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Nutrients and Organoleptic Properties of Soup and Stew made from *Glossocalyx brevipes* (Benth)

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Abstract

Proximate composition, nutrient composition and sensory evaluation of soup and stew made from *Glossocalyx brevipes* (Benth) were investigated. The proximate analysis showed that the moisture contents of the soup and stew ranged from 6.25 – 7.52%, protein 18.03 – 21.65%, fat 13.04 – 19.23%, crude fibre 6.12 – 7.58%, ash 6.10 – 6.89%, and carbohydrate 38.32 – 80.80% on wet weight basis. The result for the minerals and vitamin determination showed that the calcium content of the soup and stew samples ranged from (3.57 – 4.20mg/100g, iron (1.01 – 91.80mg/100g), magnesium (0.61 – 1.28mg/100g), sodium (0.30 – 0.33mg/100g), potassium (1.25 – 1.73mg/100g), manganese (1.01 – 92.13mg/100g), zinc (58.87 – 68.15mg/100g), copper(31.36 – 36.28mg/100g), pro -vitamin A (0.51 – 1.06mg/100g), niacin (0.38 – 0.49mg/100g), riboflavin (0.20 – 0.95mg/100g), pyridoxine (0.43 – 0.50mg/100g), cyanocobalamine (0.37 – 1.36mg/100g), vitamin E (2.82 – 3.30mg/100g) and vitamin C (2.91 – 3.53mg/100g).The results of the sensory evaluation indicated that *G. brevipes* stew leaf had the highest sensory attributes when compared to other products. In conclusion, the soup and stew made from *G. brevipes* leaf and bark contains nutrients, vitamin and mineral elements that are of high nutritional value. However, focusing our attention on underutilized vegetables is an effective way to help maintain a diverse and healthy diet and to combat micronutrient deficiencies and other dietary deficiencies particularly among the rural poor and the more vulnerable social groups.

Keywords: Nutrients, soup, *Glossocalyx brevipes, diet,* underutilized vegetables.

Introduction

There are different types of vegetables and each group contributes in its own way to the diet. Vegetables are regular ingredients in the diet of an average Nigerian and they are the cheapest, highly valuable and most available sources of important nutrients including protein, mineral elements, vitamins, fibre, essential amino acids and other nutrients which are usually in inadequate supply in daily diets (Adeniyi, Olufunmilayo & Akinnuoye, 2018). They play prominent roles in the traditional-food culture and various ethnic groups consume a variety of

different indigenous types of vegetable for different reasons, some have medicinal properties reserved for the sick and their recuperation (Mensah et al., 2008). Generally, vegetables are widely designated as "protective foods" in human diet due to their varied health benefits attributable to the richness in vitamins, essential fatty acids, minerals, amino acids and dietary fiber and various essential bioactive compounds (Shukla, Kumar & Raib, 2016).

G. brevipes (Benth) is a shrub 8m high of the lowland rainforest, recorded only in south Nigeria, West and East Cameroun. The bark is fibrous and aromatic, the flower has a flavour of nutmeg. It has young branches with fascicles of short stiff hairs. The leaves are oblong, long-acuminate, 20cm long, 6.5cm wide, obliquely cordate at the base, quite entirely glabrous above. It is hairy beneath especially on the nerve and the petiole is 5mm long. The flowers are in auxiliary fascicles; pedicels are villous and 1cm long. The perianth 4mm in diameter, oblique, green, and pubescent outside; the lip is about 5cm long, 4mm wide at the base and triangular. The carpels are about 5 in number, fusiform, and hairy. *G. brevipes* plant is used as folk medicine to treat the problem of diarrhoea and dysentery in Omuooke Ekiti, western Nigereia.

In most local Nigerian diets, approximately half of the leafy vegetables consumed are from indigenous sources constituting significant micronutrient sources especially in times of drought and famine (Lockett *et al*, 2000). Leafy vegetables alleviate the problems of micronutrient malnutrition dominant in tropical Africa (Ejoh, 2005; Grivetti and Ogle 2000). Adding a small amount of vegetable in one's food intake can prevent disease spread. The use of green leafy vegetables for the preparation of soup cuts across different cultures within Nigeria and other parts of West Africa with similar cultural and socioeconomic background. In addition, *G. brevipes* are used in the diet of postpartum women during which time it is claimed that they aid the contraction of the uterus. It is worthwhile to note that consumption of numerous types of edible plants as sources of food could be beneficial to nutritionally marginal population especially in developing countries where poverty and climate change is causing havoc to rural populace.

