Nutrients and Antioxidant composition of Local Condiment "Ogiri" Produced from Different Leguminous Seeds

Abstract

'Ogiri' refers to a fermented oily paste that is used as soup condiments for its strong smell. Apart from thefact that it's mostly used in soup preparation because of the strong pungent odour and organoleptic properties, it also impact nutrients to soup. This study investigated the Nutrients and antioxidant composition of Ogiri produced from different leguminous seeds. Raw material Samples wereprocured from Oja Oba (Oba Market) in Owo, Ondo State while Pumpkin and Castor seed were purchased at Upper Eweka market, Onitsha Anambra State, Nigeria. They were subjected to processing at Diet Kitchen, Nutrition and Dietetics Department, Rufus Giwa Polytechnic Owo for processing. Sample were analysed using chemical and instrumental analysis using standard procedures by AOAC. One-way analysis of variance (ANOVA) was used for the analysis and means separation was done using Duncan test method to determine the significant differences at 5% (0.05) probability level of significance.Findings shows that the moisture content was significantly ($P<0.05$)higher in PUM than any other sample. Sample SES was significantly ($P<0.05$) higher in Ash (10.22g/100g) content, and fibre (11.21g/100g)while EGUwas significantly ($P<0.05$) higher in fat (30.17g/100g) and protein (29.30g/100g). CAS had the highest carbohydrate content (27.58g/100g).Minerals result shows that Na (14.835mg/g)Ca (22.570mg/100g) and Mg (3.351mg/100g) were significantly($P<0.05$) higher in sample EGU.Sample SES was significantly higher in K (55.855mg/100g) and Zn (0.308mg/100g), while CAS was significantly lower ($P<0.05$) in Na (3.45mg/100g), Ca (13.15mg/100g) K, (21.655mg/100g)), Zn (0.128mg/100g) and Mg (1.925mg/mg) but has the highest value in P (12,252mg/100g). PUM was significantly higher in Vitamin E (8.270mg/100g),while CAS was significantly higher in vitamin A (7.576UI/g). Sample PUM had the highest polyphenol andTerpenoid content (106.82mg/g and 1.37mg/g respectively). Sample SES had the highest steroid content (0.92mg/g). In conclusion, this study revealed that the nutrients and antioxidant properties of the "Ogiri" samples vary proportionately. The results can guide farmers, processors, and consumers in making informed decisions regarding seed selection and Ogiri preparation.

Keywords: Ogiri, Condiment, Proximate, Minerals, Vitamin, Antioxidant, Leguminous seeds.

Introduction

Condiments are food ingredients particularly used for adding taste or flavor to food [1]. One of the ways to make a meal balanced is to improve the nutrient content of the soup. Fermented food condiments are cheap sources of plant protein with improved nutrients, enhanced flavor and possess bioactive compounds. 'Iru' locust beans in English or 'Dawadawa' in Hausa language are obtained from fermented African locust bean seed, while the seeds of melon Citrullus vulgaris are fermented to produce 'Ogiri' [2]. Condiments constitute an essential part of the human diet in various cultures from different parts of the world. They are mostly of two types:

fermented and non-fermented food condiments. They are particularly produced from leguminous plants and oilseeds. Common fermented Nigerian condiments include Ogiri from castor oil bean (Ricinus communis) or melon seed (Citrullus vulgaris), 'iru' or 'daddawa' from African locust bean (Parkia biglobosa), 'okpei' from mesquite seed (Prosopis africana) and 'ugba' from African oil bean (Pentaclethra macrophylla).

