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*Research Article*

# Recipe standardization and potential nutrient contribution of Ukazi soup commonly consumed in Umuahia, Abia State, Nigeria

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**Abstract**

Soups are key component of traditional diets, and they play important role in a country's culture, history, identity and heritage. However, they are usually neglected in meal planning due to lack of information on their nutrient composition, though they are rich source of protein and micronutrients. There is paucity of information on nutrient composition and standard recipes of majority of the soups consumed in Nigeria in the Nigerian Food Composition Table. Standardising the recipes used in cooking as well as providing information on nutrient content of soups will serve good purpose of reference for nutrition practitioners in the discharge of their duties. The study was carried out to standardise the recipes for preparing *Ukazi* soup commonly consumed in Umuahia, Abia State, Nigeria; and to determine the nutrient content of the standardised soups. Recipes for the soup were collected from two Local Government Areas of Abia State, Nigeria. A total of 110 recipes were obtained from indigenous women and food vendors using pre-tested, interviewer-administered questionnaire. Two soup samples (one without beef and smoked fish, and the other with beef and smoked fish) were prepared using the mean weight of each ingredient. The nutrient and anti-nutrient content of the soup samples were analysed using the standard methods. Data were analysed using descriptive statistics and independent t-test at $p<0.05$. One hundred gramme portion of the soups contained 37.6 and 33.1 g moisture, 18.8 and 22.8 g protein, 8.7 and 9.8 g fat, 28.9 and 27.0 g carbohydrate, 620 and 810mg potassium, 200 and 240 mg sodium, 200 and 310 mg calcium, 230 and 280 mg phosphorus, 3.42 and 4.72 mg iron, 2.87 and 3.11 mg zinc, and 530.74 and 695.99 µg vitamin A for sample without beef and smoked fish, and sample with beef and smoked fish, respectively ($p<0.05$). The anti-nutrient composition of the soups was low, and cannot hinder the absorption and utilisation of nutrients in the soups. The soups can contribute significant amount of protein, potassium, calcium, magnesium, phosphorus, zinc and vitamin A to daily nutrient requirements of consumers; hence, its consumption should be popularised among other communities of the Southeast zone of the country where the ingredients are readily available, for improved nutrition of the populace.

**Keywords:** Traditional diets, Vegetable soup, Nutrients, Anti-nutrients, Recipe standardization

## INTRODUCTION

Traditional/indigenous foods constitute important aspect of regional or country's culture, history, identity and heritage; and are key to the diets of people living the traditional lifestyle. The foods developed and promoted in various areas decide people's diets (Alozie & Ene-obong, 2018). Over 90% of the energy intake of rural communities in the Igbo cultural area is attributed to traditional foods/ diets (Okeke et al., 2009).

Nigeria is a multi-cultural society endowed with diverse traditional vegetable soups which are indigenous to different ethnic groups and consumed along with traditional dietary staples obtained from roots and tubers such as cassava,

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yam, cocoyam, sweet potatoes; and plantain, millet, rice and maize (Kayode et al., 2010). The soups are cooked using varieties of indigenous vegetables which are not only known for their rich nutrient content but are also health promoting (Asaolu et al., 2012), and usually serve as the main source of lipids, protein, minerals and vitamins, depending on the type, amount and quantity of ingredients used. Soups are the most variable in the Nigerian food system, as they range from very simple ones with few ingredients to very complex ones with many ingredients (Okeke et al., 2009).

Because Nigerians do have at least one staple meal requiring soup in a day, soups are very essential to Nigerian food recipes. Majority of Nigerian traditional diets are plant-based from cereals, starchy roots and tubers accompanied by a vegetable soup, with little contribution made by animal products (Onimawo, 2010).

In the South-western and Eastern regions of Nigeria, some of the staple foods are consumed with vegetables prepared as soups. The indigenous vegetable soup locally called *Ukazi* is a traditional soup popularly consumed among the natives of Umuahia, Abia State, Nigeria. The soup is used in many ceremonies and festivals such as wedding ceremonies, christening of new-born babies or even at funerals. It is made with assorted meats, seafood and vegetables, and served with Nigeria's side dishes as a soup. There is dearth of information on standard recipes used in preparation of the soup and its nutrient content. This study was carried out to standardize the recipes used in cooking *Ukazi* soup and determine its nutrient content.

