

## PROXIMATE COMPOSITION AND SENSORY EVALUATION OF THREE LEAFY VEGETABLES (*ASYTASIA GANGETICA*, *URTICA DIOICA* AND *CORCHORUS SPP*) FOR FOOD SECURITY

<sup>1</sup>Adaku Idika Umeh & <sup>2</sup>Ogonna Egbuchulam

<sup>1&2</sup>Home Economics/HMT Dept. Michael Okpara  
University of Agriculture Umudike, Abia State

### Abstract

Vegetables are good sources of food nutrients needed in the body, vegetables when eaten in adequate quantity helps to nourish the skin. Endangered vegetables are vegetables that were once consumed but are at the verge of extinction. The study determined the proximate composition and sensory evaluation of three endangered leafy vegetables (ELVs). Data was collected using a 9-point hedonic likert scale to determine the acceptability of the soups prepared with the vegetables. The data collected were analyzed using analysis of variance. The study found that the vegetables were rich in nutrient like vitamins and minerals and also heat affected the nutrient contents of these vegetables. The study recommended that families should incorporate these vegetables unto family meals. Also farmers should grow these vegetables in abundance to ensure food availability in the state. Government should give loan and land to Agricultural graduates to encourage this vegetable cultivation and to boast food security in the family.

**Keywords:** Food Security, Leafy, Vegetables Extinction sensory evaluation.

Corresponding Author: Adaku Idika Umeh

## Background to the Study

Many plants are consumed as vegetables or are used in food preparations only by certain areas where they are known. The knowledge of the use of the vegetables is usually transmitted by personal communication and they remain unknown to the general public consumption. Three of such plant species falls into this category of endangered vegetables. “Upom” (*Aytasia gangetica*), “Akuwa” (*Urtica dioica*) and “Kerenkere” (*Corchorus spp*). Endangered vegetables are any vegetable that are either losing their natural habitat or are no longer being widely cultivated and eaten (FAO, 2007). In the 15<sup>th</sup> and 16<sup>th</sup> century, the endangered vegetables would have been found in the domesticated varieties, this means that these vegetables were cultivated, domesticated and even the wild species of these plants were often relied upon as major foods during those early times and as a supplement food during certain crop failures in recent times as result of seasonal changes (Adetula, 2004). According to Onayemi and Badifu (1987) green leafy vegetables apart from providing variety in the diet, are good sources of ascorbic acid, dietary fibre, carotene, iron and other minerals in addition to protein.

These plants which were originally sold in the markets and cultivated in farm lands in home gardens for personal consumption are no longer available on the dining tables because it is assumed that they are food for the poor, or as a result of ignorance of the nutritional composition, living in affluence and modernization (Burkill, 2000). These vegetables are usually cooked before consumption because of their anti-nutritional factors such as trypsin, chymotrypsin inhibitors and cyanide. Moreover, the presence of these anti-nutritional and toxic factors makes their nutritional exploitation a problem. Cooking changes these ELVs texture, colour and nutrient contents. In addition, cooking usually makes these vegetables safer to eat by killing the microbes in them and reducing the effect of the anti-nutrients in them.

However, over-cooking will cause the texture, flavor, colour and nutrient contents to depreciate. Fafunso and Bassin (1997) stated that the key to cooking vegetables is to make the tissues tender without making it too soft. These three endangered leafy vegetables (ELVs) require only few minutes to cook; therefore it becomes over cooked when they turn olive green in colour.

These endangered leafy vegetables apart from their main function as good sources of food, they also perform medicinal, health, ecological, economical, social, agricultural functions among others, for instance, Bussman and Sharon, (2006) stated that leafy these endangered vegetable are eaten as vegetables and also used as a herbal remedy in traditional African medicine. They observed further that these ELVs are used as ornamental plants and cover plants in orchards because it helps to check erosion and prevents infestation by obnoxious weeds and it also attracts breeds to the orchards.

The FAO (2007) as well as USDA (2008) defined food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. While Wikipedia (2009) defined food security as “the state in which all persons obtain a nutritionally adequate, culturally acceptable diet at all times through local non-emergency sources”. The four pillars of food security are; food availability, food access, food utilization and food stability [world summit on food security 2009].

1. **Food Availability:** Food availability relates to the supply of food through production, distribution and exchange. Food production is determined by a variety of factors including land ownership and use; soil management; crop selection, breeding, livestock breeding and management and harvesting, crop production can be affected by changing rainfall and temperature among others. Crop production is not required alone for a country to achieve food security but also food distribution. However, food distribution involves the storage processing, transport, packaging and marketing of food. Food chain infrastructure and storage technology on farm can also impact on the amount of food wasted in the distribution process. Moreover, food consumers outnumber producers in every country, so food must be distributed to different regions and nations for it to go round. In spite of this, only for individuals are continuously. Self-reliance for food; thus food availability is a greater barrier to achieving food security.

2. **Food Access:** food access refers to the availability and location of food, as well as preferences of individuals and households. The UN committee on economic, social and cultural rights noted that the causes of hunger and malnutrition are often not a scarcity of food but due to poverty. Poverty can limit access to food and can also increase how vulnerable an individual or house is to food price spikes. Access depends on whether the household has enough income to purchase food at prevailing price or has sufficient land and other resources to grow its own food. Households with enough resources either human and material and economic access can overcome unstable harvests and food storages and maintain their accessibility to foods. However, this is not the case of the 3 endangered leafy vegetables which are not accessed due to ignorance, misconception and lack of awareness of their nutrient contents.

3. **Food Utilization:** This requires some knowledge of basic principles of nutrition, proper child care, and illness management. Clearly, illiteracy and education are significant factors, in this respect, particular female literacy and awareness given that it is the woman who is the homemaker. So the lack of knowledge or awareness of nutrition or the importance of balance diets availability and accessibility to foods this can happen because of misinformation, misconception or unfounded myth emanating from socio-cultural norms. Education about nutrition and food preparation can impact on food utilization and improve this pillar of food security.