According to IPGRI (International Plant Genetic Resource Institute, 2002), neglected and underutilized plant species are often considered 'minor crops' because they are less important than staple crops and agricultural commodities in terms of global production and market value. However, from the standpoint of the rural poor who depend on many of these species for their food security, nutrition and income, they are hardly minor. They may also be underutilized in terms of their potential to contribute to the income and well-being of the poor and to global food security in general. These species are also described as "neglected" or "orphan" plants since they have received scanty attention from research and development, and

there is little scientific information about them (Otitoju et al., 2014). Their potential economic value remains "underexploited" (Padulosi, 2002).

The specific objective of the study was to analyse the proximate composition of soups and stews made from *Glossocarlyx brevipes*. Similarly, analysis of vitamins and mineral contents as well as the evaluation of sensory attributes of the soups and stew were carried out.

Methodology

Materials: The leaves and bark of *G. brevipes* was collected from Aroju farm, Omuooke, Ekiti State in the Western part of Nigeria. One kilogram of the leaf was collected and cleaned by hand picking to remove extraneous materials. The leaf was washed in de-ionized water to remove dirt's. The leaf was drained in a winnower. Thereafter, the 1kg sample was divided into 500g each. Each part was chopped into small piece.

One kilogram of the bark sample collected was cleaned by hand picking and washed to remove extraneous materials. The sample was pound with mortar into pulp and afterward ground with grinding stone to a smooth paste. It was moulded into balls and sun dried. It was packaged in an air tight container.

Recipe development for the soup and stew: Traditional recipe was developed and used to prepare the soup and stew. These were done by weighing the quantities of different ingredients used in the preparation of the soup and stew made from *Glossocalyx brevipes*, by the local women (Table 1 and 2).

Table 1: Recipe for soup made from G. brevipes leaf or bark samples

Ingredients	Qty.
G. brevipes leaf/bark	45g/200g
Palm oil	200ml
Water	0.4liter
Pepper	25g
Onions	125
Okra	251g
Locust bean	5g
Maggi	25g
Salt	2g
Crayfish	125g
Stock fish	450g
Smoked fish	200g
Beef	1kg

Method of Preparation for *G. brevipes* (B) Leaf Soup

1. The meat for the soup was seasoned with pepper, onions, maggi, and salt in a sauce pan. It was allowed to marinade for 30minutes and then cooked under low temperature to tenderize the meat for 30minutes.
2. The stock fish and smoked fish were washed separately in a bowl of hot salt water twice to wash off the possible contaminants and dirt's during packaging.
3. Separate the beef and the stock. To the stock, add the stock fish and smoked fish with a little amount of palm oil. Allow to cook for 20minutes.
4. Gradually add the other ingredients in this order; crayfish, locust beans, diced onions and pepper.
5. Stir the soup evenly and allow cooking. Add the chopped okra into

the soup and cover the sauce pan to cook for 10minutes.

6. Finally, cut the *G. brevipes* vegetable and add to the soup, allow the vegetable to cook for 5minutes and then bring down.

Method of Preparation of *G. brevipes* Bark Soup

1. Repeat methods 1 to 6 above.
2. Finally, make a paste of the caked bark and stir into the soup. Allow to cook for 10minutes and bring down.

Table 2: Recipe for stew made from G. brevipes leaf or bark samples

Ingredients	Qty.
G.brevipes leaf/bark	25g/200g
Palm oil	200ml
Water	0.25liter
Pepper	25g
Onions	400
Tomatoes	325g
Locust bean	3g
Maggi	15g
Salt	2g
Crayfish	125g
Smoked fish	400g
Beaf	1kg

Methods of Preparation of *G. brevipes* Leaf Stew

1. Season the meat for the soup with pepper, onions, magi, and salt in a sauce pan. Allow to marinade for 30minutes and then cook under low temperature to tenderize the meat for another 30minutes.
2. Wash the smoked fish in a bowl of hot salt water twice to wash off any extraneous materials.
3. Separate the beef and the stock in a separate sauce pan. Thereafter, blend the fresh tomatoes and pepper together.
4. In another sauce pan, add a little quantity of palm oil and blanch for few seconds, add the sliced onions and the blended tomatoes. Stir continuously until the tomatoes is dry.
5. Add the stock and boil for 5minutes.
6. Gradually add the other ingredients in these order; crayfish, locust beans, salt and maggi.
7. Finally, add the macerated leaf of *G. brevipes* to the stew. Cook for 5minutes and bring down.

