

Quality Attributes of Condiments Made from Some Locally Underutilized Seeds

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Abstract

The use of locally produced condiments is gaining popularity as a healthier replacement for monosodium glutamate seasoning in cooking local and even some international dishes. This study determined the comparative proximate composition, mineral content and sensory properties of fermented condiments produced from two underutilized seeds namely pumpkin seeds (*Cucurbita moschata*) and watermelon seeds (*Citrullus vulgaris*). using the commonly used locust bean seed (*Parkia biglobosa*) as a control. The condiment samples were produced following traditional fermentation methods, while the proximate composition and mineral content were analyzed using standard methods. The sensory attributes were evaluated based on the consumer's preference with the exception of the watermelon seed condiments which developed a very pungent odor during fermentation. The locust bean condiments had the highest mean value of fibre and protein (3.16 and 20.32 %), but the least moisture (18.00 %), ash (2.57%) and carbohydrate (33.16%) contents. The watermelon seed condiments had the highest moisture, ash and carbohydrate contents (18.00, 2.57 and 33.16% respectively) and the least fibre, protein and fat contents (3.16, 20.32 and 22.8 % respectively). For the pumpkin seed condiments, the values of fibre and protein content were similar to those of the locust bean condiments but it had the highest fat content of 23.97%. The ash contents of all three condiments were statistically not different from each other ($P < 0.05$), while the fat content of the pumpkin seed condiment was statistically the same with that of the locust bean condiment ($P < 0.05$). The locust bean condiment contained the highest Calcium and potassium contents of 9.36 and 35.3 mg/100 g respectively, while the watermelon seed condiments contained the highest sodium content of 62.00 mg/100 g and an appreciable amount of potassium (23.78 mg/100 g). The pumpkin seed condiments had the lowest mineral contents of all three as the calcium content was 2.94 mg/100 g, potassium content was 0.49 mg/100 g, magnesium content of 1.03 mg/100 g and sodium content of 1.43 mg/100 g. The magnesium contents of all three condiments were the same statistically ($P < 0.05$). The result of sensory attributes of the condiments showed that there was no significant difference in terms of appearance, which ranged from 7.50 - 8.15, mouth feel (7.15 to 7.80) and the overall acceptability had a mean value that ranged from 7.15 - 7.80. There was no significant difference in the taste and aroma of the condiment samples with mean score values of 7.55 - 7.80 and 7.15 - 7.90. The underutilized seeds compared favorably with commonly utilized locust bean seeds showing a high nutritional value. However, the watermelon seed would need further research as it developed a very

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pungent odor during fermentation and could not be used for sensory analysis. The pumpkin seeds could be recommended as a substitute for condiment production.

Keywords: Condiments, Fermentation, Quality Attributes, water melon seeds.

INTRODUCTION

A condiment is a seasoning substance applied to food in the form of sauce or powder to enhance or improve its flavor, aroma, taste and appeal. The production of condiments largely depends on traditionally small-scale, household industries and basically under-highly variable condition (Uchenna, *et al.*, 2020).

Fermentation is one of the oldest ways of food processing (Akinyele and Oloruntoba, 2013). It is an operation carried out through the microbial activities and their enzymes to achieve desirable quality characteristics of food and food products (Akinsola, *et al.*, 2017). The fermentation process utilize biochemical constituents of the food changing it from one form to another with the aid of autolytic or enzymatic reaction which in turn enhances the palatability thereby increasing the protein content of the condiment. Fermentation improves the nutritional value, reduces anti-nutritional compounds and in some cases, improves functional properties of food (Akinsola, *et al.*, 2017). Although fermented food condiments have constituted significant proportion of the diet of many people, Nigerians have exhibited preference in terms of consumer taste and preference for such foods.

Fermentation is usually carried out in a most solid state, involving contact with appropriate microorganism at an ambient temperature of the tropics. The completion of fermentation indicated by the formation of “mucil” leading to the production of ammonia as results of the breakdown of amino acids during the fermentation (Adamu, *et al.*, 2019). The sensorial characteristics such as aroma and flavor of the condiment enhance the taste in soup and sauces especially the various soup accompanied with the starchy foods (Adamu, *et al.*, 2019). Fermented seasoning used in Nigeria includes (*Pentadethra macrophylla*), “ogiri” fermented melon, soybean, or African yam bean, African locust bean “Dawadawa” and “Okpeye” (*Prosopis africana*) (Achi, 2013; Okafor *et al.*, 2015).