# METHODOLOGY

The study involved both descriptive cross-sectional survey and laboratory analysis. The survey part was conducted for recipes data collection between November 2019 and January, 2020 in two purposively selected Local Government Areas of Umuahia consisting of five clans (*Umuopara, Ibeku, Olokoro, Ubakala and Ohuhu*) where the soup consumption is popular. The recipes for *Okazi* soup preparation were obtained from 110 randomly selected women from the clans, with minimum of twenty women per clan, using validated, interviewer-administered questionnaire and oral interview. A total of 100 recipes were obtained. Recipe standardisation was done by determining the mean weight of each ingredient from the list of collected recipes with similar ingredients. The most common recipes for cooking the soup involved addition of meat and smoked fish. However, bearing in mind the economic hardship faced by people (especially the low- and middle- income earners), and being worsened by COVID-19 pandemic, possibility of adding meat and fish may become difficult; hence, two types of soups (one without beef and smoked fish, and one with beef and smoked fish) were prepared from the standardised recipes (Adepoju, 2013).

## Sample collection and soups preparation

The ingredients for soup preparation were purchased from *Ojoo* eight-daily market in Ibadan, and the soups were prepared in the Department of Human Nutrition and Dietetics, University of Ibadan kitchen. Two soup samples were prepared (one without beef and smoked fish and the other one with beef and smoked fish) as follows.

## General ingredients

*Egusi* (melon seed) and *Usu* were mixed in a mortar with pestle. Small quantity of salt, grinded pepper and one Knor seasoning cube were added and thoroughly mixed for 30 mins with addition of warm water (a little at a time). The mixture was then made into a big ball. Pinched pieces from the ball were moulded into small firm flat balls. The moulded melon with the ingredients was then boiled in water for 1 h. The ingredients used in cooking the two soups are shown in Table 1.

**Table 1.** Standardised ingredients for *Ukazi* soups preparation (g).

| Ingredients | Quantity | |
|---|---|---|
| | Sample 1 | Sample 2 |
| *Egusi* (for sprinkling) | 152 | 152 |
| *Egusi* (for moulding) | 304 | 304 |
| *Achi* | 45 | 45 |
| *Mangala* (Smoked fish) | - | 95 |
| Beef | - | 330 |
| Dry pepper | 10 | 10 |
| *Ukazi* | 90 | 90 |
| *Achara* | 263.5 | 263.5 |
| *Usu* | 81 | 81 |
| Crayfish | 41 | 41 |
| Palm oil | 151 | 151 |
| *Okporoko* (stockfish) | 180 | 180 |
| Knor cubes | 12 | 12 |
| Onions | 40 | 40 |
| Water | As required | As required |
| Soup yield | 3118 | 3685 |

*Sample 1 = Ukazi soup without beef and smoked fish; Sample 2 = Ukazi soup with beef and smoked fish.*

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### Preparation of *Ukazi* soup without fish and meat

Washed stock fish, small dried fish (*mbasa*), and diced onion were weighed and boiled with 2000 mL distilled water with addition of palm oil. The whole ingredients were allowed to cook for 10 min, followed by addition of the small moulded melon balls, crayfish, salt, Knor cubes and pepper; stirred, and cooked for 2 min. Half cup of grinded *Egusi* was sprinkled and left to cook for another 5 min. *Achi* was added to the soup, stirred and cooked for 20 min, followed by addition of *Achara* vegetable. The whole soup was allowed to simmer for 5 min, and then *Ukazi* vegetable was added. The whole soup was allowed to simmer for 1 min and the heat turned off. The soup was labelled as Sample 1.

### Preparation of *Ukazi* Soup with fish and meat

Washed beef and stock fish were boiled together with addition of one Knor cube, diced onions and salt, and allowed to cook for 30 min. Weighed *Mbasa*, smoked fish (*Mangala*) and diced onion were added and boiled with 2000 mL distilled water, with addition of palm oil. The whole ingredients were allowed to cook for 10 min, followed by addition of the moulded small melon balls, crayfish, salt, Knor cubes and pepper. The whole content was stirred and cooked for 2 min, followed by sprinkling of half cup of grinded *Egusi* and left to cook for another 5 min. *Achi* was added to the soup, stirred and cooked for 20 min, followed by addition of *Achara* vegetable. The soup was allowed to simmer for 5 min, and then *Ukazi* vegetable was added. The whole soup was allowed to simmer for 1 min and the heat turned off. The resultant soup was labelled as Sample 2.

The method of Association of Official Analytical Chemists (AOAC) 15 was used to determine the moisture, protein, ash, fat and crude fibre content, while carbohydrate was obtained by difference and Gross energy of the samples determined by ballistic bomb calorimetric method15. All determinations were carried out in triplicate (Ene-Obong et al., 2019).

