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Effect of Processing Techniques on Nutritional Composition and Sensory Qualities of Selected Leafy Vegetable

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Abstract

This study investigated the sensory qualities and chemical composition of five indigenous vegetable soups in the study area. The vegetables were subjected to chemical analysis. The moisture, crude protein, crude fibre, ash, calcium, phosphorus and potassium content of the vegetables were determined. The vegetables were cooked as soups and subjected to sensory evaluation on 9-point hedonic scale. Results revealed among that the moisture content in shaded dried Yanrin. Bitter-leaf, igbo, moringa and ugu were higher than that of other vegetables under similar conditions. Ugu was significantly richer in crude protein (19.39%) and as well superior to other in terms of crude fat content (7.14%). However, Igbo vegetable soup was very rich in crude fibre.

Key words: Processing, Nutrition, Composition, Sensory, Vegetables.

Introduction

Vegetables are the most important part of meal combination and it is therefore prepared with much finesse. Nutritionally, leafy vegetable are highly low in calories, low in fat, high in protein content per calorie, high in dietary fibre, high in iron and calcium, and very high in phytochemicals such as vitamin C, carotenoids, lutein, folate, magnesium as well as vitamin K. The primary source of dietary in organic nitrate for nitric oxide production in the body is from leafy vegetables, in particularly spinach and arugula (Fasuyi, 2007;Bello and Fowoyo, 2014). Nitric oxide is a natural cardio protective that contribute to cardio vascular health responsible for anti-hypertensive effect of plant –based diet such as Dash diet and the Mediterranean diet reported by Oke (2007). The vitamin K content of leaf vegetable is particularly

high, since these are photosynthesis tissues and phylloquinone is involved in photosynthesis. Those vegetable are grown primary for consumption of their leafy parts, either raw or cooked (Larkcom, 2002; Njoku *et al.,* 2011).

The use of leafy vegetables in human diets dated back to time immemorial. Vegetable constitutes essential components in traditional and modern cooking and without them dishes may not be rich in essential vitamins and minerals (Nnamani *et al.,* 2009). Eating vegetables is not only beneficial in terms of their nutrients contribution to diets but also medicinal. In view of the threat to health in consumption of many hazardous synthetic foods, it is imperative to encourage the consumption of vegetables most especially the underutilized ones among households in southwestern Nigeria. The consumption of green leafy vegetables, which have the highest nutritional value add to the nutritional status of poor rural and urban households. This therefore means that improve beneficial nutrients consumption and health of people in Southwestern Nigeria there has to be positive change towards consumption of vegetables particularly the indigenous beneficial ones (Kwenin *et al.,* 2011). For this change to be brought about in a seemingly westernized society of ours where synthetic and junk foods are becoming the order of the day, there is need to provide empirical evidence on the beneficial nutritional composition and sensory qualities often neglected and underutilized vegetables in the country at large and in western Nigeria in particular.

In Africa (Nigeria inclusive), the number of indigenous vegetable species was reported to be far greater than exotic ones (Barry *et al.,* 2008; Oloyede *et al.,* 2011). Then why do consumption of indigenous vegetables seemed not appealing to teaming number of people? The answer may lie in lack of understanding of the chemical composition and sensory qualities of the vegetables. This vacuum in knowledge is what this study is set out to fill. Besides, increased consumption of African indigenous vegetables enhances crop diversity, alleviates poverty and promotes food security (Barry *et al.,* 2008). However, the statuses of the crops, as well as their conservation, processing need to be addressed to ensure sustainable use (Vorster *et al.,* 2007; Obuoto and Oloyede, 2014). Although consumption of fresh unprocessed plant food (including vegetable) is widely advocated, evidence is emerging that bioavailability of many protective compounds is enhanced when vegetables are processed (Kaur and Kapoor, 2001). Putting this fact into consideration, as well as other aforementioned need for empirical findings on the subject matter, this study focuses on assessing the effect of processing techniques in nutritional composition and sensory qualities of selected leafy vegetables in Nigeria.