Ogiri is a traditional oily paste fermented condiment which possesses a characteristic strong smell, ammoniacal flavor that enhances the taste and flavour of traditional delicacies in Nigeria [3]. It possesses very strong pungent odour and organoleptic properties which depend on microbial activities on the seed during fermentation. It is mostly used in soup preparation to impact unique aroma and taste. Ogiri is best known in West Africa. It is popular among the Yoruba and Igbo people of Nigeria. It is a product prepared by traditional method of uncontrolled solid state fermentation of seeds involving the use of natural inoculation or chance fermentation. This fermentation process is known to enhance the palatability, increases protein value, vitamin content and mineral levels of such condiments. It increases variety in the diet, improves nutritional value, reduces anti-nutritional compounds and in some cases, it improves functional properties [4, 5].

The processing of foods by fermentation has excellent advantages such as the elimination of undesirable flavours and odours, production of a good flavour, increased digestibility, and synthesis of desirable constituents and changes in physical state, longer shelf-life and destruction of inhibitors. Health benefits of fermented condiments include reduction of high cholesterol levels in the blood as well as the ability to fight and prevent tuberculosis, cancer and cardiovascular complications by boosting body immune [6]. The anti-nutritional factors in the oilseeds are reduced through fermentation, while flavour compounds, digestibility and nutritive value are improved and developed [7]. Apart from regular melon seed (Citruluslanatus) used for "Ogiri‟ preparation, it can also be produced from castor oil seeds (Ricinus cummunis) and fluted pumpkin (Telfairia occidentalis), Soybeans (Glycine max). These other seeds which are underutilized can serve as alternative substrates for the production of „Ogiri‟ thereby increasing their utilisation [8, 9]. In recent years, plant proteins have been playing significant roles in combating food insecurity in developing countries where average protein intake is less than required. The prevailing population pressure in Nigeria has resulted in an increasing demand for wild underexploited nutritious plant products with organoleptic appeal in the daily diet. This led to the focus on uncommon seeds for possible development and use, in the search for novel sources to complement the traditional ones and due to inadequate supplies of food proteins, there has been a constant search for unconventional legumes or oilseeds as new protein sources for use as both functional supplements. Modern researches have thus focused more on oilseed crops as largely unexploited sources of food crops [7].This study unravel the Nutrients and antioxidant composition of local condiment made from different leguminous seeds.