## CHEMICAL ANALYSIS

### Proximate analysis of soups

The moisture, crude protein, crude fat, crude fibre, ash and dietary fibre content of the soups were determined by using standard methods of analyses of the Association of Official Analytical Chemists (AOAC), The carbohydrate content was obtained by difference, while the gross energy was determined using ballistic bomb calorimeter (Cal 2k - Eco, TUV Rheinland Quality Services (Pty) Ltd, South Africa).

### Mineral content determination

Potassium and sodium content of the samples were determined by digesting the ash of the samples with perchloric acid and nitric acid, and the readings of the digests taken on Jenway digital flame photometer/ spectronic 20 Phosphorus was determined by Vanado-molybdate colorimetric method Calcium, magnesium, iron, zinc, manganese, copper and selenium were determined by atomic absorption spectrophotometric method (Buck Scientific, Norwalk, Conn., USA) and their absorption compared with absorption of standard solutions of these minerals (Stadlmayr et al., 2017).

## VITAMIN CONTENT DETERMINATION

### Vitamin A Determination

The vitamin A content of the samples was determined through ultraviolet absorption measurement at 328 nm after extraction with chloroform. Calibration curve of vitamin A acetate was made and sample vitamin A concentration estimated as microgram (µg) of vitamin A acetate. The beta-carotene component of the soup samples was converted to retinol equivalent by dividing the values obtained by 8 (i.e. 1 µg retinol equivalent = 8 µg of beta-carotene) (Amadi et al., 2018).

### Thiamine (Vitamin $B_1$) Determination

Thiamine content of the samples was determined by weighing 1 g of sample into 100 mL volumetric flask with addition of 50 mL of 0.1M $H_2SO_4$ and boiled in a boiling water bath with frequent shaking for 30 mins. Five milliliters (5 mL) of 2.5 M sodium acetate solution was added and the flask set in cold water to cool the content below 50°. The flask was stoppered and kept at 45-50°C for 2 hrs, and then made up to 100 mL mark. The mixture was filtered through Whatman No. 42 filter paper, discarding the first 10 mL. Ten milliliters (10 mL) of the solution was pipetted from remaining filtrate into a 50 mL volumetric flask, and 5 mL of acid potassium chloride solution added with thorough shaking. Standard thiamine solutions were prepared and treated the same way. Absorbance of the samples as well as that of standard solutions was read on a fluorescent UV Spectrophotometer (Cecil A20 Model) at a wavelength of 285 nm (Guissou et al., 2020).

### Riboflavin (Vitamin $B_2$) Determination

One gramme (1 g) of each sample was weighed into a 250 mL volumetric flask, 5 mL of 1M HCl was added, followed by addition of 5 mL of dichloroethene. The mixture was shaken and 90 mL of de-ionized water was added. The whole mixture was thoroughly shaken and heated on a steam bath for 30 mins, cooled and made up to volume with de-ionized water. It was then filtered, discarding the first 20 mL of the aliquot. Two milliliters (2 mL) of the filtrate obtained was pipetted into another 250 mL volumetric flask and made up to mark with de-ionized water. Sample solutions were read on the fluorescent spectrophotometer at a wavelength of

460 nm. Standard solutions of riboflavin were prepared and their readings taken at 460 nm. The sample riboflavin was obtained through calculation.

### Niacin (Vitamin $B_3$) Determination

Five grammes (5 g) of sample was extracted with 100 mL of distilled water and 5 mL of this solution was drawn into 100 mL volumetric flask and made up to the mark with distilled water. Standard solutions of niacin were prepared and absorbance of samples and standard solutions was measured at a wavelength of 385 nm on a spectrophotometer, and the niacin concentration of the samples estimated.

### Pantothenic Acid (Vitamin $B_5$) Determination

One gramme (1 g) of each of the samples was extracted with distilled water, filtered, and 5 mL aliquot of the sample filtrate thoroughly mixed with 5 mL of 12% KBr and 10 mL of $KMnO_4$ solutions. The mixture was warmed in a boiling water bath for 10 mins, cooled in ice for 5 mins and 20% freshly prepared $H_2SO_3$ solution added drop wise to obtain colourless solution. To the colourless solution, 10 mL of 2,4 - dinitrophenyl hydrazine (5 g/l) was added and mixed thoroughly. The mixture was heated on a steam bath for 15 mins and cooled to room temperature to obtain yellow precipitate. The precipitate was dried for 30 mins in an oven set at 100°C and dissolved in hot pyridine solution with thorough mixing. The suspension was filtered through Whatman No. 42 filter paper into a 50 mL volumetric flask and made up to mark with pyridine solution. To this solution was added 50 mL distilled water, followed by addition of 5 mL of 5M NaOH solution. The absorbance of the samples and standard solutions of pantothenic acid were read on a spectronic21D spectrophotometer at 570 nm, and sample concentration calculated in µg /100 g of sample.