4. **Food Stability:** food stability refers to the ability to obtain food over time, food stability can be transitory, seasonal or chronic. In transitory food security, food may be available during certain periods of time. While seasonal food in security can result from the regular pattern of growing seasons in food production. Also, chronic food insecurity is the long term, persistent lack of adequate food. In this case, households are constantly at risk of being unable to acquire food to meet the needs of all members. Chronic and transitory food insecurity are linked. Since the occurrence of transitory food security can make households more vulnerable to chronic food insecurity, so eating these vegetables that are available and stable at all seasons of the year will make households to be food secured.

Meanwhile a family is said to be food secured when all its members at all times have access to enough food for an active healthy life and foods available to the families can come from food produced within the household, or purchased from the market. So production and consumption of these endangered leafy vegetables (ELVs) by families will make the family to be food secured. The reintroduction of these ELVs into the family meals will make the dishes to be nutritious and it will also help in meeting their dietary requirements of the vital nutrients in the body.

### **Statement of the Problem**

Wardlaw, (20013) observed that there are naturally occurring substances in foods which manifest their toxicities especially when consumed in foods in large or little doses. Some of these anti-nutritional factors interfere with the bio-availability of nutrients and also constitute a major limiting factor to the use of such tropical plants, even though a lot of vegetables are available, most of them are expensive beyond the reach of the majority of the populace. So there is need for an alternative that will be cheaper, nutritious and of more health benefits. This study is necessary now that consumers have changed to eating mostly imported foods instead of eating locally grown foods. Secondly, the economic recession in the country has made this importation of these foods difficult, we need to look inwards to be food secured. Also, in terms of quality most of these imported foods are not nutritious, so this forms the need for this study. This study is aimed at determining the proximate composition and sensory evaluation of three endangered leafy vegetables (Akuwa, Upom and Kerenkere). The information is relevant to homemakers who are the major meal planners of the households.

### **Purpose of the Study**

The study was designed to determine the proximate composition and sensory evaluation of soups prepared with three endangered leafy vegetables (Akuwa, Upom and Kerenkere) for food security. Specifically, the study determined:

1. The proximate composition of the raw three endangered leafy vegetables, “Akuwa”, “Upom” and “Kerenkere”.
2. Determine the level of acceptability of the soups prepared with these three leafy vegetables

### **Research Question**

The study answered the following questions;

1. what are the proximate composition of these three raw leafy vegetables used in soup preparation
2. what is the level of acceptability of the soups prepared with these three leafy vegetables

### **Literature Review**

Vegetables are foods eaten by human beings and animals for sustainability of life. Green leafy vegetables constitute an indispensable component of human diets; they are utilized as major ingredients for preparing staple foods. Most vegetable are the leaves or stem of herbaceous plants, although flavor may also be consumed as vegetables. Leafy vegetables are used frequently in tropics in soups and stews and may have high nutritional value. Some vegetables may be cooked while others may be consumed raw (Ahia, 2012). In general, leafy vegetables are known to be rich in bioactive molecules such as carotenoids and polyphenols which have health promoting potentials. The USDA dietary guideline encourages consumer to eat at least a servings of vegetables each day (USDA, 2000). It is therefore hard to argue with the health benefits of a diet rich in vegetables because of the nutritive contents which are even higher in these three endangered leafy vegetables.

These endangered leafy vegetables that were once consumed but are at the verge of extinction, are Akuwa, Upom and Kerenkere. “Akuwa” which is commonly known as nettle with the scientific name *urtica dioica*, originated from Africa, Europe and North America, while

“Kerenkere” with the scientific name *Corchorus* spp originated from Africa and Asia while “Upom” with the scientific name *Asystasia gangetica* originated from south-east Asia and Africa. “Upom” and “Akuwa” leafy vegetables are both perennial herbs while “Kerenkere” is an annual herb. They are, all cultivated by seed but can also burst out on their own because of their open pollination ability which in recent times is the case because they are rarely and or not cultivated any more. These vegetables have a long history of use as medicine and food (Kokwaro, 2004). Heat changes a vegetable's texture, flavor, colour and nutrient content. High temperatures make vegetables tender and enhance flavor, texture and colour. Cooking changes these endangered leafy vegetables texture, flavour, colour and nutrient content. High temperature makes these vegetables tender and enhances flavour, in addition, heat usually makes these vegetables safer to eat by killing microbes in them and reducing the effect of anti-nutrients in nettles. Over-heating however, will cause texture, flavour, colour and nutrient content to deteriorate (Ahia, 2012). Cooking moderates and strengthens the odour of “Akuwa” vegetables (Christopher, 1996). The key to cooking vegetables is to make the tissues tender without making it too soft. These three leaf vegetables require only a few minutes to cook, therefore, they are said to be over cooked when they turn olive green in colour (Fafunso and Bassir, 1997). Most minerals and some vitamins dissolve in water so soaking “Akuwa” “Upom” and “Kerenkere” in water before cooking or cooking them in large amounts of water causes leaching of important vitamins and minerals (Ifon and Bassir, 1999). The other five factors that lead to nutrient losses are, high temperatures, prolonged cooking, alkalis (Such as baking powder), plant enzymes and oxygen. Some nutrient losses are inevitable.