METHODOLOGY

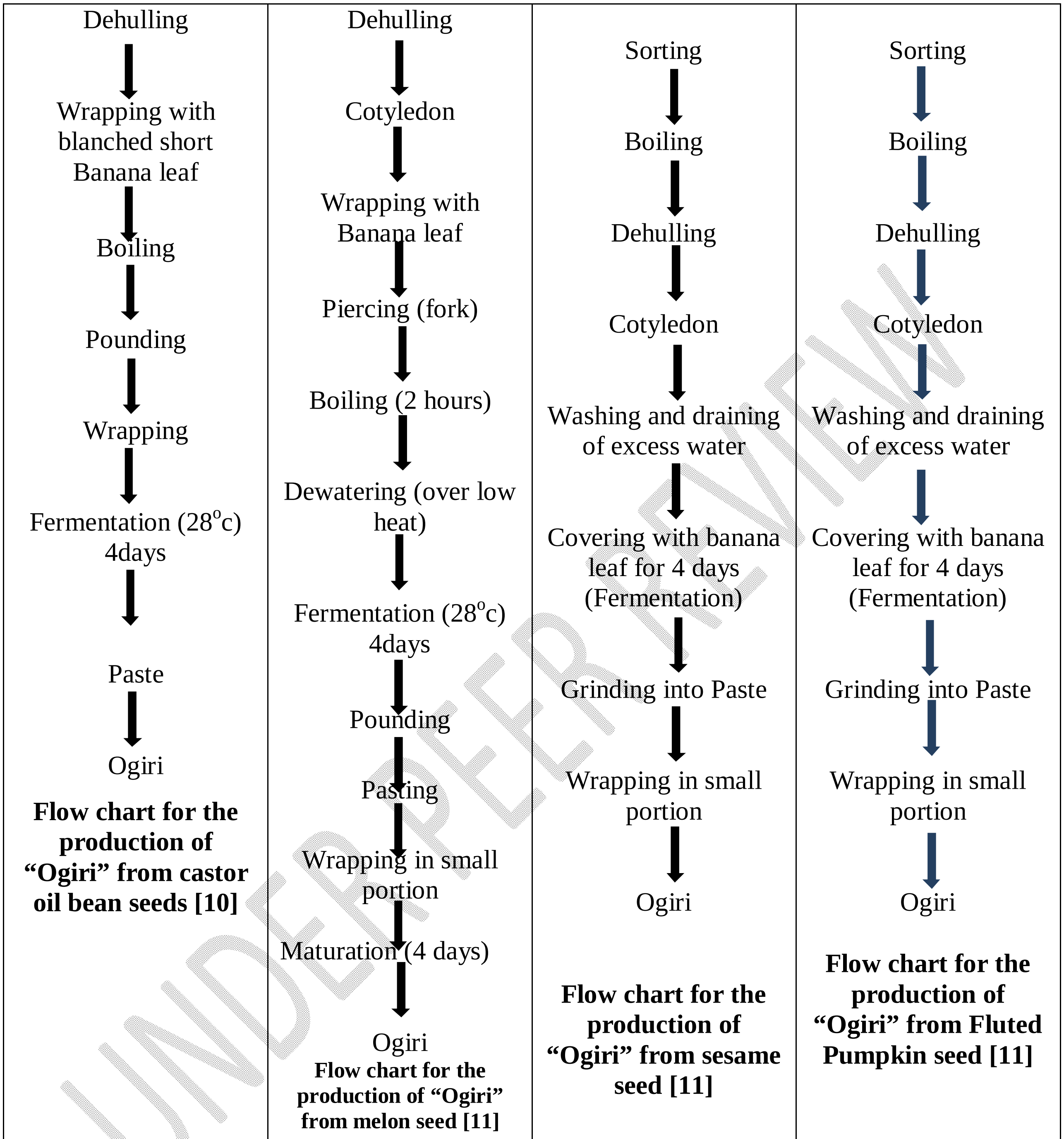
The raw materials which include: Sesame seed, Melon seed, and other ingredients that was used for this study was purchased from Oja Oba (Oba Market) in Owo, Ondo State while Pumpkin and Castor seed were purchased at Upper Ewekamarket, Onitsha Anambra State, Nigeria. It was then be taken to Diet Kitchen, Nutrition and Dietetics Department, Rufus Giwa Polytechnic Owo for processing.

Preparation of Samples

Preparation of *Ogiri* from Castor seed

Castor seed was thoroughly washed and sorted. The seed was dehulled and washed and the dehulled seed was wrapped in plantain leaves. The wrapped dehulled seed was boiled for about 9–18 hours. It was allowed to cool and ferment. Boiling of the de-hulled seeds was at a steady temperature (350C) and humidity for 3 – 4 days. The cooled seed was unwrapped and milled into a paste using a mortar and pestle. It was then be packaged in a fresh blanched leaves and allow to age under the sun for 2-3 days before consumption.

Castor seeds	**Melon seeds**	**Sesame seeds**	**Fluted Pumpkin**
↓	↓	↓	↓
Decortication	Boiling (3 hours)	Cleaning	Cleaning
↓	↓	↓	↓



Flow chart for the production of "Ogiri" from castor oil bean seeds [10]

Flow chart for the production of "Ogiri" from melon seed [11]

Flow chart for the production of "Ogiri" from sesame seed [11]

Flow chart for the production of "Ogiri" from Fluted Pumpkin seed [11]

Figure 1: Flow chart for the production of "Ogiri" from four varieties of leguminous seeds

Preparation of *Ogiri* from Melon seed

Undehulled melon seeds was properly washed and boiled for 3hours, cooked and dehulled. The cotyledon was wrapped tightly in layer of blanched short banana leaves (*Musa sapietum*) and then perforated with fork. The wrapped cotyledon was then be boiled for 2hours, and was placed on a wire mesh to drain for 1hour. The wrapped cotyledon was then left to ferment at the prevailing ambient temperature (28^{o}c) for four days. At the end of the fermentation period, the seeds was pounded in a laboratory mortal and pestle into a paste. The paste was then wrapped in little portions with banana leaves.