### Pyridoxine (Vitamin $B_6$) determination

The samples' vitamin $B_6$ content was determined by extracting 1 g of sample with 0.5 g of ammonium chloride, 45 mL of chloroform and 5 mL of absolute ethanol. The resultant mixture was thoroughly mixed in a separating funnel by shaking for 30 mins, followed by addition of 5 mL of distilled water. The chloroform layer containing pyridoxine was filtered into a 100 mL volumetric flask and made up to the mark with chloroform. Standard solutions of 0-10 ppm of vitamin $B_6$ were prepared and treated in a similar way as samples; and their absorbance measured on Cecil 505E spectrophotometer at 415 nm. The amount of vitamin $B_6$ in the samples was then calculated (Asl & Hossein, 2008).

### Folic Acid (Vitamin $B_9$) Determination

Folic acid content of the samples was determined by weighing 1 g of each sample into a 250 mL volumetric flask, followed by addition of 100 mL of distilled water and shaken for 45 mins, and the mixture made up to the mark with distilled water. The mixture was filtered into another 250 mL beaker, rejecting the first 20 mL. To another 20 mL filtrate, 5 mL of 1% sodium dithionite solution was added to decolorize the yellow colour. Standard solutions (0-10 µg/mL) of folic acid were prepared from folic acid stock. The absorbance of solutions of standard and sample were read at 445 nm on spectronic21D spectrophotometer and folic acid concentration calculated.

### Cyanocobalamin (Vitamin $B_{12}$) determination

One gramme (1 g) each of the samples was extracted with distilled water with shaking for 45 mins, followed by filtration of the mixture. The first 20 mL of the filtrate was rejected, and another 20 mL filtrate collected. To the collected filtrate 5 mL of 1% sodium dithionite solution was added. Standard cyanocobalamin solutions (0-10 µg/ml) were prepared and absorbance of samples as well as standards was read on spectronic21D spectrophotometer at 445 nm. Amount of sample cyanocobalamin was then estimated through calculation.

### Ascorbic acid Determination

Ascorbic acid content of the samples was determined by titrating the aqueous extract of each sample with solution of 2,6-dichlorophenol-indophenol dye to a faint pink end point.

### Tocopherol (Vitamin E) determination

One gramme of each of the samples was weighed into a 250 mL conical flask fitted with a reflux condenser wrapped in aluminium foil, and refluxed with 10 mL of absolute ethanol and 20 mL 1 M ethanolic sulphuric acid for 45 mins. The resultant solution was cooled for 5 mins, followed by addition of 50 mL of distilled water, and then transferred into a separating funnel covered with aluminium foil. The unsaponifiable matter in the mixture was extracted with 5×50 mL diethyl ether. The combined extract was washed free of acid and dry over anhydrous sodium sulphate. The extract was later evaporated at a low temperature and the residue obtained was immediately dissolved in 10 mL absolute ethanol. Aliquots of solutions of the samples and standards were transferred to a 20 mL volumetric flask, 5 mL absolute ethanol added, followed by careful addition of 1 mL conc. $HNO_3$ and placed on a water bath at 90°C for 30 mins from the time the ethanol begins to boil, followed by rapid cooling under running water. The absorbance of sample solution was read at 470 nm.

### Anti-nutrient Determination

Phytate was determined by titration with ferric chloride solution (Sudarmadji & Markakis, 1977). Oxalate content of the samples was determined by extraction of the samples

with water for about 3 h and standard solutions of oxalic acid prepared and read on spectrophotometer (Spectronic 20) at 420 nm. The absorbance of the samples was also read at 420 nm, and amount of oxalate estimated. The tannin content of the samples was determined by extracting the samples with a mixture of acetone and acetic acid for 5 hrs measuring their absorbance and comparing the absorbance of the sample extracts with absorbance of standard solutions of tannic acid at 500 nm on spectronic 20 (Griffiths & Jones, 1977). Saponin was also determined by comparing the absorbance of the sample extracts with that of the standard solutions at 380 nm (Makkar & Becker, 1996). Trypsin inhibitory activity was determined on casein and the absorbance compared with that of trypsin standard solutions read at 280 nm. All determinations were carried out in triplicate.