## Methodology

### Determination of the Proximate Composition of the Raw Leavy Vegetables

The protein content was determined by Kjeldahl method described by James (1995) the total nitrogen was determined and multiplied with the factor 6.25 to obtain the protein. One half gram (0.5g) of each sample was mixed with 10mls of concentrated Sulphuric acid, AR grade (Analytical Reagent Grade) in a Kjeldahl digestion flask. A tablespoon of Selenium Catalyst was added to it and the mixture was digested (heated) under a fume cupboard until a clear solution was obtained in a separate flask. The acid and other reagent were digested but without sample to form the blank control. All the digests were carefully transferred to 100ml volumetric flask using distilled water and made up to a mark in the flask. A 100ml portion each digest was mixed with equal volume of 45% NaOH solution in Kjeldahl distilling unit. The mixture was distilled and the distillate collected into 10ml of 4% Boric acid solution containing three (3) drops of mixed, indicators (bromocresol green methyl red). A total of 50ml distillate was obtained and titrated against 0.02M H<sub>2</sub> SO<sub>4</sub> solution. Titration was done from the initial green colour to deep red-end point. The nitrogen content calculated is shown below

$$\% N_2 = \frac{(100 \times N \times 14 \times VF) T}{W \times 1000 \times V_a}$$

Where: W= Wt of sample analyzed, N= Conc of H<sub>2</sub> SO<sub>4</sub> titrate, VF= Total Volume of digest, V<sub>a</sub>= Volume of digest distilled T= Titre value- Blank

### Determinations of Fat Content

Fat content of the samples were determined by the continuous solvent extraction method using a sox let apparatus. The method is described by Pearson (1976) and James (1995). Five grammes (5.0g) of each samples wrapped in a porous paper (Whatman no 1 filter paper). The wrapped sample was put in a sox let reflux flask containing 2 (2ml of petroleum ether. The upper end of the reflux flask was connected to a condenser by heating the solvent in the flask through electro-thermal heater; it vaporizes and condensed into the reflux flask. Soon the warped sample was completely immersed in the solvent and remained in contact with it until the flask filled up and siphoned over thus carrying oil extract from the sample down to the building flask. This process was allowed on repeatedly for about 4hrs before the defatted sample was removed and reserved for Crude fiber analysis. The solvent was recovered and the extracting flask with its oil content was dried in the oven at 60°C for 3 mins (ie to remove any residue solvent). After cooling in desiccators the flask was reweighted. By difference the weight of fat (oil) extraction was determined and expressed as a percentage of the sample weight. It was calculated.

$$\% \text{ Fat} = \frac{W_2 - W_1}{\text{Wt of sample}} \times 10$$

Where, W = Weight of Crucible + sample after washing and drying in oven.

W<sub>3</sub> = Weight of Crucible + sample as ash

### Determination of Total Ash

This was done using the furnace incineration gravimetric method (AOAC 1990). A measured weight (5g) of each fruit sample was in a previous weighted porcelain crucible. The sample in crucible was placed in muffle furnace set at 55°C and allowed to burn for 2-3hrs (Until the sample became a gray ash). The sample in crucible was very carefully removed from the furnace (taking care and to allow air blow ash away) and cooled in a desiccators. It was reweighted by difference the weight of ash was obtained and in percentage. It was given by the formula

Where,

W<sub>1</sub> = Wt of Crucible

W<sub>2</sub> = Wt empty Crucible.

$$\% \text{ Ash} = \frac{W_2 - W_1}{\text{Wt of sample}} \times 100$$

### Determination of Carbohydrate

The carbohydrate content was calculated by difference as the nitrogen free extractive (NFE), a method separated described by Pearson (1976) and James (1995). The formulae was by % NFE = 100% (a + b + c + d + e)

Where, a = protein, b = Fat, c = Fiber, d = Ash, e = Moisture



### Determination of Moisture Content

Moisture content was determined by the gravi metric method (James, 1995) was used. A measured weight of each sample (5g) was weighted into a weighted moisture can. The can and its sample content were dried in the oven at 105<sup>o</sup> c for 3 hrs in the first instance. It was cooled in desecrators and reweighed. The weight was recorded while the sample was retained to the oven and further drying. The drying, cooling and weighing was continued repeatedly until a constant was obtained by the difference. The weight of moisture lost was determined and expressed as percentage it was calculated as shown below,

Where, W1= Wt of empty moisture can, W2= Wt of can before drying W3= Wt of can t sample after drying to a constant.

### Determination of Riboflavin

The riboflavin content of the test sample was determined using the method AOAC (1990) 5g of the sample was extracted with 100ml. of 50% ethanol solution and shaken for one hour. This was filtered into a 100ml flask. 10ml of the extract was pipette into 50ml volume tric flask. 10ml of 5% potassium permanganate and 10ml of 30% hydrogen peroxide (H<sub>2</sub> O<sub>2</sub>) were added and allowed to stand over hot water bath for about 39 minutes. 2ml of 4% sodium sulphate was added. This was made up to 50ml mark and the absorbance measured at 510m in spectrophotometer

### Determination of Vitamin C

Vitamin C content of the plant was determined by the Barakat titimetic method. 20g of each process plant sample was homogenized in 100ml of EDTA/TCA extraction solution by blending for 5 mins in a national slender. The homogametic was filtered and the titrate used for the analysis. Titrate for each test sample was passed through a backpacked carton wool containing activated charcoal to remove the colour. The wool volume of the filtrate was adjusted to 100ml by washing with more of the extracting solution 20mls of exhilarate was measured into a conical flask-1omls of 20% potassium iodide solution was added to each of the flasks followed by 5ml of starch solution (indicator) the mixture was titrated against C of ml Cus04 solution titration was done to an end point marked by black specks of the brink of the mixture, the Vit C. content was given by the relationship that 1ml of 0.01mol Cus04 O. 88mg Vit C.