Methods of Preparation of *G. brevipes* Bark Stew

1. Repeat methods 1 to 6 above.
2. Finally, make a paste of the cake bark and stir into the soup. Allow to cook for 10minutes and then bring down.

Proximate Composition and Nutrient Analysis

The proximate composition of the soup and stew made from *G. brevipes* (B) leaf and bark was determined by Association of Official Analytical Chemists (AOAC, 2005) was used to determine the moisture, crude protein, crude fat, total ash and crude fibre contents of each sample. Calcium, copper, iron, zinc, magnesium, potassium, phosphorus and manganese contents of the soup and stew were determined using AOAC, (1995).

Vitamins E and C were determined using the Institute of Public Analytes, (2005). Pro - vitamin A and thiamine content was determined using Harborne method as described by Pearson, (1976). Riboflavin, pyridoxine, cyanocobalamin contents was determined using atomic absorbance spectrophotometer (Onwuka 2005).

Sensory Evaluation

Population of study: The population of this study consisted of students in various programmes in the Department of Home Science, Nutrition and Dietetics, University of Nigeria, Nsukka.

Sample panel: A panel of 20 women was selected at random sampling from the final year class of Home Science, Nutrition and Dietetics to determine the sensory attributes of test products. The sensory evaluation was conducted in one day using the food and diet therapy laboratory. The laboratory was large enough to accommodate 20 women. Each of the panelists was seated comfortably with windows opened for proper ventilation; fluorescent lightening and the environment were free from distractions.

Instrument for the study: The judges evaluated the samples using a nine point hedonic scale, where 9 was the highest score and one the lowest score. The soup and stew were presented to each of the panelist as coded in the hedonic scale. Each panelist were given serving bowl, with spoon and a cup of water to rinse their mouth after testing each sample to avoid carrying over effect. Ambient room temperature was maintained throughout the testing session. The soup and stew were evaluated by the panelists for flavour, texture, colour, taste and general acceptability.

Data collection Procedure: The sensory evaluation hedonic scoring form with the codes of the products was placed near the product so that each judge collects one and fills accordingly. These forms were collected at the end of the evaluation for data analysis.

Nutrient Analysis: The proximate composition of the soup and stew made from *G. brevipes* (B) leaf and bark was determined by Association of Official Analytical Chemists (AOAC, 2005) was used to determine the moisture, crude protein, crude fat, total ash and crude fibre contents of each sample. Calcium, copper, iron, zinc, magnesium, potassium, phosphorus and manganese contents of the soup and stew were determined using AOAC, (1995). Vitamins E and C were determined using the institute of public analytes, (2005). Pro - vitamin A and thiamine content was determined using Harborne method as described by Pearson, (1976). Riboflavin, pyridoxine, cyanocobalamin contents was determined using atomic absorbance spectrophotometer (Onwuka 2005).

Statistical Analysis: Data generated from the study was statistically analyzed using SPSS (Statistical Package for Social Sciences) to calculate the mean and Standard deviation and Duncan's New Multiple Range Test was used to separate the means. The analysis was done in triplicates. Significance was accepted at ($p < 0.05$).

Results

Table 3: Proximate composition of soup and stew made from *G. brevipes* (Benth) leaf and bark

Nutrients (%) (100g/sample)	Gbsl	Gbsb	Gbpl	Gbpb
Moisture	6.25 ± 1.20[a]	6.34 ± 0.61[a]	7.52 ± 2.20[a]	6.94 ± 1.10[a]
Protein	18.03 ± 1.69[a]	21.65 ± 2.29[a]	20.73 ± 6.49[a]	20.83 ± 1.51[a]
Fat	13.04 ± 2.54	18.93 ± 3.01	19.23 ± 1.70	16.22 ± 1.12
Carbohydrate	48.28 ± 0.64[a]	40.53 ± 7.01[a]	38.32 ± 7.60[a]	42.91 ± 3.43[a]
Crude fibre	7.58 ± 1.53[a]	6.12 ± 0.56[a]	7.31 ± 0.76[a]	7.01 ± 2.15[a]
Ash	6.82 ± 1.60[a]	6.43 ± 1.36[a]	6.89 ± 1.22[a]	6.10 ± 1.26[a]