### Data analysis

The data obtained were analysed using descriptive statistics and independent t-test to check for significant difference between the soup samples at $p<0.05$.

## RESULTS AND DISCUSSION

### Proximate composition of *Ukazi* Soups

Table 2 shows the proximate composition of the two prepared *Ukazi* soups. Moisture content constituted about one-third of the soup samples. Sample 1 without beef and smoked fish was significantly higher in moisture, ash, carbohydrate and gross energy content ($p<0.05$) while sample 2 containing beef and smoked fish was significantly higher in crude protein and fat content ($p<0.05$).

The two soup samples had relatively high moisture content. However, the moisture values obtained in this study were significantly lower than the value reported for *Ukazi* soup by (Okeke et al., 2009). The relatively high moisture content obtained for the soup samples is suggestive of possible microbial spoilage over a long storage period, as elevated moisture content in a food sample has been implicated in microbial growth.

The two soups contained substantial amount of crude protein, with sample 2 containing both beef and smoked fish having the higher value. The protein values of the two soups are suggestive that they can contribute significantly to protein needs of consumers, especially the sample 2 which contain smoked fish and beef. Animal proteins do contain essential amino acids in required proportion, and hence, are of high biological value. Both soups contain animal-source protein (stockfish, dry fish (*Mbasa*), crayfish), and therefore, the protein content of the soups will likely be bioavailable to the consumers.

The fat content of the soups was less than 10% and significantly lower than the value reported for *Ukazi* soup in a previous study. Beef and smoked fish contain fatty tissues that have varying amount of fat (Ahmad et al., 2018). This explains the significantly higher fat content of sample 2. Fats and oils are important source of energy for cellular function as well as source of essential fatty acids which assist in hormonal functions (Whitney & Rolfe, 2019).

The dietary fibre component of the soups was more than 10%. The dietary fibre contents of the soup samples qualify them as good source of fibre reported the fibre contents of soups such as *Achara*, *Nsala*, *Ofeose* and *Uha* soups, with *Achara* soup having the highest value of fibre content. This imply that traditional soups are good sources of both crude and dietary fibres. The presence of *Achara* and *Ukazi* vegetables in the *Ukazi* soup should have contributed to the high fibre content of the *Ukazi* soups. The dietary fibre and crude fibre contents of *Ukazi* soups from this study were significantly lower than the value reported by (Obiakor-Okeke et al., 2014) but much higher than the fibre value reported by (Adepoju & Ugochukwu, 2019) for *Ceiba pentandra* leaf soup, and can contribute significantly to the daily intake of fibre of its consumers (Obiakor-Okeke et al., 2014).

The soups were high in ash content. The ash contents of the soups are suggestive that they can be good source of minerals, especially macro minerals. The moderately high ash values for the two soups may be attributed to the ingredients (stockfish, crayfish and *mbasa*) used in preparing the soups. The available carbohydrates constituted almost one third of the soups. The carbohydrate content of the soups is relatively low when compared with that of roots,

**Table 2.** Proximate composition (g/100 g) and energy content (kcal/100 g) of *Ukazi* soup samples.

| Parameter | Sample 1 | Sample 2 |
|---|---|---|
| Moisture | $37.6 \pm 0.03^a$ | $33.1 \pm 0.02^b$ |
| Crude Protein | $18.8 \pm 0.10^a$ | $22.8 \pm 0.09^b$ |
| Fat | $8.7 \pm 0.02^a$ | $9.8 \pm 0.02^b$ |
| Ash | $1.8 \pm 0.02^a$ | $1.5 \pm 0.03^b$ |
| Crude Fibre | $4.2 \pm 0.02^a$ | $5.8 \pm 0.02^b$ |
| Carbohydrate | $28.9 \pm 0.02^a$ | $27.0 \pm 0.06^b$ |
| Dietary Fibre | $12.1 \pm 0.02^a$ | $11.9 \pm 0.05^a$ |
| Gross Energy | $330.4 \pm 0.07^a$ | $308.0 \pm 0.03^b$ |

*Sample 1 = Ukazi soup without meat and smoked fish; Sample 2 = Ukazi soup with meat and smoked fish.*

tubers, grains and legumes, indicating that soups are generally not major source of energy for body use, but rather as supplementary source of carbohydrates and energy. (Omah et al., 2015) suggested the carbohydrate contents of soups were lower probably because of high moisture content of the products and that ash and fibre contents were higher in the products with lower moisture content. The soups were high gross energy content, which is believed to be due to their high values of protein, fat and moderate carbohydrate content.