Traditional preparation of condiments “Ogiri” from selected legumes (melon seed, soya bean, African yam bean) is by the method of uncontrolled solid state fermentation (Achi, 2013) and it involves boiling the raw seeds after which they are dehulled, then boiled again to soften the seeds for fermentation. The softened seeds were then wrapped in plantain leave incubated near the earthen pot for a period of three to five days or longer after which the mash is dried and milled to a smooth paste, the ogiri. The dehulling process is the separation of the seed coat (melon seed, soybean, African yam bean) from the cotyledons though it requires an abrasive action (Achi, 2013; Okafor *et al.*, 2015). The abrasion removes the hulls manually. Due to its tedious nature removal, the local processors have resorted to dehulling the boiled seeds by robbing the seeds between palms as this technique proves easier and faster for separation.

Various studies have been documented on condiments which includes their microbiology, mineral content and amino-acid content Achi (2013) and Okafor *et al.*, (2015). The proximate composition reported indicate that condiments produced from a variety of raw materials could contribute to the protein level, lipid and mineral daily intake of Nigerian diets when used liberally, as done in several homes where expensive animal products are a luxury (Okafor *et al.*, 2015). In view of the controversy surrounding the use of monosodium based seasonings, many homes in Nigeria now use condiments produced from legumes as a

flavoring in traditional soups and this practice is gaining acceptance in intercontinental dish preparation. However, there is limited information on the anti-nutrient and proximate quality of these locally produced condiments from underutilized seeds (Achi, 2013).

The traditional methods of preparation of these condiments are generally very laborious, time and energy consuming and are usually carried out with rudimentary utensils. The essential steps in the preparation of these condiments are similar with minor differences occurring from one condiment to the other and among different localities. Due to the high demand of condiments and low productivity of locust beans, other under-utilized legume seeds can be used to exploit their full potentials in areas of condiments processing thereby making it more readily available at low cost and also providing all the necessary nutrients required by the body such as; protein and mineral for daily intake (Okafor *et al.*, 2015).

The condiments are used to enhance the flavor of many African dishes including soups and sausages and also provides protein, vitamin and minerals such as; zinc, iron, sodium, potassium and calcium. These fermented food “condiment” are also known to be good source of protein, vitamin and is believed to provide all the essential nutrients required by the body for the maintenance and regulation of its processes. This study therefore aims at producing condiments from available and underutilized melon and legume seeds. Furthermore, the proximate and mineral contents of the condiments produced as well as their sensorial properties would be determined (Olasupo, 2016).

METHODOLOGY

Sample Collection

The locust bean and pumpkin seeds used in this study were purchased from Dawana’u market, situated in Dawakin Tofa Local Government Area of Kano state with geographical coordinates 12° 5' 23" North, 8° 25' 45" East. Purchase of the watermelon seeds was made from Yan-lemo fruit market, Na’ibawa in Kumbotso Local Government Area of Kano State, Nigeria.

Sample Pre-treatment

The raw materials obtained were sorted, cleaned and then washed to remove all extraneous matter. They were then allowed to dry and packaged separately in labeled polythene bags, ready for processing.

Preparation of condiments from Locust bean (*Parkia biglobosa*) seeds

Exactly 1.0 Kg of the locust bean seeds was boiled under high pressure for 6 hours in order to soften the cotyledon, and then allowed to cool down to room temperature of 40 °C. The seeds were rubbed in between the palms to remove the cotyledons. These were washed thoroughly in water, after which a basket sieve was used to separate the chaffs from the seeds as described by Musliu and Idayat, (2014). The cleaned seeds were then re-boiled for another 4 - 6 hours at a temperature of 100 °C and then drained. They were then ground using a mortar and pestle in order to increase the surface area for an increased rate of fermentation (Akinyele and Oloruntoba, 2013). The ground seeds were packaged in plantain leaves and placed in an airtight container then allowed to ferment for 4 days (Musliu and Idayat, 2014). The locust bean condiment was used as a control in this study.