Mean ± SD of samples in triplicates
Mean values of different alphabets are statistically significant at $p < 0.05$
Gbsl = *Glossocalyx brevipes* stew leaf
Gbsb = *G. brevipes*stew bark
Gbpl = *G. brevipes*soup leaf
Gbpb = *G. brevipes*soup bark

Table 3 shows the proximate composition of soup and stew made from *G. brevipes* leaf and bark. The *G. brevipes* soup leaf (Gbpl), had the highest moisture content (7.52%) while the *G. brevipe s*stew leaf (Gbsl) had the least (6.25%). *G. brevipes* stew bark (Gbsb) had the highest protein content (21.65%) while the *G. brevipes* stew leaf (Gbsl) had the least (18.03 %). The *G. brevipes* soup leaf (Gbpl) had the highest fat content (19.23%) while the *G. brevipes* stew leaf (Gbsl) had the least (13.04 %). The G. *brevipe*s stew leaf (Gbsl) had the highest crude fibre content 7.58% while the *G. brevipes* stew bark (Gbsb) had the least 6.12%. The *G. brevipes* soup leaf (Gbpl) had the highest ash content (6.89%) while the *G. brevipes* soup bark (Gbpb) had the least 6.10%. The *G. brevipes* stew leaf (Gbsl) had the highest carbohydrate content 48.28% when compared to others.

Table 4: Vitamin composition of soup and stew made from *G. brevipes* (Benth) leaf and bark

Vitamins (mg/100g)	Gbsl	Gbsb	Gbpl	Gbpb
Pro vitamin A	0.51 ± 0.43[a]	1.06 ± 0.31[a]	0.89 ± 0.09[a]	1.01 ± 0.09[a]
Vitamin B_1	0.45 ± 0.45[a]	0.49 ± 0.03[a]	0.40 ± 0.06[a]	0.38 ± 0.09[a]
Vitamin B_2	0.73 ± 0.20[a]	0.20 ± 0.06[a]	0.95 ± 0.75[a]	0.38 ± 0.36[a]
Vitamin B_6	0.43 ± 0.70[a]	0.43 ± 0.11[a]	0.45 ± 0.06[a]	0.50 ± 0.07[a]
Vitamin B_{12}	0.76 ± 0.30[a]	1.36 ± 1.48[a]	0.37 ± 0.30[a]	0.38 ± 0.11[a]
Vitamin E	2.82 ± 0.36[a]	3.12 ± 0.48[a]	3.03 ±1.39[a]	3.30 ± 0.51[a]
Vitamin C	3.35 ± 0.77[a]	2.91 ± 0.58[a]	3.25 ± 0.59[a]	2.95 ± 0.45[a]

Mean ±SD of samples in triplicates
Mean values of different alphabets are statistically significant at $p < 0.05$

Table 4 shows the vitamin composition of the different soup and stew samples. The pro- vitamin A content of the soup and stew ranged from (0.01 – 0.89mg/100g). The vitamin B_1content of the soup and stew values ranged from (0.38 – 0.49mg/100g). The vitamin B_2 content ranged from (0.20– 0.95mg/100g). The vitamin B_6 content of the soup and stew ranged from (0.43 – 0.50mg/100g). The vitamin B_{12} content of the soup and stew differed. The values ranged from (0.37 – 1.36mg/100g). The vitamin E content of the soup and stew ranged from (2.82 – 3.30mg/100g). The vitamin C content of the soup and stew ranged from (2.91 – 3.53mg/100g).

Table 5: Mineral composition of soup and stew made from *G. brevipes*(Benth) leaf and bark

Minerals(mg/100g)	Gbsl	Gbsb	Gbpl	Gbpb
Calcium	3.59 ± 1.20[a]	3.75 ± 0.72[a]	4.02 ± 0.28[a]	3.57 ± 1.41[a]
Magnesium	0.61 ± 0.25[a]	0.98 ± 0.58[a]	1.28 ± 0.53[a]	1.06 ± 0.81[a]
Potassium	1.42 ± 0.39[a]	1.25 ± 0.79[a]	1.41 ± 0.49[a]	1.73 ± 0.94[a]
Sodium	0.33 ± 0.05[a]	0.30 ± 0.03[a]	0.32 ± 0.04[a]	0.33 ± 0.55[a]
Phosphorus	69.63 ± 1.14[a]	69.89 ± 2.56[a]	69.29 ± 0.95[a]	69.57 ± 1.12[a]
Manganese	1.02 ± 15.48[a]	1.11 ± 19.90[a]	92.13 ± 16.17[a]	1.01 ± 17.78[a]
Iron	1.06 ± 29.92[a]	91.80 ± 17.24[a]	1.01 ± 23.02[a]	1.04 ± 27.75[a]
Zinc	68.15 ± 19.63[a]	58.87 ± 11.29[a]	64.85 ± 15.67[a]	67.20 ± 18.28[a]
Copper	36.28 ± 10.45[a]	31.36 ± 6.04[a]	34.52 ± 8.07[a]	35.75 ± 9.73[a]