Preparation of *Ogiri* from Sesame seed

Sesame seed was sorted, washed and cleaned thoroughly in clean water. The seed was cooked until they get softened so that the seeds coverings can easily be peeled off. Afterwards, the cotyledons was washed and poured in a sieve to drain excess water. Then the cotyledons was placed into a canister or vessel then cover with local leaves (banana leaves) and was allowed to stay for at least 4 days to undergo fermentation. To hasten up the fermentation process the vessel was placed under sunlight during the process of fermentation. Once the fermentation process is complete, the fermented seeds was grounded into a smooth thick paste, and was mould into small balls and packaged.

Preparation of *Ogiri* from Fluted Pumpkin seed

Pumpkin seed was sorted, washed and cleaned thoroughly in clean water. The seed was cooked until they get softened so that the seeds coverings can easily be peeled off. Afterwards, the cotyledons was washed and poured in a sieve to drain excess water. Then the cotyledons was placed into a canister or vessel then cover with local leaves (banana leaves) and was allowed to stay for at least 4 days to undergo fermentation. To hasten up the fermentation process the vessel was placed under sunlight during the process of fermentation. Once the fermentation process is complete, the fermented seeds was grounded into a smooth thick paste, and was mold into small balls and packaged.

Determination of Chemical Analysis

Samples was taken to the laboratory to analyze its contents for Nutrients and antioxidant composition.

Proximate Determination

The moisture, ash, protein, crude Fibre and crude fat were determined according to AOAC (12). Protein conversation factor of 6.25 was used to convert Nitrogen content to crude protein, while **the** carbohydrate content was determined by difference. The percentage total carbohydrate was estimated to be equal to the sum of percentage moisture, protein, ash and fibre subtracted from 100g.i.e%carbohydrate= 100%- protein (%),+ fat (%) + crude fibre (%) +ash(%).

Procedure for Mineral Analysis

Analysis of phosphorus was determined by the phosphovanado-molybdate method of AOAC (12), while Calcium, sodium, Magnesium, potassium and Zinccontent of each sample was estimated using the method of AOAC (12). Two grams of each sample was ashes in muffle furnace at 550°C for 6 to 8 hours. The ash was dissolved with HCl. The analysis of sodium, calcium, potassium, magnesium, and zinc was carried out with a Buck Model 210 VGP atomic absorption spectrometer, USA. In all cases, air-acetylene the flame was used and hollow cathode individual metals was the resonance line source. The calibration plot method was adopted for the analysis. For each element, the instrument was auto zeroed using the blank (de-ionized water) after which the standard was aspirated into the flame starting from the lowest concentration. The corresponding absorbance values was obtained and the graph of absorbance against concentration was plotted by the instrument. The digested samples was analyzed in duplicates with the average concentration of the metal present being displayed in part mg/g the instrument after extrapolation from the standard curve.

Vitamin Determination in the samples

β- Carotene and α- tocopherol determination

The procedure adopted in the extraction though instead of petroleum ether, hexane was used [13]. This protocol agrees [14] method. In each extraction about 2.00 g of the mashed samples were used. The extracts were purified and diluted to a standard volume of 25 ml in the mobile phase constituted as methanol; dichloromethane; water (79:18:3). Three extractions were done in duplicate for each fruit's seeds. The extracts were filtered using a 0.45 micro millipore filter before 30 µl were injected in a HPLC (Hitachi, model L4000H), pump (L6000), RP C18 column (25 cm x 4.5 mm)) rate set at 1 ml / min with a UV/Visible detector at 450 nm for β-carotene and 470 nm αtocopherol.