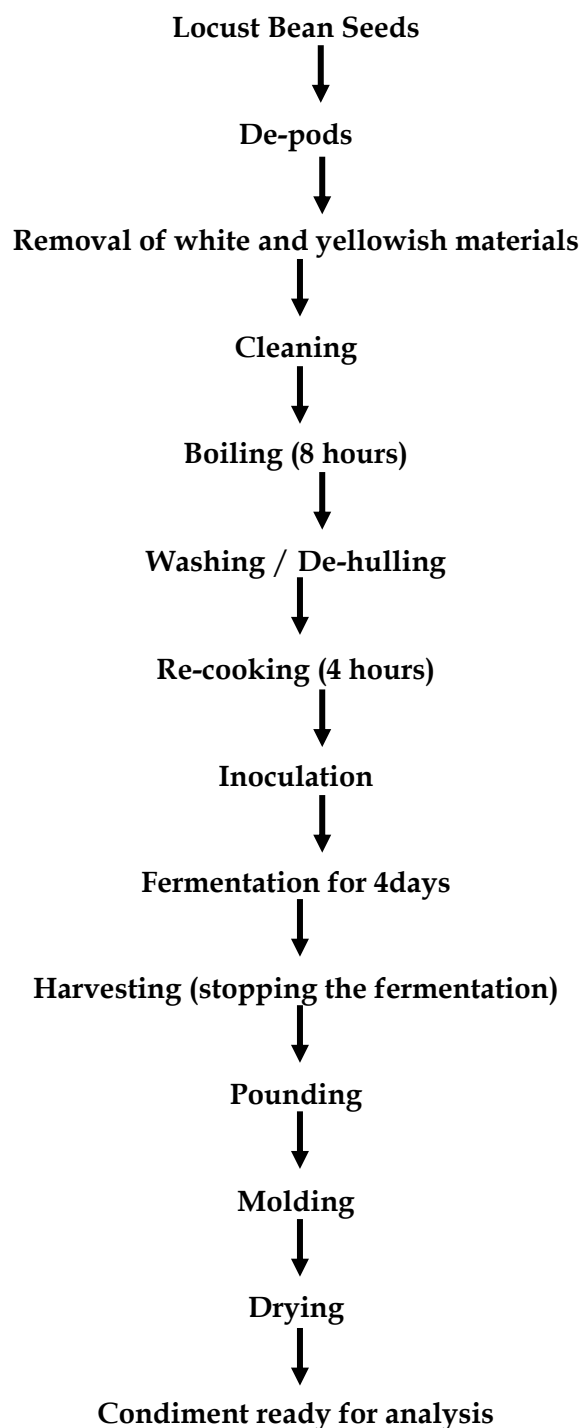


Figure 1.0: Flow Diagram for the Processing of African Locust Bean Seed Condiment.
Source: Adopted from Ojewumi (2016) and modified.

Preparation of condiments from watermelon and pumpkin seeds

One (1.0) Kg of each of the seeds were soaked in hot water for four (4) hours and dehusked to remove the seed from the cotyledon, after which it was boiled again for up to 4 hrs (Musliu and Idayat, 2014). About 0.5 g of Potassium chloride was added as a catalyst to soften the seeds. After the seeds were allowed to cool, they were then transferred aseptically into a sterile air tight earthen pot container. The samples were allowed to ferment for a period of 72 hours. The fermented melon and pumpkin samples were pounded in a cleaned mortar and pestle to

stop the fermentation process, and then molded into shapes and packaged ready for analysis (Mohammed, 2011).