Mean ± SD of samples in triplicate
Mean values of different alphabets are statistically significant at $p < 0.05$

Table 5 shows the mineral composition of the different soup and stew samples. The calcium content of the soup and stew ranged from (3.57 - 4.20mg/100g). The magnesium content of the soup and stew ranged from (0.61 – 1.28mg/100g). The potassium content of the soup and stew ranged from (1.25 – 1.73mg/100g). The *G. brevipes* soup bark (Gbpb) had the highest potassium content, while the *G. brevipes* stew bark (Gbsb) had the lowest potassium content. The sodium content of the soup and stew ranged from (0.30– 0.33mg/100g). The phosphorus content of the soup and stew ranged from (69.29 – 69.89mg/100g). The *G. brevipes* soup bark (Gbsb) had the highest phosphorus content while the *G. brevipes* soup leaf (Gbpl) had the lowest phosphorus content. The manganese content of the soup and stew ranged from (1.01 – 92.13mg/100g). The iron content of the soup and stew ranged from (1.01 – 91.80 mg/100g). The zinc content of the soup and stew ranged from (58.87 – 68.15mg/100g). The copper content of the soup and stew ranged from (31.36 – 36.28mg/100g).

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Table 6: Sensory evaluation of soup and stew made from *G. brevipes* (Benth) leaf and bark

Parameters	Gbsl	Gbsb	Gbpl	Gbpb
Colour	8.25 ± 0.85^{b}	7.50 ± 1.93^{b}	3.90 ± 3.68^{a}	7.30 ± 2.15^{b}
Flavour	8.15 ± 0.88^{b}	7.40 ± 1.96^{ab}	5.90 ± 3.31^{a}	6.40 ± 2.64^{a}
Taste	6.35 ± 3.33^{ab}	7.40 ± 1.98^{b}	6.80 ± 3.11^{ab}	5.15 ± 3.38^{a}
Texture	7.75 ± 2.71^{b}	8.00 ± 0.86^{b}	5.65 ± 3.47^{a}	7.15 ± 1.57^{b}
Degree of Acceptability	7.65 ± 1.50^{a}	6.95 ± 1.96^{ab}	6.75 ± 1.86^{ab}	6.10 ± 2.61^{a}

Mean ± SD of samples in triplicates

Mean values of different alphabets are statistically significant at $p < 0.05$

Table 6 shows the organoleptic characteristics of soup and stew made from *G. brevipes* (Benth) leaf and bark. The scores for colour ranged from (3.90-8.25). The scores for flavour ranged from (5.90 – 8.15). The taste of the soup and stews varied. It ranged from (5.15– 7.40). The scores for texture ranged from (5.65- 8.00). The degree of acceptability ranged from (6.10 – 7.65).

Discussion

Consumption of parts or whole plant as a vegetable source is a common practice in most developing countries as a means to fight hunger and diseases. In the south west region of Nigeria *G. brevipes* is mostly use in the preparation of soup accompanying new yam products. Although the locals believe that new yam causes diarrhea and dysentery but when consumed with

soup prepared with *G. brevipes,* the diarrhea or dysentery will not be experienced. Hence a traditional condiment use in the celebration of new yam festival. The import of this work is to look at the nutrient and chemical composition of this plant and products (soup and stew) made from it.

The moisture content of any food is an index of its water activity as reported by (Parra and Magan 2004). In Table 3, the lower moisture content (6.25%) for *G. brevipes* stew leaf indicates that it will keep longer than the other soup and stew samples.