Objectives of the Study

The major objective of the study was to assess the effect of processing techniques on nutritional composition and sensory qualities of selected leafy vegetables. Specifically the study determined:

(1) proximate composition in the leafy vegetables;

(2) mineral composition of the leafy vegetables;

(3) sensory qualities of soups prepared from the processed leafy vegetables.

The study focused on processing technique used in different uncommon vegetable. The vegetables covered include bitter leaf (Efo Ewuro), egg plant leaves (Efo Igbo), wild lettuce (Efo Yanrin), fluted pumpkin leaf (Ugu) and Moringa Olifera leaves by boiling in hot water prior cooking as soup, blanching prior to cooking as soup, soaking in hot water, soaking in cold water, shade-drying and sun – drying of the vegetables.

Materials and Methods

***Materials*:** Five (5) different leafy vegetables, including bitter leaves (Efo Ewuro), egg plant leaves (Efo Igbo), wild lettuce (Efo Yanrin), fluted pumpkin leaf (Ugu) and Moringa Olifera leaves were purchased from Ayetoro market, Ogun State.

***Methods*:** The leaves were shaded-dried in ambient temperature and sun-dried in direct sunlight and later taken to laboratory for analysis using the AOAC (1990) procedures.

***Processing of all leafy vegetables*:** The following processing activities were carried out:

Bitter Leaf (ewuro): Fresh bitter leaves were removed from the stalk, cut into smaller sizes prior to parboiling in clean water with the addition of potash (3g) for 20 minutes. After parboiling, the water was decanted and rinsed in fresh water. The parboiled leaves were rubbed in between the two palms thoroughly to remove the bitterness. The leaves were divided equal parts. One part was sundried for two days, while the other remaining part was shaded-dried for 14 days. These two batches were named sundried bitter leaves (SUBL) and shade-dried bitter leaves (SHBL).

***Fluted pumpkin leaf (ugu)*:** Fresh fluted pumpkin leaf was removed from the stalk, cut into smaller sizes. The leaves were divided equal parts. One part was sundried for two days, while the other remaining part was shaded-dried for 14 days. These two batches were named sundried fluted pumpkin (SUFL) and shade-dried fluted pumpkin (SHFL).

Eggplant leaves (Efo igbo): Eggplant leaves were removed from the stalk, cut into smaller sizes prior to parboiling in clean water with the addition of potash (5g) for 2 minutes. After parboiling, the water was decanted and rinsed in fresh water. The leaves were divided equal parts. One part was sundried for two days, while the other remaining part was shaded-dried for 14 days. The two batches were named sundried

eggplant leaves (SUEL) and shade-dried eggplant leaves (SHEL).

Wild lettuce (Efo yanri): Wild lettuce leaves were removed from the stalk, cut into smaller sizes prior to parboiling in clean water with the addition of potash (5g) for 20 minutes. After parboiling, the water was decanted and rinsed in fresh water. The leaves were divided equal parts. One part was sundried for two days, while the other remaining part was shaded-dried for 14 days. The two batches were named sundried wild lettuce leaves (SUWL) and shade-dried wild lettuce leaves (SHWL).

Moringa oleifera (moringa): Moringa oleifera leaves were removed from the stalk. The leaves were thereafter sundried or shade-dried for 4 days. The two batches were named sundried Moringa oleifera leaves (SUML) and shade-dried moringa oleifera leaves (SHML).

Preparation of Soups

Five (5) different soups, including bitter leaves (Efo Ewuro), egg plant leaves (Efo Igbo), wild lettuce (Efo Yanrin), fluted pumpkin leaf (Ugu) and Moringa Olifera leaves soups were prepared in this study. The recipes used in preparing the soups are summarized in Table 1, 2, 3, 4 and 5 respectively.

Table 1: Bitter Leaf Soup

Recipe	Quantity
Beef	250g
Smoked fish	250g
Palm oil	1 cooking spoonful
Pepper (dried and grinded)	2 table spoon
Spices (Black pepper)	2 table spoon
Locust beans	2 medium wrap
Stock cubes	None
Groundnut (roasted and grinded)	100g
Bitter leaves (washed)	10g
Water	as desired
Pomo (washed)	as desired
Assorted meat[parboiled}	as desired

Bitter Leaf Soup Method of Preparation

- Beef was seasoned and allowed to boil in a pot until tender.
- Water was added as desired to the pot containing the beef
- Spices; dried pepper, fish, pomo, assorted meat, locust beans were poured and allowed to boil for 25 minutes.
- The pot was shook together gently and mixed the groundnut paste with a little water to separate the texture. Then, they were added to the boiling stock liquid.

