nutritional status in the long run. This work is therefore designed to produce and evaluate the nutrient composition of plain and turmeric enriched *Hibiscus sabdariffa* drink.

2. MATERIALS AND METHODS

2.1 Source of Raw Materials

Dried calyces of Roselle (*Hibiscus sabdariffa*) were bought from Funtua Market, Katsina State. Turmeric rhizome (*Curcuma longa* .L), black pepper (*Piper nigrum*), iodized sugar, and cloves (*Syzygium aromaticum*) were purchased at Isi-gate in Umuahia, Abia State, Nigeria.

2.2 Raw Material Preparation

Stones and other extraneous materials were manually picked from the roselle calyces. Thereafter the calyces were washed under running tap water to remove adhering dust. The turmeric rhizomes were washed under running tap water. The skin of the turmeric was manually scraped off using a kitchen knife and sliced into small pieces of 2cm thickness using a kitchen knife and kept in a dish for further usage.

2.3 Preparation of *Hibiscus sabdariffa* Drinks

The plain *Hibiscus sabdariffa* (sample A) drink was prepared by adding dried rosella calyces (125g) and 1500ml of water in an iron pot and boiled for 20 mins at a temperature of 100^{o}C over a gas cooker.

Plain *Hibiscus sabdariffa* drink (sample A) was produced using dried rosella calyces (125g) and water (1500ml) while turmeric enriched *Hibiscus sabdariffa* drink (sample B) was produced using dried rosella calyces (125g), water (1500ml) and turmeric (100g). The extracts collected were allowed to cool at ambient temperature (29^{o}C) for 2 hr in clean bowls, after which 50ml of sugar syrup was added to extract and stirred with a clean stirrer. Each *Hibiscus sabdariffa* sample was poured into a plastic container sealed tightly, and carried to the analytical laboratory for analysis.

2.4 Determination of Mineral Content of *Hibiscus sabdariffa* Drinks

Minerals were determined using wet-acid digestion method for multiple nutrients determination as described by the method of AOAC [11]. The digest was used for the determinations of calcium (Ca) and magnesium (Mg) using the ethylamine ditetra acetic acid

(EDTA) Versanate complexiometric titration method. Sodium (Na) was evaluated using flame photometry method and phosphorus (P) by the vanadomolybdate method using the spectrophotometer (Model 3030, Perkin Elmer, Norwalk USA). Microminerals (Zn, Fe, Cu) were determined by Atomic Absorption Spectrophotometer (Model 3030 Perkin Elmer, Norwalk USA).

2.5 Determination of Vitamin Content of *Hibiscus sabdariffa* Drink

The β – carotene (pro-vitamin A), riboflavin, niacin and thiamin of the products were determined spectrophotometrically, and ascorbic acid (using titration method) as described by AOAC [14].

2.6 Statistical Analysis

The data generated from duplicate analysis were analyzed using Statistical product for service solution (SPSS version 20). Means and standard deviations were calculated. Means were compared using student-T test. All calculations were done at 5% level of significance ($p< 0.05$).

3. RESULTS AND DISCUSSION

3.1 Mineral Composition of Plain and Turmeric Enriched *Hibiscus sabdariffa* Drink

Mineral composition of the drinks is presented in Table 1. The calcium content (103.81mg/100g) of turmeric enriched *Hibiscus sabdariffa* drink was significantly ($p>0.05$) higher than the calcium content (18mg/100g) of plain *Hibiscus sabdariffa* drink. Higher calcium value obtained in turmeric enriched *Hibiscus sabdariffa* could be due to the fact that turmeric is naturally a good source of calcium. When compared to other studies the value of calcium (18.52mg/100g) obtained in plain *Hibiscus sabdariffa* drink was higher than value of calcium (2.8mg/100g) in a similar study [3] but lower (1756mg/100g) as reported Adesokan et al. [15] for unspiced *Hibiscus sabdariffa* drink. Reasons for this disparity are not clear but it is possible that differences in processing method and amount of ingredient used in the preparation of the drink may be responsible for the variation in calcium values. The magnesium content (190.50mg/100g) of turmeric enriched *Hibiscus sabdariffa* drink was observed to be significantly lower than that of plain *Hibiscus sabdariffa* drink (210.85mg/100g). This could be because turmeric is a poor source of magnesium. The phosphorus and sodium values (196.26 and 21.10mg/100g respectively) of turmeric enriched *Hibiscus sabdariffa* were significantly ($p>0.05$) higher than the values of phosphorus (105.79mg/100g) and sodium (6.65mg/100g) in plain *Hibiscus sabdariffa* drink. Though higher sodium value was obtained for turmeric enriched *Hibiscus sabdariffa* drink, this amount may not be of any health implication for healthy individual as the sodium obtained was far lower than the Recommended Daily Intake of 200mg/d for the maintenance of physiological functions [16]. Sodium is needed in the body to maintain fluid balance within and outside the cells [17] while phosphorus is needed in the body for proper bone formation and maintenance of acid-base balance in the body. Results of micro-minerals showed that the plain *Hibiscus sabdariffa* drink was a good source of iron (10.71mg/100g), zinc (2.05mg/100g) and copper (500µg/100g), incorporating turmeric in *Hibiscus sabdariffa* drink production however increased the iron, zinc and copper values of *Hibiscus sabdariffa* drink with 23, 63 and 26% . When compared to other study the values of iron (10.71 and 13.18mg/100g) and zinc (2.05 and 3.35mg/100g) were higher than iron (0.85 – 1.14mg/100g) and zinc (0.84 – 0.97mg/100g) values reported for a similar study [18]. Lower values of iron and zinc obtained in that study could be because the drink was produced using *Hibicus sabdariffa* leaves instead of the calyces as in the case of the current study.