Antioxidant determination of the samples

The determination of the antioxidant; Polyphenols, steroids and were done through the following procedures: The quantitative analysis were determined by using standard method [13].

Determination of Polyphenol

0.50g of sample was measured into a 50m1 beaker 20m1 of 50% methanol was added and covered with parafilm film and placed in a water bath at 77-80oC for 1 hour. It was shaken thoroughly to ensure a uniform mixing. The extract was quantitatively filtered using a double layered Whatman No 41 filter paper into a 100ml volumetric flask, 20ml water added, 2.5ml folin-Denis reagent and 10ml of 17% Na2CO2 was added and mixed properly. The mixture was made up to mark with water mixed well and allow to stand for 20mm. The bluish —green color was developed at the end of range 0-10ppm treated similarly as 1ml sample above. The absorbance of the tannic acid standard- solutions as well as samples was read after color development on a spectronic 21D spectrophotometer at a wavelength of 760nm. % Tannin was calculated using the formula.

Determination of Steroids

5 drops of concentrated sulphuric acid was added to 1 ml of the extract. A red colouration indicates the presence of steroids.

Statistical Analysis

All data obtained from the analysis of the samples was subjected to statistical analysis using SPSS 16 software package and expressed as Mean ± Standard deviation for triplicate experiment. One-way analysis of variance (ANOVA) was used for the analysis and means separation was done using Duncan test method to determine the significant differences at 5% (0.05) probability level of significance.

Result

Table 1 below shows the proximate composition of the condiment samples moisture content ranged from 14.52±0.00%-19.17±0.00% respectively. Sample CAS had the lowest value of moisture content (14.52+0.00%) while sample PUM had the highest value of moisture content (19.17±0.00%) with significant difference ($p>0.05$) respectively. The ash content ranged from 5.41±0.00%-10.22±0.00%. Sample SES had the highest value of ash content (10.22±0.00%) while sample EGU had the lowest value of ash content (5.41±0.00%) with significant difference ($P>0.05$) respectively. The fiber content ranged from 7.53±0.00%-11.21±0.00% respectively. Sample SES had the highest value of fibre content (11.21±0.00%) while sample EGU had the lowest value of fiber content (7.53±0.00%) with significant difference. The protein content ranged from 20.7±0.00%- 29.30±0.00% respectively. Sample EGU had the highest value of protein content (29.30±0.00%) while sample CAS had the lowest value of fiber content (20.71±0.00%) with significant difference (p>0.05) respectively. The carbohydrate ranged from 10.85±0.02%-27.58+0.00%. Sample EGU had the lowest value of carbohydrates content (10.85±0.02%) while sample CAS had the highest value of carbohydrates content (27.58±0.00%) with significant difference (p>0.05) respectively.

Table 1: Proximate Composition of condiment samples

Parameters (g/100g)	CAS	EGU	SES	PUM
Moisture	$14.52±0.002^{d}$	$16.72±0.009^{b}$	$15.38±0.009^{c}$	$19.17±0.004^{a}$
Ash	$6.34±0.005^{c}$	$5.41±0.002^{d}$	$10.22±0.004^{a}$	$6.58±0.012^{b}$
Fat	$22.51±0.004^{d}$	$30.17±0.009^{a}$	$25.64±0.003^{c}$	$28.79±0.011^{b}$
Fibre	$8.31±0.004^{b}$	$7.53±0.002^{c}$	$11.21±0.004^{a}$	$6.73±0.010^{d}$
Protein	$20.71±0.002^{d}$	$29.30±0.007^{a}$	$21.65±0.002^{c}$	$24.28±0.004^{b}$
Carbohydrate	$27.58±0.002^{a}$	$10.85±0.026^{d}$	$15.88±0.019^{b}$	$14.42±0.002^{c}$

Values are mean ± standard deviation of duplicate analysis. Values in the same superscript in the same row are statistically not significant at (P<0.05).Key: CAS: Ogiri from Castor seed, EGU: Ogiri from Melon seed, SES: Ogiri from Sesame seed and PUM: Ogiri from Pumpkin seed.