Therefore Vit C content mg/100g sample

$$=100 \times \frac{VF}{V} \times 0.88T$$

$$W = \frac{Vax0.88}{Va} \times 1$$

### Determination of Vitamin

Determination of Vit E. (tocopherol) was done by Fruto Mayer method of the association of vitamin chemist as described by Pearson (1976). A measured weight of each sample was mixed with 10ml of absolute ethanol followed by 20ml of Molar alcoholic Sulphur acid the flask was wrapped in aluminum foil to be transferred to a separating funnel. The unsaponified matter was extracted with two portions of 30ml direct ether. The combined extract was washed free of acid and allowed to dry in desiccators over anhydrous Na<sub>2</sub>s04. It was later evaporated to

dryness of a low temperature while being protected from light. The dried extract was redissolved in 10ml ethanol and used for the assay. Standard vit E solutions were prepared and its concentration was noted. An aliquots volume of the extract was measured to a separate test tube. 5ml of ethanol was added to each followed carefully by 1ml Conc HN03. The mixture was placed on boiling water bath for three minutes it cooled rapidly (Using turning water and their absorbance measure at 470nm wavelength

Where F= Experimental factor,D= Dilation factor ,Au= Absorbance of Unknown (Sample),As= Absorbance of standard VTE, Vf= Total extract Volume,Va= Volume of extract analysed ,C= Cone of standard VtE,C= Cone of standard VtE 2/u/100g

### **Determiration of Calcium and Magnesium**

Calcium and Magnesium was determined by (Pearson, 1976). Calcium and Magnesium content of the test sample was determined by the versanale EDTA Complex Cometric titration 20ml of each extract was dispersed into a conical flask, pinches of the masking agents. Hydroxyl tannin, hydrochlorate, Potassium Cyanide was added and the mixture was shaken very well. It was titrated against 0.02N EDTA solution. Titration was from a mauve colour to a permanent blue coloration. A reagent blank consisting of 20ml distilled water was also treated as described above. The titration gave a reading for combine Ca and Mg Complexes in the samples. A separate titration was then conducted for calcium alone 10% NaOH solution at pH12.0 was used in place of the ammonia buffer while Solechrome dark blue (Calcon) was used as indicator in place of Erichrome black. The Calcium and Magnesium were calculated separately using the formular below:

$\% \text{ Calcium or Magnesium} = (100/WXEW/100XVF/VA)T$

Where;W= weight of sample analyzed ,EW= equivalent weight ,Vf= total volume of extract,N= Normality of EDTA=0.027,Va= Volume of extract titrated  
T= titre value less blank.

### **Determiration of Potassium and Sodium**

Potassium and Sodium were determined by AOAC (1990) and the potassium and Sodium in the sample were determined by the flame photometry. The instrument was set up according to the manufacturer's instruction. The equipment was switched and allowed to stay for about 10mins. The gas and air lets were opened as the start knob was turned on. The equipment being self igniting and the flame were adjusted to a non-luminous level (i.e blue colour). Mean while standard potassium and Sodium solutions were prepared separately and each was diluted to concentration of 2,4,6,8 and 10 ppm. When analyzing for specified element say potassium, the appropriate filter was selected and the instrument flushed with distilled water. The highest concentration standard solution was put in place and the reading adjusted to 100ml

### **Data Analysis Technique**

The analysis of Variance (ANOVA) and least significance difference were used to test for the differences among the samples.



**Table 1: Proximate Composition of the Raw Endangered leafy Vegetable Samples**

Samples Moisture Content	Dry Molder	Total Ash	Crude Fibre	Total Fat	Crude Protein	Cho
--- <sup>b</sup> ±0.00	17.30 <sup>c</sup> ±0.00	10.64 <sup>c</sup> ±0.01	11.47 <sup>b</sup> ±0.02	2.74 <sup>c</sup> ±0.02	11.84 <sup>b</sup> ±0.01	19.38a ±0.07
Akuwa 88.68 <sup>a</sup> ±14.08	21.33 <sup>a</sup> ±0.06	12.29 <sup>b</sup> ±0.01	11.64 <sup>a</sup> ±0.01	2.85 <sup>b</sup> ±0.00	10.79 <sup>c</sup> ±0.00	16.25 <sup>c</sup> ±0.09
Kerenkere 79.26 <sup>c</sup> ± 0.08	20.74 <sup>b</sup> ±0.08	12.77 <sup>a</sup> ±0.01	10.71 <sup>c</sup> ±0.01	12.64a ±0.00	12.64a ±0.01	18.99 <sup>b</sup> ±0.01

Mean in the same column with different superscript are significantly different (P<0.05) Means with the same superscript are not significantly different (P>0.05)

Moisture content ranged from 79.26% in Kerenkere to 88.6% in Akuma. The findings shows that there was a significant different (P<0.05) in the moisture content of these endangered leafy vegetables. The result also shows that “Akuwa” has the highest moisture content which reduces its shelf life while “Kerenkere” has the highest shelf-life and lowest moisture content among the three vegetables. The dry matter content ranged from 17.30% Upom to 21.33% “Akuwa”. The result indicated that “Akuwa” has the highest dry matter content. It also shows that dry matter content of these endangered vegetables differed significantly (P<0.05). It was also found that “kerenkere” has the highest ash content. The fibre contents of these endangered leafy vegetables ranged from 10.71 (Kerenkere) to 11.64% (Akuwa). This showed a significant difference (P<0.05) in the vegetable. The study showed that the vegetables had high fat content ranging from 2.74 (“Upom”) to 3.61% “Kerenkere” thus there was a significant difference in these endangered vegetable. When compared with findings of Ifon and Bassir (1979) on commonly used vegetables, the fat contents of these three endangered leafy vegetables were much higher. Protein contents of these vegetables ranged from 10.79% (Akuwa) 12.64% (Kerenkere) which showed a significant difference in the vegetables. The findings also revealed that the amount of protein content in “Kerenkere” is the highest. The Carbohydrate content in these vegetables ranged from 16.25% (“Akuwa”) to 19.38% in “Upom” indicating that “Akuwa” has the least carbohydrate content while “Upom” has the highest carbohydrate content. The findings also revealed a significant difference amongst the endangered vegetables (P<0.05)