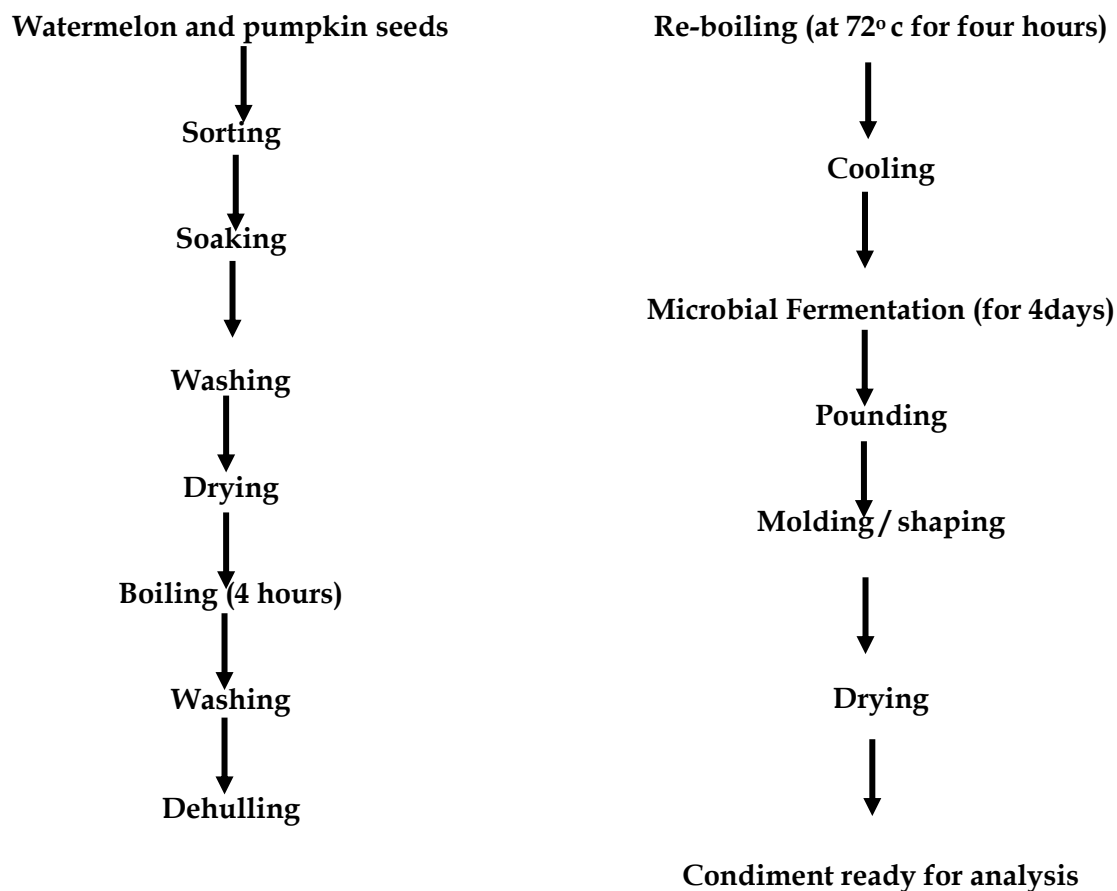


Figure 2.0: Flow Diagram for the Processing of melon and pumpkin Seeds Condiment. Source: Adopted from Muhammad (2011) and modified.

Proximate Analysis

Moisture Content Determination

Moisture content of the condiments was determined following the method described by Onwuka, (2018). A cleaned dried empty petri-dish was weighed as W_1 . About 5g of the condiment sample was measured into a petri-dish and this weight was taken as W_2 . The petri dish was then transferred into a hot air oven set at 105 °C to dry for 3 hours and then reweighed as W_3 . The process was repeated for each sample until constant weight was obtained

$$\% \text{ Moisture} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Ash Content Determination

The ash content of the condiment samples was determined following the method of Onwuka, (2018). A clean dried crucible was weighed and the weight taken as W_1 . Exactly 5.0 g of the sample was also weighed into the crucible and this weight was recorded as W_2 . The condiment samples were transferred into a muffle furnace using a pair of tongs and heated at 550 °C for

4 hours until fully ashed to a grey colour. The dish with the ash was cooled down in a desiccator and then re-weighed (W_3).

$$\% \text{ ASH} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

Determination of Protein Content

The protein content of the condiment sample were determined according to the method of Onwuka, (2018). Two grams (2.0 g) of the finely grounded sample was digested in a digestion flask with kjeldahl catalyst tablet and 10 mL of concentrated tetraoxosulphate VI acid (H_2SO_4) for 4 hours until a clear solution was obtained. This was followed by distillation process in a Kjeldahl apparatus with 20 mL of 2 % NaOH. The steam exhaust was closed and timing started when the solution of the boric acid and indicator turned greenish. The distillation was carried out for 15 minutes and the distillate was titrated with 0.05 M HCl Onwuka, (2018).