Mineral composition of the samples

Table 2 shows the mineral composition of *Ogiri* produced from different seeds. Sodium (Na) ranged between 3.450mg/g - 14.835mg/g. Sample EGU shows the highest level of sodium while sample CAS has the lowest value. There is a significant difference (P<0.05) among the samples. The result from table shows that the calcium content of sample EGU is higher (22.570mg/g) compared to the other samples. There is a significant difference (P<0.05) between the samples. The potassium content of sample SES is higher (55.855mg/g) compared to the other samples and there is a significant difference (P<0.05) among the samples. It was revealed from the table that sample SES also had the highest Zinc content (0.308mg/g) amongst the samples and there is a significant difference (P<0.05) among the samples. The magnesium content of the sample ranged between 1.925mg/g in sample CAS - 3.351mg/g in sample EGU.

Table 2: Macro element compositions of the samples (mg/100g)

Parameters (mg/100g)	CAS	EGU	SES	PUM
Sodium (Na)	$3.450±0.42^{d}$	$14.835±0.21^{a}$	$10.275±0.07^{b}$	$7.775±0.21^{c}$
Calcium (Ca)	$13.150±0.28^{d}$	$22.570±0.28^{a}$	$20.235±0.50^{b}$	$19.540±0.14^{c}$

Potassium (K)	21.655±0.50^{d}	37.220±0.28^{b}	55.855±0.50^{a}	29.070±0.14^{c}
Zinc (Zn)	0.128±0.00^{d}	0.258±0.00^{b}	0.308±0.01^{a}	0.218±0.00^{c}
Magnesium (Mg)	1.925±0.00^{d}	3.351±0.00^{a}	2.788±0.01^{b}	2.457±0.00^{c}
Phosphorus (P)	12.525±0.00^{a}	6.793±0.00^{d}	11.421±0.00^{b}	9.524±0.00^{c}

Values are mean ± standard deviation of duplicate analysis. Values in the same superscript in the same row are statistically not significant at (P<0.05). Key: CAS: Ogiri from Castor seed, EGU: Ogiri from Melon seed, SES: Ogiri from Sesame seed and PUM: Ogiri from Pumpkin seed.

Vitamin and anti-oxidant composition

Table 3 shows the Vitamin and anti-oxidant composition of Ogiri produced from different seeds. It was revealed that vitamin A ranged between 2.95(IU/g) – 7.576(IU/g). Sample CAS shows the highest vitamin A while sample SES shows the lowest value of vitamin A. There is a significant difference (P>0.05) among the samples. There is a significant difference (P>0.05) between the samples. Sample EGU has the lowest Vitamin E content (3.518mg/g) while sample PUM has the highest vitamin E content (8.270mg/g).Polyphenol and Steroid in the samples ranged between 69.17 in sample SES to 121.57 in sample PUM and 0.63 in sample SES to 1.51 in sample PUM respectively and there is significant difference (P>0.05) between the samples. Terpenoid in the samples ranged between 0.94 – 2.19. Sample EGU shows the highest Terponoid value while sample SES has the lowest Terpenoid content.

Table 3: Vitamin and Antioxidant composition of the samples

Parameters	**CAS**	**EGU**	**SES**	**PUM**
Vitamin A (IU/g)	7.576±0.01^{a}	4.218±0.00^{c}	2.957±0.00^{d}	5.177±0.00^{b}
Vitamin E (mg/g)	6.910±0.01^{b}	3.518±0.01^{d}	3.808±0.00^{c}	8.270±0.00^{a}
Polyphenol	75.31±0.01^{c}	106.82±0.01^{b}	69.17±0.01^{d}	121.57±0.00^{a}
Steroid	0.92±0.00^{c}	1.21±0.01^{b}	0.63±0.01^{d}	1.51±0.01^{a}
Terpenoid	1.37±0.00^{c}	2.19±0.01^{a}	0.94±0.00^{d}	1.82±0.00^{b}

Values are mean ± standard deviation of duplicate analysis. Values in the same superscript in the same row are statistically not significant at (P<0.05). Key: CAS: Ogiri from Castor seed, EGU: Ogiri from Melon seed, SES: Ogiri from Sesame seed and PUM: Ogiri from Pumpkin seed.