**Table 2: Mineral Contents of the Raw endangered leafy Vegetable Samples**

Samples	Sodium	Potassium	Phosphorus	Calcium	Iron	Zinc
Upom 17.27 <sup>b</sup> ±0.04	54.92 <sup>c</sup> ±0.00	10.64 <sup>c</sup> ±0.01	34.61 <sup>b</sup> ±0.01	43.27 <sup>a</sup> ±0.04	3.74 <sup>b</sup> ±0.00	2..30 <sup>b</sup> ±0.00
Akuwa 13.63 <sup>a</sup> ±0.03	58.70 <sup>a</sup> ±0.00	12.29 <sup>b</sup> ±0.01	27.65 <sup>a</sup> ±0.04	29.47 <sup>b</sup> ±0.02	4.24.79 <sup>c</sup> ±0.00	2..09 <sup>b</sup> ±0.01
Kerenkere 54.64 <sup>c</sup> ± 0.19	65.82 <sup>b</sup> ±0.01	12.77 <sup>a</sup> ±0.01	16.75 <sup>c</sup> ±0.01	23.43c ±0.03	5.61 <sup>a</sup> ±0.01	3.42 <sup>a</sup> ±0.03

Mean in the same column with different superscript are significantly different ( $P < 0.05$ ) Mean with the same superscript are not significantly different ( $P > 0.05$ )

The findings in table 2 revealed that a significant difference was observed amongst the endangered leafy vegetables. The sodium content ranged from “Akuma” 13.63% to “Kerenkere” 54.64%. The potassium content of these endangered vegetables ranged from Upom 54.92% to “Kerenkere” 65.82% which also showed a significant difference ( $P < 0.05$ ). There was also a significant difference in the phosphorus content of these endangered vegetables. The values ranged from “Kerenkere” 16.75% to “Upom” 34.61% and this shows that “Kerenkere” has the least phosphorus content while “Upom” has the highest content of phosphorus. The calcium content was equally high in these vegetables with values ranging from 23.43% “Kerenkere” to 43.27% “Upom”. A significant difference was also detected in the vegetables. The iron content of these vegetables ranged from 3.74% “Upom” to 5.61% “Kerenkere” which showed that there was a significant difference ( $P < 0.05$ ). This implies that “Kerenkere” has the highest iron content and “Upom” had the least iron content. There was also a significant difference in the Zinc content of these endangered leafy vegetables ranging from 2.09% “Upom” to 3.42% “Kerenkere” but there was no significant difference ( $P > 0.05$ ) in the Zinc content of these vegetables ranging from 2.09% “Upom” to 3.42% “Kerenkere” but there was no significant difference ( $P > 0.05$ ) in the zinc content of “Akuwa” and “Upom”

**Table 3 Vitamin Contents of the raw Vegetables Samples (mg/100g dry matter)**

Samples	Vit A	Vit B <sub>1</sub>	Vit B <sub>2</sub>	Vit B <sub>3</sub>	Vit C	Vit E
–	2.76 <sup>c</sup> ±0.00	2.81 <sup>b</sup> ±0.01	3.7 ±0.01	1.19 <sup>c</sup> ±0.01	19.4 <sup>c</sup> ±0.01	6..62 <sup>c</sup> ±0.00
“Akuwa”	3.25 <sup>b</sup> ±0.01	1.74 <sup>a</sup> ±0.00	2.36 <sup>c</sup> ±0.00	1.26 <sup>b</sup> ±0.00	24.76 <sup>a</sup> ±0.00	0..76 <sup>b</sup> ±0.01
“Kerenkere”	3.95 <sup>a</sup> ±0.00	3.17 <sup>a</sup> ±0.01	4.92 <sup>c</sup> ±0.00	2.30 <sup>a</sup> ±0.00	20.16 <sup>a</sup> ±0.01	0.86 <sup>a</sup> ±0.01

Means in the same Column with different superscript are significantly different ( $P < 0.05$ ) while those with the same superscript are not significantly different ( $P > 0.05$ ).

The result in table 3 showed that there was a significant difference ( $P < 0.05$ ) in the vitamin contents of the endangered leafy vegetables with values ranging from 2.76% in “Upom” to 3.95% in “Kerenkere”. “Kerenkere” was found to have greatest vitamin A while “Upom” has the least vitamin A content. There was also significant difference ( $P < 0.05$ ) in the vitamin B<sub>1</sub> content of these vegetables ranging from 1.74% in “Akuwo” to 3.17% in “Kerenkere”. The finding revealed that “Akuwo” had the least vitamin B<sub>1</sub> content while “Kerenkere” equally had the highest vitamin B<sub>2</sub> 4.92% followed by “Upom” 3.71% with “Akuwa” having the least vitamin B<sub>2</sub>. Also the vitamin B<sub>3</sub> content ranged from “Upom” 1.19% to Kerenkere 2.3% which a significant difference was observed. However, there was a significant difference ( $P < 0.05$ ) in the vitamin C contents of these endangered leafy vegetables with values ranging from “Upom” 19.41% to “Akuwa” 24.76%. The finding showed that “Akuwa” has the highest vitamin C content “Upom” had the least. The vitamin E content of these vegetables showed a significant difference ( $P < 0.05$ ) “Upom” had the least vitamin E content 0.62% while “Kerenkere” has the highest vitamin E content.