The percentage (%) total nitrogen = Titre Value x Atomic mass of nitrogen x Normality of HCl used x 4.

Therefore, the crude protein content was determined by multiplying the percentage free nitrogen constant factor of 6.25 i.e. % crude protein = % N x 6.25

Determination of Crude Fat content

The fat content of the condiments was determined using soxhlet apparatus method as described by (Onwuka, 2018). Two (2.0) grams of the dried sample was weighed into a fat free thimble plugged lightly with cotton wool and extraction was carried out with petroleum ether for 5 hours. The residue extract was evaporated in an air oven at 100°C for 30 minutes, cooled and weighed. The fat content was calculated as;

$$\% \text{ Fat} = \frac{\text{weight of thimble + sample}}{\text{sample weight}} \times 100$$

Determination of Crude Fibre content

The crude fibre content of the fermented condiment was determined according to the method described by Onwuka, (2018). Two grams (2.0 g) of each of the samples were accurately weighed into a flask and 100 mL of 0.255 N H_2SO_4 was added. The mixture was then heated under reflux for 30 minutes. The hot mixture was filtered through a fibre muslin cloth. The obtained filtrate was thrown off and the residue was returned to the fibre flask to which 100 mL of 0.313 M NaOH was added and heated for another 30 minutes. The residue was removed and finally transferred into the crucible. The crucible and the residual sample were oven dried at 105 °C overnight to drive off the moisture. The oven dried crucible containing the residual sample were cooled in a desiccator and later weighed to obtain the W_1 . The crucible with W_1 was transferred to the muffle furnace for ashing at 550 °C for 4 hours. The crucible containing white or grey ash (Free of carbonaceous materials) were cooled in the desiccator and weighed to obtain W_2 the difference $W_1 - W_2$ give the weight of fibre.

$$\% \text{ Fibre} = \frac{W_1 - W_2}{\text{Weight of sample}} \times 100$$

Carbohydrate Content

The carbohydrate content of the condiment sample was calculated by 'difference' as described by (Onwuka, 2018) as given below:

$$\% \text{ available carbohydrate} = 100 - (\% \text{ moisture} + \text{Protein} + \text{Fibre} + \text{fat} + \text{Ash})$$

Determination of Mineral Elements

Mineral content such as; calcium, potassium, magnesium and sodium of the condiment samples were determined using a method described by (AOAC, 2010). Where calcium and magnesium was Determined by Atomic Absorption Spectrophotometer. The standard solution of 1.0 g of the sample was first digested with 20 mL of acid mixture (650 mL) concentrated. HNO₃, 80 mL per-chloric acid (PCA); 20 mL concentrated. H₂SO₄ and aliquots of the diluted clear digest used for atomic absorption spectrophotometry using filters that match the different elements. On the other hand, sodium and potassium were determined by dissolving 1.907 g of KCl in water. A standard solution with concentration of 0.0, 0.2, 0.4 and 0.6 ppm were prepared as described by (AOAC, 2010) from the stock solution.

A stock solution of 1.0 % lithium-chloride was prepared and added to the potassium and sodium standard solutions such that the concentration in the final solution is 0.1 % of the concentrations of these elements are determined using their calibration curves (AOAC, 2010).

Sensory Analysis

The condiments samples produced were used in the preparation of “Kuka soup” and “Jollof rice” dish to assess its comparative sensory attributes Sensory attributes were carried out by a panel of fifteen judges who tested the following characteristics using nine (9) point Hedonic scale for: general appearance, taste, mouth feel and aroma and overall acceptability.

Statistical Analysis

All parameters were analyzed in triplicates except for the sensory attributes scored by 15 panelist. The data obtained were entered into the computer and then analyzed using Minitab Statistical software (version 17.0). Means and standard deviation were calculated among samples values obtained from the analysis as described by (Onwuka, 2018). The analysis of variance (ANOVA) results were used to compare the mean obtained and the Level of significance at ($p \leq 0.5$) using DMRT as described by DFT and DNUD (2016).