But EGU sample still content the highest protein and fat content while sesame seed was richer in fibre. Mineral constituent such as sodium, calcium and magnesium were richer in EGU while

Zinc and potassium find more expression in SES sample. CAS sample i.e Castor seed was more in phosphorus and vitamin A. PUM was significantly higher in polyphenol, vitamin E and steroid

Discussion

Moisture content ranged from 14.52%-19.17% respectively. Sample CAS had the lowest value of moisture content (14.52%) while sample PUM had the highest value of moisture content (19.17%) with significant difference ($p>0.05$) respectively. Which means that condiment will have a longer storage time than the other samples. However 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 [19]. Reduced moisture content indicates better storage potential because microorganisms require water for their activities [19]. The moisture content obtained in this study were lower from the reports by [20] in their study, on traditional fermented protein condiments in Nigeria. This may be attributed to sample source or method of processing. The ash content ranged from 5.41%-10.22%. Sample SES had the highest value of ash content (10.22%) while sample EGU had the lowest value of ash content (5.41%) with significant difference ($p>0.05$) respectively. This high ash content translates into high mineral and vitamin contents or this might be due to sesame seed content high amount of mineral in them. However the result obtained from this study was higher than the result obtained by [21]. The high ash content of all the condiment samples is indicative of the high mineral contents of the castor seed, melon seed, sesame seed and pumpkin seeds, although the mineral composition vary in different proportions. These minerals are required for body regulation and bone formation. This might be due to all the sample are rich in mineral and vitamin. The fiber content ranged from 7.53%-11.21% respectively. Sample SES had the highest value of fiber content (11.21%) while sample EGU had the lowest value of fiber content (7.53%) with significant difference. High fiber content in food aids stool transition, digestion and water retention in the human system [22]. The difference in fibre content of the condiment may be attributed to the differences in the composition of the seeds used [22]. However the result obtained from this study was higher than the result obtained. This might be due to the different seed used in this study. The protein content ranged from 20.7%- 29.30% respectively. Sample EGU had the highest value of protein content (29.30%) while sample CAS had the lowest value of fiber content (20.71%) with significant difference ($p>0.05$) respectively. This might be due to melon plant are legumes crop. The protein contents of melon condiment was higher than the result obtained condiment, however, the values were generally higher than that of other commonly consumed plant foods in Nigeria such as cassava products, yam tubers and leafy vegetables [23].. This high protein content in these condiments could be a good and cheap source of dietary protein, where animal proteins are presently highly unaffordable to many of the populace. The carbohydrate ranged from 10.85%-27.58%. Sample EGU had the lowest value of carbohydrates content (10.81%) while sample CAS had the highest value of carbohydrates content (27.58%) with significant difference ($p>0.05$) respectively. This might be due to the higher the fat content in the seed the lower the carbohydrate content in that seed. However the result obtained from this study was lower than the result obtained by [21]. This might be due to the specie of pumpkin seed and other seed used for their samples.