## Mineral content of *Ukazi* Soups

Table 3 shows the mineral composition of the *Ukazi* soup samples. The two samples were rich in potassium, sodium, calcium, magnesium and phosphorus; with moderate values for iron, zinc, copper, and manganese. Sample 2 with beef and smoked fish contained significantly higher amount of all the minerals studied compared with sample 1 without beef and smoked fish ($p<0.05$). The *Ukazi* soups can serve as good source of macrominerals. The micromineral content of the soups is also appreciable. However, the soup with addition of beef and fish (Sample 2) had higher values of these minerals. Its higher mineral content may be attributed to the addition of beef and smoked fish. Beef has been reported to have notably high contents of potassium, phosphorus and iron; and the iron content of sample 2 is very similar to that reported for meat *Ukazi*, the main vegetable in this soup has been reported to contain appreciable amount of calcium, iron, potassium, zinc, copper, sodium, and manganese.

The sodium contents of the soups were high, while the potassium contents were very high. This high level of potassium is advantageous, as it plays important role in balancing the intracellular fluid, and its high level is associated with lower blood pressure values. The potassium value is significantly higher in sample 2 compared with sample 1. The very high potassium: sodium ratios of 3.10 and 3.38 for samples 1 and 2, respectively, are health-promoting and advantageous for the consumption of the soups by the hypertensive. The potassium value for sample 2 is comparable to the level of potassium in *Miyan kuka*, *Onugbu* and *Edikang-ikong* soups reported by (Kayode et al., 2010). Also, the calcium content of the soup with meat and smoked fish is comparable to calcium values reported for *Nsala* and *Onugbu* soups.

The two samples contained high amounts of magnesium and can contribute meaningfully to magnesium daily requirements of both adults and children. The high magnesium values of the soups could be attributed to contribution from the ingredients, especially crayfish which has been reported to contain high amount of magnesium. The phosphorus contents of the soups were high. Beef and smoked fish have good levels of phosphorus and crayfish also is high in phosphorus. Hence, the observed high value of phosphorus in the soups (Morakinyo et al., 2016).

The two soup samples had moderate iron content which is believed will be bioavailable, as the soups contained ingredients from animal source which contributed significantly to the iron values of the soups. The soups can contribute significantly to daily iron needs of consumers and help prevent or reduce anaemia which has been shown to be linked with maternal mortality and premature child birth (Carriaga et al., 1991).

Also, the soups contained appreciable amounts of zinc. The amounts of zinc in the two *Ukazi* soup samples were significantly higher than the value reported. This may probably be due to difference in processing methods used by the authors compared to the standardisation method used in this study. The copper contents of the two soup samples are significantly lower compared to the value reported for *Ukazi* soup by (Okeke et al., 2009). This may be due to the source of the Ukazi vegetable used in the two studies, as geographic location and seasonal variation can have significant effects on nutrient content of foods. The two soups contained appreciable amount of manganese which exceed the Recommended Dietary Allowance value for the mineral. The high level of manganese in the soups could be due to the high manganese content of *Ukazi* leaves.

**Table 3.** Mineral composition of *Ukazi* soup samples (mg/100 g).

| Parameter | Sample 1 | Sample 2 |
|---|---|---|
| Potassium | $620.00 \pm 0.20^{a}$ | $810.00 \pm 0.20^{b}$ |
| Sodium | $200.00 \pm 0.30^{a}$ | $240.00 \pm 0.20^{b}$ |
| Calcium | $200.00 \pm 0.20^{a}$ | $310.00 \pm 0.30^{b}$ |
| Magnesium | $350.00 \pm 0.30^{a}$ | $390.00 \pm 0.30^{b}$ |
| Phosphorus | $230.00 \pm 0.20^{a}$ | $280.00 \pm 0.30^{b}$ |
| Iron | $3.42 \pm 0.02^{a}$ | $4.72 \pm 0.03^{b}$ |
| Zinc | $2.87 \pm 0.03^{a}$ | $3.11 \pm 0.02^{b}$ |
| Copper | $0.45 \pm 0.02^{a}$ | $0.66 \pm 0.03^{b}$ |
| Manganese | $3.38 \pm 0.03^{a}$ | $3.66 \pm 0.03^{b}$ |
| Selenium (µg/) | $0.005 \pm 0.000^{a}$ | $0.007 \pm 0.000^{b}$ |