RESULTS AND DISCUSSION

Proximate Composition of Condiment Samples

The comparative study on the proximate composition of locally fermented condiments produced from watermelon, pumpkin and locust bean seeds are shown in Table 1.0. All the values of the nutritional composition of the three samples were significantly different from each other, with the exception of the ash content values which were not significantly different at ($P > 0.05$). The watermelon seed condiment had the highest moisture content of 23.42 %, followed by pumpkin seed condiments (21.17 %) and then the least was the locust bean condiment (18.00 %). High moisture content affects the shelf-life which leads to spoilage over a short period of time unless the product undergoes drying to further reduce the moisture content. Reduced moisture content indicates better storage potential because microorganisms require water for their activities (Mutiat, *et al.*, 2017). The moisture content obtained in this study were slightly different from the reports by Achi (2010). This may be attributed to sample source or method of processing. The high ash content of all the condiment samples is indicative of the high mineral contents of the locust bean, watermelon and pumpkin seeds, although the mineral composition vary in different proportions. These minerals are required for body regulation and bone formation. The fiber contents of the condiment samples produced in this study were significantly different ($P < 0.05$), among the samples when compared with the control sample with the highest mean value from each other. The control sample had the highest fibre content of 3.16 %, while the watermelon condiment had the least fibre content of 1.75 %. This agrees with the previous study of Achi, (2010). High fibre content

in food aids stool transition, digestion and water retention in the human system. The difference in fibre content of the condiment may be attributed to the differences in the composition of the seeds used (Akinyele and Oloruntoba, 2013). The protein content of the condiment samples showed a wide variation in the values, ranging from 9.92 to 20.32%. The watermelon seed condiments had the lowest protein content while the control sample and has the highest mean value. The recommended daily allowance for protein for children ranges from (23.0 - 36.0 g) and for adults, 44 - 56 g Akinyele and Oloruntoba, (2013). Fat content was lowest in the watermelon seeds condiment sample, while the fat content of the control sample and the pumpkin seeds was statistically the same ($P > 0.05$). Fat content is important in diets because it promote fat soluble vitamin absorption. It is a high energy source and does not add to the bulk of the diet (Akinyele and Oloruntoba, 2013). Conversely, the carbohydrate content of the condiments ranged from 33.16 to 41.04 % with significant differences among all the samples.

Table 1.0: Proximate Composition of condiments

Code	Moisture (%)	Ash (%)	Fibre (%)	Protein (%)	Fat (%)	Cho (%)
LBC(control)	18.00±0.75 ^c	2.57±0.52 ^a	3.16±0.79 ^a	20.32±0.94 ^a	22.80±1.67 ^a	33.16±1.87 ^c
WMC	23.42±0.43 ^a	2.88±0.75 ^a	1.75±0.35 ^b	9.92±0.93 ^c	21.26±1.10 ^{ab}	41.86±2.78 ^a
PSC	21.17±0.03 ^b	2.62±0.32 ^a	2.86±0.82 ^{ab}	14.33±1.28 ^b	23.97±0.10 ^a	37.04±3.05 ^b

* Values are presented as mean ± SD of triplicate measurements* Samples with different subscripts are significantly different at 5% ($P \leq 0.05$) of significance. * Means where separated using turkey's test.

Key:

LBC (Control): Locust bean condiments sample WMC: Watermelon seed condiments sample PSC: Pumpkin seeds condiments sample.

Mineral Content of Condiment Samples

Table 2 shows the mineral composition of the locally produced condiments from watermelon seeds, pumpkin seeds and locust bean seed condiment samples which was used as control. The values ranged from 2.44 to 9.36 mg/100 g for calcium, 35.36 mg/100 g for potassium and 1.43 to 62.00 mg/100 g for sodium. All these values were statistically different from each other. For the magnesium content however, the values ranged 1.02 to 1.63 mg/100 g and were not significantly different from each other. The calcium and potassium contents of the locust bean condiments were the highest (9.36 and 35.3 mg/100 g respectively), while the pumpkin seed condiment had the least content of calcium and potassium (2.44 and 0.49 mg/100 g). Minerals are essential for the maintenance of the overall mental and physical wellbeing and are important constituents for the development and maintenance of bones, teeth, tissues, muscles, blood, and nerve cells. They aid acid-base balance, nerve response, physiological stimulation and blood clotting (Akinyele and Oloruntoba, 2013).