**Table 4: Proximate Composition of the Okro Soup Samples (mg/100g dry matter)**

Samples	Moisture content	Dry Matter	Total Ash	Crude Fiber	Total Fat	Crude Protein	CHO
101	62.3 <sup>a</sup> ±0.04	22.73 <sup>d</sup> ±0.04	13.73 <sup>a</sup> ±0.01	3.77 <sup>a</sup> ±0.01	17.81 <sup>b</sup> ±0.01	9.45 <sup>b</sup> ±0.00	12.03±0.08
102	59.41 <sup>d</sup> ±0.01	37.35 <sup>c</sup> ±0.05	11.85 <sup>c</sup> ±0.00	2.44 <sup>d</sup> ±0.01	19.27 <sup>a</sup> ±0.04	8.88 <sup>c</sup> ±0.00	4.69 <sup>b</sup> ±0.07
103	60.32 <sup>c</sup> ±0.01	40.59 <sup>a</sup> ±0.01	10.63 <sup>c</sup> ±0.02	2.94 <sup>c</sup> ±0.00	13.86 <sup>d</sup> ±0.01	8.72 <sup>d</sup> ±0.02	4.45 <sup>b</sup> ±0.06
104	62.3 <sup>b</sup> ±0.01	39.65 <sup>b</sup> ±0.04	12.50 <sup>b</sup> ±0.10	3.42 <sup>b</sup> ±0.00	16.21 <sup>c</sup> ±0.02	10.23 <sup>a</sup> ±0.00	2.74 <sup>c</sup> ±0.18

Means in the same column with different superscript are significantly different ( $P < 0.05$ ). Mean with the same superscript are not significantly different at ( $P > 0.05$ )

101 (Control) Okro/Ugu Soup, 102 Okro with “Kerenkere”, 103 Okro/soup with “Akuwa”, 104 Okro Soup with “Upom” The level of moisture content of a food item is a measure of the degree of its freshness and length of storage. The presence of high moisture content in leafy vegetables when not preserved underscores their freshness and possibility of easy spoilage (Lawande and Chavan (1998).

**Table 5: Mineral Contents of the Okro Soup Samples (mg/100g dry matter)**

Samples	Magnesium	Potassium	Sodium	Calcium	Phosphorous	Iron	Zinc
101	17.26 <sup>b</sup> ±0.02	11.49 <sup>a</sup> ±0.01	3.76 <sup>b</sup> ±0.00	19.79 <sup>a</sup> ±0.01	16.85 <sup>a</sup> ±0.00	0.77 <sup>b</sup> ±0.10	0.40 <sup>a</sup> ±0.01
102	14.72 <sup>c</sup> ±0.00	8.32 <sup>d</sup> ±0.00	3.65 <sup>c</sup> ±0.00	13.78 <sup>c</sup> ±0.02	14.79 <sup>b</sup> ±0.01	0.90 <sup>a</sup> ±0.01	0.47 <sup>b</sup> ±0.01
103	11.61 <sup>d</sup> ±0.01	9.72 <sup>b</sup> ±0.00	4.74 <sup>a</sup> ±0.02	16.39 <sup>b</sup> ±0.01	0.65 <sup>d</sup> ±0.00	0.65 <sup>d</sup> ±0.00	0.42 <sup>b</sup> ±0.06
104	19.27 <sup>c</sup> ±0.04	8.94 <sup>c</sup> ±0.02	3.25 <sup>d</sup> ±0.01	12.77 <sup>d</sup> ±0.01	12.83 <sup>c</sup> ±0.04	0.83 <sup>b</sup> ±0.00	0.60 <sup>a</sup> ±0.00

Mean in the same column with different superscript are significantly different ( $P < 0.05$ ) while those with the same superscript are not significantly different ( $P > 0.05$ )

101 (Control) Okro, 102 okro/kerenkere, 103 Okro/ “Akuwa” 104 Okro/ “Upom”

**Mineral Composition:** The result of the mineral composition of the endangered leafy vegetables is shown in table 5. Calcium and Phosphorous contents are highest in Okro/ “Akuwa” Soup and Okro/ Kerenkere Soup. “Upom” has the highest amount of Magnesium while “Akuwa Soup” has the highest sodium followed by Okro/Ugu Soup. However the iron content of the vegetables were equally significant in Okro/Kerenkere 0.90% and “Upom” Okro Soup 0.83%. Also, the zinc content was equally high in Okro/”Upom”. The minerals which were found in endangered leafy vegetables include amongst others Phosphorus and Magnesium which are involved in bone formation while iron, zinc, Potassium, Sodium were highly significant among these vegetables and Calcium and Magnesium serve as cofactors to many enzymes involved in the synthesis of hemoglobin, myoglobin and also prevent synthesis of hemoglobin, myoglobin and also prevent Synthesis, Meanwhile, Sodium and Potassium are involved in membrane transport and transmission of nerves. Cooking reduces the mineral contents of these endangered vegetables which is also in agreement with Ahia (2012) that heat has adverse effect on leafy vegetables, so cooking should be done carefully to keep loss of nutrients at minimum. This is also in agreement with Adigbo and Maddah (2011) who observed that colour changes occur during cooking as the pigments like chlorophyll are affected by heat.

**Table 6: Vitamin Contents of the Okro Soup Samples (mg/100g dry matter)**

Samples	Vit A	Vit B <sub>1</sub>	Vit B <sub>2</sub>	Vit B <sub>3</sub>	Vit E	Vit C
101	12.95 <sup>c</sup> ±0.00	1.72 <sup>a</sup> ±0.00	2.08 <sup>a</sup> ±0.03	0.82 <sup>c</sup> ±0.00	1.91 <sup>a</sup> ±0.01	13.76 <sup>a</sup> ±0.00
102	12.74 <sup>b</sup> ±0.02	1.48 <sup>b</sup> ±0.00	1.85 <sup>c</sup> ±0.00	0.63 <sup>c</sup> ±0.00	1.48 <sup>d</sup> ±0.00	9.64 <sup>c</sup> ±0.01
103	9.48 <sup>d</sup> ±0.00	1.44 <sup>c</sup> ±0.01	1.72 <sup>c</sup> ±0.02	0.84 <sup>b</sup> ±0.01	1.65 <sup>c</sup> ±0.00	10.74 <sup>b</sup> ±0.01
104	10.84 <sup>c</sup> ±0.01	1.06 <sup>d</sup> ±0.01	1.68 <sup>d</sup> ±0.00	0.94 <sup>a</sup> ±0.00	1.84 <sup>c</sup> ±0.02	8.76 <sup>d</sup> ±0.01

Mean in the same Column with different superscript are significant different ( $P < 0.05$ ). Mean with the same superscript are not significantly different ( $P > 0.05$ ).