## Vitamin composition of *Ukazi* Soups

The soups were very high in vitamin A content but very low in values of all the water-soluble vitamins (Table 4). The soup cooked with beef and smoked fish contained significantly higher content of both fat and water-soluble vitamins compared with the soup without beef and smoked fish ($p<0.05$). However, sample 1 had significantly higher value of vitamin C ($p<0.05$); while there was no difference in value of vitamin E for the two soup samples. The two soup samples were very rich in vitamin A. The high vitamin A content of the soups qualify them as good source of this vitamin which is of public health concern. The animal source ingredients might have contributed meaningfully to this vitamin, as the sample containing beef and smoked fish (Sample 2) had higher value than sample 1 containing the basic ingredients alone.

The soups contained appreciable amounts of vitamins $B_1$, $B_3$, $B_6$ and C. The appreciable amounts of water-soluble vitamins observed in this study might have been due to their retention during cooking. The presence of high amount of vitamin A coupled with the presence of vitamins C and E qualify the soups as good source of antioxidants. The presence of good sources of antioxidants in the soups coupled with their high level of dietary fibre make them to possess good health-promoting characteristics which can prevent or reduce development and progression of non-communicable, nutrition-related diseases of public health concern such as hypertension, diabetes mellitus, coronary heart diseases and cancers.

Meat is a good source of thiamine, riboflavin, nicotinic acid, pyridoxine, and cyanocobalamin; and contains pantothenic acid and biotin, but is a poor source of folacin (Wyness et al., 2011). This may explain the reason for the higher value of these vitamins in the soup with beef and smoked fish in this study. The recommended daily allowances of thiamine are 1.2 mg and 1.1 mg for adult males and females respectively; Hence, one hundred gramme portion of the *Ukazi* soup samples can help meet the daily recommendation of the vitamin. The high amount of thiamine in the soups could be attributed to the use of crayfish which is high in thiamine. The amounts of cyanocobalamin contained in the soup samples are higher than the values obtained by (Mustapha, 2013) for *Aaru* and *Miyan kuka* soups.

Pyridoxine plays vital role in the functioning of approximately one hundred enzymes that catalyse the essential chemical reactions in the human body, helps in the synthesis of the neurotransmitters, and is important in the synthesis of haeme iron (Ahmad et al., 2018). The pyridoxine contents of the soups are higher than that of *Nsala* and *Miyan kuka* soups (Mustapha, 2013), and the recommended dietary allowance for the vitamin, suggesting that *Ukazi* soup can serve as an excellent source of this vitamin (Lupton et al., 2012).

## Antinutrient composition of *Ukazi* Soups

The two soup samples were low in phytates and oxalates, but contain substantial amounts of tannins, saponins and trypsin inhibitors (Table 5). The phytates, oxalates, saponins, and trypsin inhibitory activity contents of sample 1 were significantly higher than those of sample 2 ($p<0.05$), while sample 2 was significantly higher in tannin content ($p<0.05$). Tannins and saponins have the role of phytochemicals with health-promoting properties, hence,

**Table 4.** Vitamin Composition of *Ukazi* soup samples (mg/100 g).

| Parameter | Sample 1 | Sample 2 |
|---|---|---|
| Vitamin A (RE µg/)* | 530.74 ± 4.04[a] | 695.99 ± 2.02[b] |
| Vitamin $B_1$ | 1.10 ± 0.02[a] | 1.55 ± 0.03[b] |
| Vitamin $B_2$ | 0.08 ± 0.00[a] | 0.10 ± 0.00[b] |
| Vitamin $B_3$ | 2.17 ± 0.03[a] | 3.03 ± 0.02[b] |
| Vitamin $B_5$ (µg/) | 0.54 ± 0.02[a] | 0.69 ± 0.03[b] |
| Vitamin $B_6$ | 2.45 ± 0.04[a] | 3.31 ± 0.04[b] |
| Vitamin $B_9$ (µg/) | 0.81 ± 0.03[a] | 1.02 ± 0.04[b] |
| Vitamin $B_{12}$ (µg/) | 0.69 ± 0.02[a] | 0.86 ± 0.02[b] |
| Vitamin C | 6.91 ± 0.03[a] | 5.92 ± 0.03[b] |
| Vitamin E | 0.29 ± 0.02[a] | 0.29 ± 0.03[a] |