- They were simmered gently, stirred occasionally to break up the lumps for 5 minutes.
- Lastly, the washed bitter leaves were added without stirring, left to cook for another 5 minutes after which the seasoning were corrected and served with fufu, semolina or pounded yam.

Table 2: Egg Plant Vegetable Soup

Recipe	Quantity (Measure)
Dried fish	250g
Pomo	5 big size
Beef	250g
Assorted meat	250g
Fresh pepper, tomato, red pepper (grinded not too smooth)	
Locust beans	2 medium size
Ginger (grated)	1 medium size
Garlic grated)	As desired
Egg plant leaves (washed and sliced)	A bunch
Onions	3 big size
Stock cubes	None
Salt	as desired
Water	as desired
Fresh crayfish (optional)	
Palm oil	

Egg plant Soup Method of Preparation

- Beef and assorted meat were seasoned and allowed to boil in a pot until it became tender. They were then placed aside when they were cooked.
- Clean pot was put on fire, 5 cooking spoonful of palm oil was poured. This was allowed to bleach for 2 minutes after which pepper, stock fish, pomo, dried fish and locust beans were added. They were allowed to boil very well for 30 minutes.
- Assorted meat was added to the boiling stock to boil for 10 minutes. The sliced egg plant leaves were added and allowed to steam for two minutes. The seasoning was corrected and served with eba, wheat, pounded yam, fufu or white rice

Table 3: Wild Lettuce Soup

Recipe	Quantity
Dried fish	25g
Pomo	5 big size
Beef	250g
Assorted meat	250g
Fresh pepper, tomato, red pepper (grinded not too smooth)	
Locust beans	2 medium size
Ginger (grated)	1 medium size
Garlic grated)	As desired
Wild lettuce (washed and sliced	A bunch
Onions	3 big size
Stock cubes	None
Salt	as desired
Water	as desired
Fresh crayfish (optional)	
Palm oil	5 cooking spoonful

Wild Lettuce Soup Method of Preparation

- Water was put in kettle and allowed to boil at 100^0C
- Wild lettuce leaves were blanched for 2 minutes and sieved
- Beef and assorted meat were seasoned and allowed to boil until they became tendered. They were later placed aside when it was cooked.
- Clean pot was put on fire, 5 cooking spoonful of palm oil were poured and allowed to bleach for 2 minutes. Then, grounded pepper, stock fish, pomo, dried fish, locust and beans were added. They were allowed to boil thoroughly for 30 minutes.
- Assorted meat was later added to the boiling stock . it was allowed to allowed to boil for 10 minutes. Then, sliced wild lettuce leaves were poured, steamed for two minutes and poured in the soup. The season were corrected and served with eba, wheat flour, pounded yam, fufu or white rice.

Table 4: Fluted Pumpkin (ugu)

Recipe	Quantity
Chicken (washed)	1kg
Garden egg (washed)	5 pieces (big size)
Fluted Pumpkin leaves (washed and sliced)	1 bunch
Smoked fish (washed)	250g

Stock fish (washed)	250g
Dried pepper (grinded to paste)	
Assorted meat (washed)	250g
Ogiri	as desired
Locust beans	
Ginger (peeled and grated)	
Garlic (peeled and grated)	
Palm oil	
Onions (washed and sliced)	1 big size

Fluted Pumpkin leaves Soup Method of Preparation

- The fluted pumpkin leaves were boiled to a tender texture
- Chicken and assorted meat were washed, seasoned with garlic, ginger, and onions, seasons and allowed to boil thoroughly on fire.
- Then, ogiri, locust beans, stocked fish, smoked fish, grinded pepper and palm oil were added to the boiling stock liquid
- They were allowed to boil for 10 minutes after which pumpkin leaves were added. The pumpkin leaves were steamed for 2 minutes and served with pounded yam, fufu, wheat or semovita.