101 (Control) Okro/Ugu Soup, 102 Okro/ “Kerenkere” Soup, 103 Okro/ “Akuwa” Soup, 104 Okro/ “Upom” Soup.

The vitamin contents of the endangered leafy vegetables were generally high. Vitamin A contents of the vegetables ranged from “Ugu” 12.95% to 9.48% “Akuwa” vitamin B<sub>1</sub> ranged from 1.06 “Upom” to 1.72% in “Ugu”, vitamin B<sub>2</sub> ranged from “Upom” 1.68% “Ugu” 2.08% and Vitamin B<sub>3</sub> varied from “Kerenkere” 0.63% to “Upom” 0.94%. Also vitamin E had the least 1.48% Kerenkere to 1.91% “Ugu” being highest. The vitamin C content ranged from 8.76 in “Upom” to 13.76% in “Ugu”. The result indicated that the raw state of the endangered vegetables vitamins B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub> and C contents were higher than when subjected to heat. Also, cooking significantly increased the vitamin A and E contents in all the Okro Soup samples. The findings of the study are in agreement with Adigbo and Madah (2011) who observed that vitamins especially vitamin C is lost during cooking of vegetables, it is also in line with Ahia (2012) that vitamins and minerals are destroyed by heat during cooking.

The fresh endangered leafy vegetables (ELVs) were picked, cleaned and washed in a basin of water. The other materials like crayfish, okro, meat, red oil, dryfish, stockfish head pepper, salt, onions and ugu were purchased from Umuahia main market. The same quantity of ingredients and method were used in preparing each okro soup sample but varying the vegetables (ugu, Upom, Akuwa and kerenkere) Ugy/okro was used as the control.

### Sensory Evaluation

Sensory evaluation is how consumers perceive foods with the use of the senses to determine taste, texture, colour, flavour and aroma. Samples were drawn for sensory evaluation. It was conducted on the products to establish their acceptability. Twenty semi-trained panelists were used for the sensory evaluation using hedonic likert scale of rating (Onwuka, 2013). The attributes evaluated are texture, colour, taste, aroma, flavor and general acceptability. Four (4) samples were used for the sensory evaluation. The first sample coded '101' was okro soup with ugu (control), the second sample coded '102' was okro soup with “kerenkere” while the third sample was coded '103' okro soup with Akuwa and the fourth sample coded '104' was okro soup with “upom”. The samples were served in soup bowls coded with 101-104. The panelists were asked to evaluate these samples based on numerical scores assigned to the ratings. The score ranged from 1-9. Water was provided for the panelists to rinse their mouth intermittently after each sample is tested for accurate result. All data were subjected to analysis of variance and least significance difference was used to test for the difference among the samples.

**Table 7: Sensory Evaluation of Scores for the Okro Soups**

Samples	Texture	Taste	Flavour	Aroma	Colour
101	7.10 <sup>a</sup> ±1.17	7.35 <sup>b</sup> ±1.66	7.40 <sup>a</sup> ±1.10	10.40 <sup>a</sup> ±15.70	6.70 <sup>b</sup> ±1.08
102	7.85 <sup>a</sup> ±0.81	8.10 <sup>ab</sup> ±0.72	7.70 <sup>a</sup> ±0.92	7.70 <sup>a</sup> ±1.07	8.15 <sup>a</sup> ±0.93
103	5.80 <sup>b</sup> ±1.82	8.20 <sup>a</sup> ±0.77	8.00 <sup>a</sup> ±0.73	7.65 <sup>a</sup> ±1.09	4.15 <sup>a</sup> ±1.53
104	7.50 <sup>a</sup> ±0.95	6.10 <sup>c</sup> ±1.52	6.65 <sup>b</sup> ±1.35	6.00 <sup>a</sup> ±2.22	5.65 <sup>c</sup> ±2.30

Mean in the same column with different superscripts are not significantly different ( $P < 0.05$ ) while those with the same superscripts are not significantly different ( $P > 0.05$ ).

- 101 (Control) Okro soup with “ugu”
- 102 Okro soup with “Kerenkere”
- 103 Okro soup with “Akuwa”
- 104 Okro soup with “Upom”

### Result

Table 7 showed that a significant difference was observed ( $P < 0.05$ ) between samples 103 and the other samples (101, 102 and 104). Also, there was no significant difference ( $P > 0.05$ ) between sample 101, 102 and 104, which means that their texture were very much accepted. There was a significant difference in the taste of the samples but there was no significant difference ( $P > 0.05$ ) between sample 101 and sample 102 and also between sample 102 and sample 103. This result showed that sample 103 had the highest generally acceptable taste. There was a significant difference ( $P < 0.05$ ) in the flavor of sample 104 and the other three samples (101, 102 and 103). In the flavor of samples 101, sample 102 and samples 103 there was no significant difference ( $P > 0.05$ ). This implies that the flavor of samples 101, 102, and 103 were highly accepted than sample 104 because they are almost in flavour. In the colour, there was a significant difference ( $P < 0.05$ ) between the samples but the sample that had the best generally acceptable colour was sample 102 and sample 103 had the least generally acceptable colour, which means it was not liked much. In summary, excluding the control, sample 102 had the highest level of general acceptability followed by sample 103 and then sample 104. This is in agreement with the study of Burkill (2000) that these endangered leafy vegetables had nutritional compositions which compared favourably with other common Nigerian leafy vegetables.