*****RE = Retinol equivalent (obtained through conversion 8 µg β-carotene = 1 µg RE).*

**Table 5.** Antinutrient content of *Ukazi* soup samples (mg/100 g).

| Parameter | Sample 1 | Sample 2 |
|---|---|---|
| Phytates | 1.47 ± 0.00 | 0.73 ± 0.00 |
| Oxalates | 0.90 ± 0.00 | 0.37 ± 0.00 |
| Tannins | 7.20 ± 0.00 | 9.43 ± 0.00 |
| Saponins | 11.00 ± 0.02 | 7.10 ± 0.02 |
| Trypsin Inhibitor TIU/) | 5.71 ± 0.02 | 4.15 ± 0.03 |

**Table 6**. Percent nutrient contribution by *Ukazi* Soup samples to adult RDA.

| Nutrient | RDA/AI* | Sample 1 | % RDA | Sample 2 | % RDA |
|---|---|---|---|---|---|
| Energy (kcal) | 2300 | 330.4 | 14.37 | 308.0 | 13.39 |
| Protein (g) | 65 | 18.8 | 28.92 | 22.8 | 35.08 |
| Calcium (mg) | 1200 | 200.00 | 16.67 | 310.00 | 25.83 |
| Potassium (mg) | 2500 | 620.00 | 24.8 | 810.00 | 32.4 |
| Phosphorus (mg) | 700 | 230.00 | 32.86 | 280.00 | 40 |
| Magnesium (mg) | 420 | 350.00 | 83.33 | 390.00 | 92.86 |
| Zinc (mg) | 11 | 2.87 | 26.09 | 3.11 | 28.27 |
| RE (µg) | 1000 | 530.74 | 53.07 | 695.99 | 69.60 |
| Vitamin $B_1$ (mg) | 1.2 | 1.10 | 91.67 | 1.55 | 129.17 |
| Vitamin $B_3$ (mg) | 16 | 2.17 | 13.56 | 3.03 | 18.94 |
| Vitamin $B_5$ (mg) | 5 | 0.54 | 10.8 | 0.69 | 13.8 |
| Vitamin $B_6$ (mg) | 1.7 | 2.45 | 144.12 | 3.31 | 194.71 |
| Vitamin C (mg) | 90 | 6.91 | 7.67 | 5.92 | 6.58 |

they may not constitute any nutritional hazard. For instance, saponins and tannins exhibit cytotoxic effects and growth inhibition, making them suitable as tumour inhibiting agents (Akindahunsi & Salawu, 2005). Saponins and tannins are known to have antimicrobial activity (Evans, 2005).

### Percent nutrient contribution by *Ukazi* Soups

The possible nutrient contribution to daily nutrient requirements of adult consumers of any of the two soups are shown in Table 6. The two soups can contribute significantly to nutrient requirements of its consumers, though it is not taken as a full meal but as part of a diet. One hundred gramme portion size of the soups can contribute 13.39 and 14.37% energy, 28.92 and 35.08% protein, 16.67 and 25.83% calcium, 24.8 and 32.4% potassium, 32.86 and 40% phosphorus, 83.33 and 92.86% magnesium, 26.09 and 28.27% zinc, 53.07 and 69.60% vitamin A, 91.67 and 129.17% vitamin B1, 13.56 and 18.94% B3, 10.8 and 13.8% B5, 144.12 and 194.71% B6, and 7.67 and 6.58% of vitamin C to recommended dietary allowances of adult consumers (Ajayi et al., 2018).

## CONCLUSION

The *Ukazi* soup traditionally being consumed by the Umuahia people is nutritionally very rich and nutrient-dense. It can serve as good source of meeting significant part of dietary requirements of good quality protein, potassium, sodium, calcium, magnesium and phosphorus needs of consumers. The soup is also rich in vitamin A and dietary fibre, and hence, can serve as good source of antioxidants. The presence of phytochemicals such as tannins and saponins convey special health-promoting benefits on the soup. Nutritionally, the soup can contribute meaningfully to the daily dietary needs of consumers; hence its consumption should be promoted beyond ethnicity across to the different geo-political zones where the ingredients are available.

## RECOMMENDATION

There is need to standardise our traditional diets, especially the soups and mixed meals for maximum benefits of consumers, and for appropriate detailed information to be provided on Nigerian Food Composition Table to assist professionals in quantifying and recommending diets to various categories of patients that require dietary regimen for treatment and ameliorating the effects of non-communicable diseases among the Nigerian populace.

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