Table 5: Moringa Oleifera Soup

Recipe	Quantity
Beef	250g
Dried fish	100g
Stock fish	250g
Pomo (washed)	5 medium size
Fresh pepper or dried pepper	
Crayfish	1 cups
Ogiri	12 medium wrap
Locust beans	1 medium wrap
Moringa oleifera leaves	5g
Palm oil or palm fruit	
Stock cubes	None
Water	as desired

Moringa oleifera Soup Method of Preparation

- The moringa oleifera leaves was washed thoroughly in a big bowl. Crayfish was grinded to a smooth texture
- Palm fruits were washed and poured in a pot. Water was added and allowed to boil on fire until it got soft. The palm fruits were poured into a mortar and pounded to extract oil from the palm fruits.

Having extracted the oil, it was placed aside.

- ❖ The beef were washed and parboiled after which it was placed aside
- ❖ The stockfish as well as the dried fish and pomo were also washed with salt and plenty of water. Having washed them, they were kept aside. The dried fish, stockfish, pomo, ogiri, locust beans, seasons were added and allowed to boil for 10 minutes.
- ❖ The washed vegetables were thereafter added and allowed to the boiling stock and allowed to boil thoroughly. It was later tasted and re-seasoned after which the soup was serve with pounded yam, fufu, or eba.

Findings of the Study

Proximate Composition of the Five Indigenous Soups

The result obtained on the proximate composition of the vegetables is presented in Table 2.

Table 2: Proximate Chemical Composition of the selected vegetables

soup	treatment	M (%)	CP (%)	CFAT (%)	CFIBRE (%)	ASH (%)	CA (%)	P (%)	K (%)
Yanrin	Sundried	7.68	16.78^{a}	5.79^{a}	13.38	9.86	0.689^{b}	0.286^{b}	0.778^{b}
Yanrin	Shaded dried	9.77	16.39^{a}	4.83^{a}	11.76	8.69	0.697^{b}	0.295^{b}	0.791^{b}
Bitterleaf	Sundried	7.52	17.52^{b}	5.84^{a}	12.97	10.11	0.67^{a}	0.27^{a}	0.793^{a}
Bitterleaf	Shaded dried	9.63	17.41^{b}	4.96^{a}	9.87	9.38	0.51^{a}	0.24^{a}	0.685^{a}
Igbo	Sundried	8.01	15.87^{c}	5.65^{a}	13.81	9.28	0.71^{b}	0.296^{b}	0.824^{b}
Igbo	Shaded dried	11.26	15.58^{c}	4.38^{a}	11.89	8.92	0.69^{b}	0.285^{b}	0.803^{b}
Moringa	Sundried	8.23	19.38^{d}	7.13^{b}	9.76	10.34	0.534^{a}	0.265^{a}	0.671^{a}
Moringa	Shaded dried	11.12	19.14^{d}	6.59^{c}	8.57	9.89	0.485^{a}	0.243^{a}	0.598^{a}
Ugu	Sundried	8.24	19.39^{d}	7.14^{b}	9.77	10.36	0.712^{a}	0.230^{a}	0.765^{a}
Ugu	Shaded dried	11.12	19.16^{d}	6.6^{c}	8.58	9.99	0.624^{a}	0.251^{a}	0.732^{a}

CP = Crude Protein, CFAT = Crude fat, Cfibre = Crude fibre, CA = Calcium, P = Phosphorus, K = Potassium, M = Moisture

Moisture content: Although there was no significant difference in moisture content among the various vegetables under consideration (Yanrin, Bitter leaf, Igbo, Moringa and Ugu), the vegetables generally have high moisture content ranging between 7.52 to 11.26. However, the moisture content in shaded dried Yanrin. bitterleaf, igbo, moringa and ugu were high (>9%) and could likely lead to faster deterioration of soups made from the vegetables ahead of others Turkmen *et al* (2006) reported that

foods containing moisture more than 9% tend to undergo microbial degradation upon long time storage.

Crude Protein: Moringa and ugu soup (irrespective of whether sundried/shaded dried) had the highest crude protein content ranging between 19.14 to 19.39%. Plant protein is very beneficial to humans.