### Discussion of Findings

The endangered leafy vegetables are succulent green plants grown mainly in gardens, orchards, around homes and as wild plants. They provide variety in the meals and are good sources of ascorbic acid, dietary fibre, carotene and iron among others. So a regular supply of vegetables should be essential part of good living and food security for all in the home. This is in accordance with Ahia (2012) who stated that vegetables are good sources of vitamin C, carotene and the greener the leaf the larger the quantity of vitamins present. She further asserted that they add to the attractiveness of meals because they are always greenish in colour the findings is also in line with USDA (2000) finding that 9 servings of vegetables are needed everyday. This infers that vegetables are important to human beings for growth and maintenance. All the samples were generally accepted in terms of colour which means that they could be exploited in planning accepted meals by household members.



The moisture content of the Okro soup prepared differed significantly ( $P < 0.05$ ). The moisture content of the soups ranged from 59.41% in Okro with “Akuwa” to 67.27% in Okro soup with “Ugu”. This showed that heat significantly reduces the moisture contents of these vegetables. This is similar to the observation of Leng, Butrum and Chang (1976) that heat has an adverse effect on the moisture content of “Upom” and “Akuwa” vegetables. The dry matter content ranged from 22.73% in Okro soup with “Ugu” to 40.59% in Okro soup with “Akuwa”. This study showed that the Okro soups were significantly different ( $P < 0.05$ ). This result indicates that heat increased the dry matter contents of these vegetables mostly “Akuwa” and that heat has the least effect on the dry matter content of “Ugu”. The Ash content ranged from 10.63% in Okro Soup with “Akuwa” to 13.73% in Okro Soup with “Ugu” showing that there is significant difference ( $P < 0.05$ ) between the Okro soups. The result also showed that heat increased the ash content of “Upom” from 10.64% to 12.50% and decreased the ash content of “Akuwa” from 12.29% to 10.63% and Kerenkere 12.77% to 11.85%. The relevance of ash content is that it gives an idea of the amount of mineral elements present in the food sample. Fiber content ranged from 2.44% in Okro Soup with “Kerenkere” 3.77% in Okro Soup with “Ugu” showing significant different ( $P < 0.05$ ) among the other Okro Soup samples produced. Heat drastically reduced the fiber contents of these vegetables from 11.47% in “Upom” to 3.42%, 11.64% in “Akuwa” to 2.94% and 10.71% in “Kerenkere” to 2.44%. Crude fiber is beneficial for reducing heart diseases, maintaining and improving digestive health and reducing the risk of diabetes and some types of cancer (Luke, 1984). It has been documented that non-starchy vegetables are the richest in dietary fiber and are employed in the treatment of diseases such as obesity, diabetes and gastrointestinal disorders (Sri, 2003).

The Okro Soup samples showed high fat content in these vegetables ranging from 13.86% in Okro Soup with “Akuwa” to 19.27% in Okro Soup with “Kerenkere”. A significant difference ( $P < 0.05$ ) was observed in the fat content of the Okro Soups which means that cooking significantly increased the fat contents of “Kerenkere” from 3.61% to 19.27% “Upom” 2.74% to 16.21% and “Akuwa” 2.85% to 13.86%. Dietary fats help in the absorption and transportation of fat soluble vitamins (Demayer, 2000). The findings of this study do not correspond with the findings of Bamigboye, Adigum and Komolafe (2013) that fat contents of vegetables are less and cannot possibly be good source of fat soluble vitamins. The result indicated that cooking slightly reduced the content of protein in these vegetables especially in “Akuwa” from 10.79% to 8.72%. This is not in agreement with Ahia (2012) who stated that the goal of cooking vegetables is to retain nutrients and maintain a high level of palatability. She further stated that it is essential to use the method of cooking that will minimize loss of food value. Significant difference existed among the endangered leafy vegetable soup samples. Okro Soup with “Ugu” had the highest carbohydrate content (12.03%) while Okro Soup with “Upom” had the least value (2.74%). These endangered vegetables are thus good sources of carbohydrate. The indigestible carbohydrate which is referred to as the crude fiber was determined to be 11.47% in “Upom” and 10.71% in Kerenkere. This crude fibre can be used in the development of high fiber food products suitable for consumption by obese and weight watchers.

The texture, taste and Aroma were highly accepted because there was no significant difference which implies that these 3 ELVs should be included in the family meals thereby increasing household food security and reducing the incidence of micronutrient deficiencies in the



households. This is also in agreement with Burkill (2000) that nutrient content of these 3 endangered leafy vegetables should be determined in order to disabuse the thinking of people that because they grow on their own and require no extra attention and they are of no value and therefore worthless. The acceptability of these 3 ELVs shows that their cultivation and their ultimate consumption should be encouraged to avoid their going into extinction. It is also in line with FAO (2007) that the production and consumption of these 3 ELVs cannot only help prevent nutrition deficiency but can also reduce the risk of cardiovascular diseases.

### **Conclusion**

The sensory evaluation showed that these 3 ELVs were widely accepted by consumers who know these vegetables and so awareness should be created by home economics and nutritionist so that people will know the leaves and should cultivate and eat these vegetables so that it will not go into extinction. Moreover, these leaves should be used by hospitality industries ,restaurants and fast food centers in preparing okro soups so that customers will tap the nutrients in these three leafy vegetables.

### **Recommendations**

The following recommendation where made base on the proximate composition and sensory evaluation of soups prepared with three endangered leafy vegetable (Akuwa, Upom and Kerenkere) for food security.

1. The use of these 3 ELVs in households will improve the nutritional value of foods of family members and will help to prevent and eliminate micronutrient malnutrition as a way of ensuring food security in the households.
2. The cultivation of these endangered leafy vegetables in home gardens, school or office farms will prevent them from going into extinction.
3. Farmers should grow these vegetables in abundance to ensure food availability in the state.
4. Government should give loan and land to agricultural graduates to encourage these vegetable and cultivation and to boast food security in the family, state and nation.

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