Table 2.0: Mineral content of condiments from locust bean, melon and pumpkin seeds

Code	Ca (mg/100 g)	K (mg/100 g)	Mg (mg/100 g)	Na (mg/100 g)
LBC (control)	9.36±0.03 ^a	35.3±6.31 ^a	1.62±0.00 ^a	3.02±0.05 ^b
WMC	6.52±0.02 ^b	23.78±0.20 ^{ab}	1.65±0.00 ^a	62.00±0.37 ^a
PSC	2.44±0.01 ^c	0.49±0.10 ^b	1.03±0.01 ^a	1.43±0.07 ^{bc}

* Values are presented as mean ± SD of triplicate measurements.

* Samples with different subscripts are significantly different at 5% ($P \leq 0.5$) level of significance. * Means where separated using turkey's test.

Key:

LBC (Control): Locust bean condiment' sample.
 WMC: melon condiments sample
 PSC: Pumpkin seed condiments sample

Sensory Evaluation of Condiments Sample

Comparative sensory evaluation were performed on the “kuka” soup and jollof rice produced with the locust bean and pumpkin seed condiments. The watermelon seed condiments had a very offensive odor so they were not used in the sensory analysis. The samples were evaluated for appearance, taste, aroma, mouth feel and overall acceptability. The scores for all the sensory parameters in Jollof rice were not significantly different from each other ($P < 0.05$). However, the mouth feel for the locust bean condiment in kuka soup was significantly lower than all other samples. The uniformity in the taste and aroma of the food sample prepared may be due to similar treatment applied on the seeds before fermentation or the use of same starter culture given it a unique taste and aroma in all the sample (Adamu, *et al.*, 2019). Although, locust bean condiment sample were more preferred by the panelists in all the sensory attributes evaluated. The locust bean seeds had a unique flavour and aroma which made it more preferable in most of the local dishes and getting more popularity in intercontinental dishes (Ganiyu, (2006); Adamu, *et al.*, (2019)).

Table 3.0: Sensory evaluation of condiment samples

Code	Appearance	Taste	Aroma	Mouth-feel	Overall acceptability
LBCJ	8.15±0.67 ^a	7.75±1.25 ^a	7.80±0.89 ^a	7.80±1.00 ^a	7.80±1.15 ^a
PSCJ	7.50±1.10 ^{ab}	7.30±1.26 ^a	7.65±1.31 ^a	7.90±1.02 ^a	6.75±1.37 ^a
LBC ^K	7.75±1.02 ^{ab}	7.40±1.35 ^a	7.55±1.09 ^a	7.15±1.42 ^b	7.15±1.97 ^a
PSC ^K	7.55±0.99 ^{ab}	7.45±0.99 ^a	7.85±1.08 ^a	7.35±1.38 ^a	7.40±0.99 ^a

* Values are presented as mean ± SD of twenty replicates

* Samples with different subscripts are significantly different at 5% ($P \leq 0.05$) level of significance. * Means where separated using turkey's test.

KEY: LBCJ - Locust bean seed condiment Jollof rice, PSCJ - Pumpkin seed condiment Jollof, LBC^K - Locust bean seed condiment Kuka soup, PSC^K - Pumpkin seed condiment Kuka soup.

CONCLUSION

From this study it can be concluded that pumpkin seeds can serve as a good substitute for locust bean condiments with significant nutritional and mineral qualities as well as consumers acceptability whereas, melon seed condiment had a pungent taste and requires further study to improve its sensory acceptability due to its richness in nutritional value. The utilization of these underutilized seeds can also be recommended as the best substitute for a large scale production of condiments as that of locust bean seeds. Therefore, further research into packaging, storage techniques and its reaction should be studied for safety and public health.

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