They are one of the building blocks of body tissue. This makes the two vegetables particularly suited for people recovering from sickness and to maintain healthy body system. According to Janick *et al.,* (2008), moringa leaves are rich in protein, vitamin A, vitamin B, vitamin C and minerals. According to the West African composition table in Food and Agricultural Organization (FAO, 2012), 100g of fresh Moringa leaves have 9.3g protein, 434 mg calcium, 404 mg potassium, 738µg vitamin A, and 164 mg vitamin C.

Crude Fat: The leaves generally had low fat content. However, higher ($p < 0.05$) significant amounts of fat ranging from 6.59% to 7.14% were obtained in moringa and ugu soups (either sundried or shaded dried) seasoned.

Crude Fibre: Lower amount of crude fibre raising from 0.10% to 0.28% were obtained across the vegetable samples. These lower value of crude fibre are not likely to have positive effect in the gastro-intestine organ of man.

Ash: Ash is the inorganic residue remaining after the water and organic matter have been removed by heating in the presence of oxidizing agents, which provides a measure of the total amount of minerals within a food. The ash content were not significantly ($p<0.05$) different across the vegetables. However, higher amounts of ash were obtained in sundried igbo soup (13.81%), sundried yanrin (13.38%) and sundried bitter leaf (12.97%). The ash content is indicative of the mineral composition. Therefore, the vegetable with higher ash value are likely to have higher amount of food minerals.

Calcium: Calcium is a very important mineral in human metabolism, making up about 1-2% of an adult human's body weight (Nnamani, *et al.,* 2009). In addition to its widely known role in bone structure, calcium is used to help control muscle and nerve function, as well as to manage acid/base balance in our blood stream (Diof, 1997). The study results show that there was significant difference ($p<0.05$) in the calcium content of the vegetable. Besides, Yanrin and bitter leaf had higher calcium content.

Phosphorus: Phosphorus is required by the body for bone and teeth formation. Calcium alone can't build strong bones and tissues. New research (Obel-Lawson, 2005) shows calcium needs phosphorus to maximize its bone-strengthening benefits, and taking a lot of calcium supplements without enough

phosphorus could be a waste of money. Higher significant ($p < 0.05$) phosphorus was obtained in yanrin, igbo and ugu vegetables.

Potassium: Potassium is a mineral that's crucial for life. Potassium is necessary for the heart, kidneys, and other organs to work normally. The U.S. Department of Agriculture recommends 4,700 milligrams of potassium per day for healthy people USDA (2005). Although the potassium content of the vegetables are low, significant difference ($p < 0.005$) exist across the vegetable samples. Higher potassium was obtained from yanrin and igbo.

Sensory Qualities: The results obtained on the sensory qualities of the soups are presented in Table 3.

Table 3: Sensory qualities of the five indigenous soups spiced with

Soup	Taste	Flavour	Colour	Odour	Texture	Overall
Bitter Leaf Soup (SD)	6.60[a]	6.60	6.70	6.25	6.70	6.65
Bitter Leaf Soup(SHD)	6.75[a]	6.35	6.45	6.45	6.85	6.65
Eggplant Vegetable Soup (SD)	6.05[b]	6.20	5.95	6.15	6.45	8.76
Eggplant Vegetable Soup (SHD)	6.25[b]	6.35	6.05	6.40	6.25	6.94
Wild Lettuce Soup (SD)	6.00[b]	5.85	5.85	5.90	6.05	6.41
Wild Lettuce Soup (SHD)	6.15[b]	6.10	6.20	6.45	6.60	6.59
Flutted Pumpkin Soup (SD)	6.20[b]	6.20	6.25	6.05	6.60	6.71
Flutted Pumpkin Soup (SHD)	6.40[b]	5.80	5.90	6.00	6.35	6.69
Moringa Oleifera Soup (SD)	6.15[b]	6.55	6.25	6.30	6.45	6.65
Moringa Oleifera Soup (SHD)	6.25[b]	6.25	6.80	6.25	6.65	6.88