Table 1. Mineral composition of plain and turmeric enriched *Hibiscus sabdariffa* drink

Nutrients	Sample A	Sample B
Calcium (mg/100g)	18.52^{b} ± 0.02	103.81^{a} ± 0.26
Magnesium(mg/100g)	210.85^{a} ± 0.77	190.50^{b} ± 0.27
Phosphorus(mg/100g)	105.79^{b} ± 1.56	196.26^{a} ± 0.11
Sodium(mg/100g)	6.65^{b} ± 0.07	21.10^{a} ± 0.14
Iron(mg/100g)	10.71^{b} ± 0.29	13.18^{a} ± 0.02
Zinc(mg/100g)	2.05^{b} ± 0.07	3.35^{a} ± 0.00
Copper(µg/100g)	500^{b} ± 0.02	630^{a} ± 0.02

Values of mean ± standard deviation of duplicate samples
Key: Sample A – Plain Hibiscus sabdariffa drink;
Sample B- turmeric enriched Hibiscus sabdariffa drink

Table 2. Vitamin compositions of plain and turmeric enriched *Hibiscus sabdariffa* drink

	Sample A	Sample B
Thiamin (mg/100g)	$0.15^{a} \pm 0.00$	$0.16^{a} \pm 0.00$
Riboflavin (mg/100g)	$0.62^{b} \pm 0.02$	$0.68^{a} \pm 0.00$
Niacin (mg/100g)	$0.06^{b} \pm 0.02$	$0.86^{a} \pm 0.05$
Vitamin C (mg/100g)	$5.60^{b} \pm 0.00$	$5.85^{a} \pm 0.39$
B-carotene (mcg/100g)	$36.76^{b} \pm 0.05$	$106.85^{a} \pm 1.91$

Values of mean ± standard deviation of duplicate samples
Key: Sample A – Plain Hibiscus sabdariffa drink;
Sample B- turmeric enriched Hibiscus sabdariffa drink

3.2 Vitamin Composition of Plain and Turmeric Enriched *Hibiscus sabdariffa* Drink

The vitamin composition of plain and turmeric enriched ***Hibiscus sabdariffa*** drink is shown in Table 2. The result showed that both products are good sources of thiamin (0.15 and 0.16mg/100g respectively) and riboflavin (0.62 and 0.68 mg/100g respectively) but poor sources of niacin and vitamin C. Thiamin value (0.16mg/100g) obtained for turmeric enriched *Hibiscus sabdariffa* drink was not significantly higher than the thiamin value (0.15mg/100g) obtained for plain *Hibiscus sabdariffa* drink. Other water soluble vitamins (riboflavin, niacin and vitamin) analysed were however significantly higher in turmeric enriched *Hibiscus sabdariffa* drink compared to values obtained plain *Hibiscus sabdariffa* drink. Riboflavin (0.68mg/100g), niacin (0.86mg/100g) and Vitamin C (5.85mg/100g) were significantly higher than the values (0.62, 0.06 and 5.60mg/100g) obtained for plain *Hibiscus sabdariffa* drink. Even though turmeric did not add appreciable amount of thiamin to the drink, other water soluble vitamin analysed were significantly increased particularly niacin which increased with over 13-folds over the value (0.06 mg/100g) of niacin in plain *Hibiscus sabdariffa* drink. Vitamins are micronutrients needed in very small (>100mg/d) amount in the body [19], they are however very essential in the body for proper physiological activities; their absence in diets result in clinical symptoms. Deficiency of thiamin is known to cause beriberi [20], riboflavin – ariboflavinosis [21] and niacin – pellagra [22]. Being a good source B- vitamins, consumption of *Hibiscus sabdariffa* drink particularly *Hibiscus sabdariffa* enriched with turmeric will prevent the occurrence of beriberi, ariboflavinosis and pellagra. Although vitamin C is low in the two products, their consumption together with other foods rich in vitamin C will increase cumulative intake of the vitamin. Vitamin C plays significant role in diets rich in plant iron as it is known to convert plant iron (Fe^{3+}) to absorbable iron (Fe^{2+}). The β-carotene content of turmeric enriched *Hibiscus sabdariffa* drink (106.85µg/100g) was significantly higher than that of plain *Hibiscus sabdariffa* drink (36.76µg/100g). β-carotene is pro-vitamin A as well as an antioxidant. A moderate availability of β-carotene in turmeric enriched *Hibiscus sabdariffa* drink is one way of improving vitamin A status as well as preventing some non-communicable diseases such as cancer and night blindness in individuals that may consume it.

4. CONCLUSION

The study showed that most o the minerals and vitamins analysed (with the exception of magnesium) were significantly higher in turmeric enriched *Hibiscus sabdariffa* drink. Consuming turmeric enriched *Hibiscus sabdariffa* drink rather than plain *Hibiscus sabdariffa* drink could be a surer way of increasing micronutrient intake and thus a means of preventing nutrient deficiency diseases.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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