The protein content of *G. brevipes* soup bark (20.83%) was high when compared to other soup and stew samples, which makes it a good source of protein. The utilization of lesser known vegetables cheaply available and equally rich in protein cannot be overemphasized in the reduction of protein energy malnutrition (Ubesie and Ibeziakor, 2012). The vegetable studied contain appreciable amount of protein which indicates that the vegetables can be used for building and repairing of body tissues, regulation of body processes and formation of enzymes and hormones. The fat content of soup and stew made from *G. brevipes* leaf and bark samples (13.04 – 19.23%) could be due to the added oil during the soup and stew preparation. Lipids are essential nutrients since they provide the body with maximum energy.

The crude fibre content (7.58 – 7.31%) of *G. brevipes* soup leaf and stew leaf of the samples were high compared to that of *G. brevipes* soup bark and stew bark which could be as a result of the high fibre content in the leaf. Consumption of most leafy vegetables, relatively high in crude fibre, has been shown to reduce serum cholesterol level, risk of coronary heart diseases and hypertension. It also increases glucose tolerance and insulin sensitivity (John *et al*., 2004).

Ash content of the soup and stew sample is a non-organic compound containing mineral in food substances and nutritionally it aids in the metabolism of other organic compounds such as fat and carbohydrate (Tiga., *et al* 2008). The comparable value for ash (6.10 – 6.89%) indicates that any of the soup and stew can equally supply the nutrient. The samples produced from *G. brevipes* leaf had the highest ash content (6.82 – 6.89%). Nutritionally, this means that when used in food preparation, it will improve the ash content of the food. The varying carbohydrate contents of the samples (38.32 – 48.28%) support the statements made by (Ubesie & Ibeziakor, 2012) that the lower the protein, fat, and ash contents, the higher the carbohydrate.

In table 4, the pro-vitamin A content of the four soup and stew samples ranged from (0.51 – 1.06mg/100g). Pro-vitamin A is important for normal vision, gene expression, growth and immune function by its maintenance of epithelial cell functions (Lukaski, 2004). *G. brevipes* stew leaf had (3.53mg/100g) of vitamin C content when compared with *G. brevipes* stew bark with (2.91mg/100g) which is the least. Vitamin C is an antioxidant that facilitates the transport and uptake of

non-heme iron at the mucosa, the reduction of folic acid intermediates and the synthesis of cortisol. Its deficiency includes fragility to blood capillaries, gum decay, scurvy (Sharanabasappa *et al*., 2013). Vitamin E content varied from (2.82–3.30mg/100m). Vitamin E is a powerful antioxidant which helps to protect cells from damage by free radicals and it is vital to the formation and normal function of red blood cell and muscles (Lukaski, 2004). The B complex vitamins contents B_1 (0.38 -0.49mg/100g), B_2 (0.20 - 0.95mg/100g), B_6 (0.43 - 0.50mg/100g), B_{12} (0.37 – 1.36mg/100g), in the soup and stews made from *G. brevipes* leaf and bark were in appreciable amount. *Glossocarlyx brevipes* stew leaf had the highest value of B complex vitamin when compared to other soup and stew samples. The B complex vitamins are a group of water soluble vitamins that play important roles in cell metabolism, its inclusion in diet could be good source of anti-oxidants and enough vitamins for formation of enzymes that are essential for optimum health (Ekeanyanwu, *et al*., 2005).

In Table 5, the result showed that *G. brevipes* soup and stew leaf, were richer in mineral elements than *G. brevipes* soup and stew bark. Sodium and potassium are closely related in the body fluids. They regulate the acid-base balance. Sodium remains one of the major electrolytes in the blood. The sodium contents of *G. brevipes* soup and stew had comparable values (0.30 – 0.33mg/100g) while that of potassium varied a little (1.25 – 1.73mg/100g). The values of sodium and potassium were higher in *G. brevipes* soup and stew leaf and lower in *G. brevipes* soup and stew bark. According to Akinyeye, (2010), a diet high in potassium and low in sodium content has added advantage because of the direct relationship of sodium intake with hypertension in humans.

The calcium and manganese concentration were found to be higher in *G. brevipes* soup leaf (4.20mg/100g) when compared to other soup and stew samples. High concentration of calcium in the body is very important because of its role in formation of bones and teeth, clotting of blood, muscle contraction and synaptic transmission of nerve impulses (Ghani, 2012). Calcium is an essential structural and functional element in living cells. The intake of calcium has been found to be very important for cancer patients (Raju, 2013). Thus, the concentration of calcium contained in *G. brevipes* soup leaf (4.20mg/100g) may be of high therapeutic value. Magnesium is a mineral, known to prevent cardiomyopathy, muscle degeneration, growth retardation, alopecia, dermatitis, immunologic dysfunction, gonadal atrophy, impaired spermatogenesis, congenital malformations and bleeding disorders **(**Arasaretnam, Kiruthika & Mahendran, 2018)**,** . Magnesium content was found to be in the range of (0.61 – 1.28mg/100g). The magnesium concentrations are expected since magnesium is a component of the chlorophyll of plant leaves.