Source: Field Survey, 2014, SHD = Shaded-dried, SD = Sundried

***Taste*:** The taste scores of the soups ranged from 6.00 to 6.75. Higher taste scores of 6.75, 6.60, 6.40, 6.25 and 6.25 were obtained in shaded dried bitter leaf soup , sundried bitter leaf soup, shaded dried flutted pumpkin soup, shaded dried eggplant vegetable soup and shaded-dried moringa oleifera soup respectively. Generally the shaded dried vegetable soups had higher taste value than the sundried vegetable soups. These values were however not significantly ($p < 0.05$) different from one another except for bitter leaf soup (sundried or shaded dried) that had significantly different taste value from the other soups. The implication of this finding is that bitter leaf soup had higher taste preference than any of the other soups.

***Flavour*:** The data obtained on the flavor of the soups in this study showed non-significant ($p > 0.05$) differences across the mean values. The sundried and shaded-dried bitterleaf soup however had highest degree of likeness (6.60 and 6.75 respectively) in terms of flavor when compared with other soups. Generally, the likeness score obtained for shaded-dried vegetable soups where higher (although not

significantly different) across the soups except for bitter leaf soup.

***Colour*:** The data obtained on the colour of the soups in this study showed non-significant ($p > 0.05$) differences across the mean values. The scores obtained on the colour of the soup samples ranged from 5.85 to 6.80. Higher scores of colour of 6.80, 6.70 and 6.45 were obtained in the shaded dried moringa oleifera soup, sundried bitter leaf soup and shaded dried bitter leaf soup respectively.

***Odour*:** The obtained results from the study show that odour was not significant ($p < 0.05$) different across the soup samples indicating that odour might not significant influence choice of consumers for any of the vegetable soups.

***Texture*:** Similarly, texture was not significantly different ($p>0.05$) across the soup samples. Besides, the texture of the soup ranges between 6.05 to 6.85 with bitter leaf soup (shaded dried) scoring higher than any of the soups in terms of texture appeal.

***Overall Acceptability*:** Like flavor, colour, odour and texture of the soup, the overall acceptability of the soups was not significantly ($p<0.05$) different across the soup samples. However, eggplant vegetable soup (sundried) had the highest overall acceptability score (8.76). The insignificance of the difference in overall acceptability of the soups, as well as minimum overall acceptability score of the soups which exceeds 4.5 on a 9-point hedonic (likeness) scale, indicates that the sensory qualities of the soups are generally acceptable to the consumer.

Discussion

This study investigated the sensory qualities and chemical composition of five indigenous vegetable soups in the study area. The indigenous soups were yanrub soup, bitter leaf soup, Igbo soup, moringa soup and ugu soup either sundried or shaded-dried.

Results obtained from the evaluation of chemical composition of the soups revealed that ugu soup had the highest moisture content followed by moringa and igbo soup. Bitter leaf, however, had the least moisture content. Likewise, ugu soup was the richest in crude protein and as well superior to other in terms of crude fat content. However, Igbo vegetable soup was very rich in crude fibre. Ugu had the highest ash content indicating its richness in food value, while Igbo had the highest calcium as well as phosphorus and potassium content.

Comparative evaluation of sensory qualities of the vegetable soups showed that consumers liked shaded-dried wild lettuce and Moringa oleifera soups more than sundried ones while sundried eggplant vegetable and fluted pumpkin soups were liked more than the shaded-dried ones. Besides, the sundried and shaded-dried bitter leaf soups were liked equally

Conclusions

From the results obtained in this study, it is concluded that ugu and moringa vegetables either sundried or shaded dried are very rich in moisture, crude protein, crude fat and ash while yanrin, bitter leaf and Igbo are very rich in crude fibre. Also, there were marginal but insignificant ($p < 0.05$) differences in the degree of likeness between the sundried vegetable soups and the shaded-dried ones. These were even repeated in the acceptability.

Recommendations

It is hereby recommended in this study that food processors shaded-dried wild lettuce and Moringa oleifera soups and sundried eggplant vegetable and flutted pumpkin soups to maximize degree of likeness of consumers. Besides, moringa and ugu vegetables are particularly recommended for consumption because of its rich crude protein, crude fat and ash (food value).

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