The iron content (91mg/100g) of *G. brevipes* stew bark was considerably high when compared to other samples

which indicate that *G. brevipes* bark is high in iron which could be used to fight anemia in rural communities. Iron is very important in the formation of haemoglobin and in transporting oxygen in the body. Iron deficiency effects include reduced work capacity, impairments in behaviour and intellectual performance and decreased resistance to infection (Adeniyi, Olufunmilayo & Akinnuoye, 2018). *G. brevipes* present a good source of iron, and thus guiding against its deficiency effects when regularly consumed. Zinc concentrations in *G. brevipes* soup and stew made from the leaf and bark obtained in the present study were within this range (58.87 – 68.15mg/100g). Zinc is essential for growth and development. It is essential for the function of the cells of the immune system. It is used in the prevention and treatment of diarrhoea, pneumonia, cold, respiratory infections and malaria (Ghani, 2012). Zinc is one of the most important mineral elements for normal growth and development in humans. It is a co-factor for enzymes such as arginase and diaminase and it takes part in the synthesis of DNA and insulin. It is essential for the normal functioning of the cells including protein synthesis, carbohydrate metabolism, cell growth and cell division (Hussain, *et. al* 2011). It is also important for normal sexual development, especially for the development of testes and ovaries, and also essential for reproduction, and for healthy functioning of the heart (Ayoola, Adeyeye & Onawumi, 2010).

The copper content of the samples ranged from (31.36 – 36.28mg/100g). Copper is an essential nutrient, required for a wide range of biological functions such as enzymatic and redox reactions (McLaughlin et al., 2006). Copper is an essential micronutrient which functions as a biocatalyst. It is required for body pigmentation in addition to iron, to maintain a healthy central nervous system and to prevent anaemia, while it is interrelated with the functions of zinc and iron in the body. It is also necessary for normal biological activities of aminooxides and tyrosinase enzymes. Tyrosinase enzyme is required for the catalytic conversion of tyrosine to melanin, the vital pigment located beneath the skin, which protects the skin from dangerous radiation (Hussain, *et. al* 2011).

The result of the sensory evaluation indicates that *G. brevipes* stew leaf had the highest score for colour (8.75) when compared to other soup and stew sample. The comparable colour of *G. brevipes* stew bark and *G. brevipes* soup bark indicates that the colour of these soup and stew were equally liked by the judges. The lower colour (3.90) indicates that *G. brevipes* leaf did not improve the colour of the soup as compared to *G. brevipes* stew leaf. The high flavour (8.15) for *Glossocarlyx brevipes* stew leaf indicates that it has an edge over the other soup and stew samples in terms of its flavour. The taste of *G. brevipes* stew bark was high (7.40) which indicate that the sample will be generally accepted because of its taste. The higher values for texture (8.00) in *G. brevipes* stew bark showed that the judges liked the texture

of the *G. brevipes* soup bark sample when compared to other samples. The result of the degree of acceptability of the soup and stew samples indicates that the judges preferred *G. brevipes* stew leaf which had the highest value (7.65) and would be generally accepted when compared to other samples made from *G. brevipes* leaf and bark.

Conclusion

The soup and stew made from *G. brevipes* leaf and bark have good nutritional profile. However, focusing our attention on neglected and underutilized species is an effective way to help maintain a diverse and healthy diet, and to combat micronutrient deficiencies, and other dietary deficiencies particularly among the rural poor and the more vulnerable social groups.

Recommendations

Based on the findings of this study, the following recommendations were made:

- The use of *Glossocarlyx brevipes* in our diets should be encouraged because of its nutritional benefits.
- More awareness and promotion should to be created on the nutritional benefits of our indigenous vegetable plants both leaf and bark as this would increase its utilization thereby enhancing the nutritional wellbeing of the population.
- Intensive and aggressive nutrition education in both rural and urban communities should be pursued to elucidate the nutrient potentials of lesser known vegetables and their effective utilization.

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