The value of sodium content in this study varied across all samples. Sample EGU shows the highest sodium while sample CAS has the lowest sodium content. The value obtained in sample CAS in this study is lower to the value (147.22mg/g) reported by [10] in their study on Nutritional property of indigenous fermented condiments. Sodium obtained from PUM is higher than the value (0.015mg/g) reported by [24] in their study on Nutritional composition and anti-oxidative potentials of fermented fluted pumpkin seed (Ogiri). All results of sodium obtained from this study is lower to the value (113mg/g) reported by [25] in his study on Chemical and microbial evaluation of *Ogiri*. This variation could be due to high sodium content present in groundnut seed. This low sodium content of Ogiri could serve as a good condiment for people with hypertension. Sodium is an essential nutrient involved in the maintenance of normal cellular homeostasis and in the regulation of fluid and electrolyte balance and blood pressure (BP) [26, 27]. Appreciable amount of sodium calcium (Ca) which is one of the major minerals, which our bodies need in relatively larger amounts to keep healthy was found in this study. These values are higher to the value (0.74mg/g) obtained by [11] in their study on *Ogiri* produced from watermelon seed. However, the values in this study is lower than the value 108mg/g obtained by [25]. This variation could be due to different seeds used in the preparation of *ogiri*. [28] reported a value 0.10mg/g for calcium in their study on Nutritional value and safety of castor bean seed detoxified in solid-state fermentation, this value is lower compared to the value 13.150mg/g obtained in this study. Sample PUM calcium content in this study is higher than the value

(0.28mg/g) reported by [24] in their on *ogiri* produced from pumpkin. This difference could be as a result of fermentation duration. This study revealed that sample EGU could be a better source of calcium compared to other samples. Calcium, together with phosphorus, is needed to form and keep our bones and teeth strong. Calcium is also a key element to activate different enzymes and helps our bodies release hormones [29, 30]. Potassium (K), one of the body's electrolytes found in this study is higher than the value 1.08mg/g obtained in *Ogiri* produced from watermelon seed as reported by [11]. The potassium content found in sample EGU is higher than the value (1.11mg/g) obtained by [11] in their study on Effect of fermentation on the anti-nutritional factors and mineral composition of melon seed varieties for *Ogiri* production. The value 29.070mg/g reported in sample PUM is lower to the value 77mg/g reported by [24] in their study. The value 641.02mg/g obtained in this study for sample CAS is lower than the value (641.02mg/g) obtained by [10] in their study on Nutritional property of indigenous fermented condiments. The value 27.93mg/g obtained by [25] is lower to the value obtained from sample EGU, SES and PUM but higher than the value obtained from sample CAS. This variation could be as a result of different nutritional makeup of the seeds. Potassium is required for proper fluid balance, nerve transmission and muscle contraction. It acts as a vasodilator, reduces blood constriction, and lowers blood pressure [31, 32]. The zinc content found in this study ranged between 0.128mg/g - 0.308mg/g. This shows that *Ogiri* from from Melon, Sesame, Pumpkin and Castor seed have a trace amount of zinc. The values obtained in this study is comparably the same with the value 0.29mg/g obtained by [11]. [10] and [28] reported a value (0.49mg/g) and (0.69mg/g) respectively for *Ogiri* produced from Castor bean, this value is higher to the value obtained from this study. The value of zinc reported in this study for sample EGU is similar to the value 0.31mg/g reported for *ogiri* from Melon seed by [11]. Zinc (Zn) is an essential cofactor of more than 70 enzymes. Its deficiency is ranked in the top five risk factors of disease and death in developing countries [33-35]. Magnesium content found in this study is lower to the value (0.84mg/g) reported by [11] on their study on *ogiri* from watermelon seed. The value reported for sample CAS in this study is lower to the value 6.86mg/g and 7.16mg/g reported by [28] in their study on Nutritional value and safety of castor bean seed. Sample EGU magnesium content is higher than the value 0.94mg/g reported by [11] in their study on *ogiri* from Melon seed. Sample PUM magnesium content in this study is higher than the value (0.650mg/g) reported by

[24] in their on *ogiri* produced from pumpkin. Magnesium is found in bones, and is required for production of protein, muscle contraction, nerve transmission, and immune system health [36].

Phosphorus is found in every cell; important for healthy bones and teeth, and part of the system that maintains acid-base balance [39]. The phosphorus content found in sample PUM in this study is higher than value 2.4mg/g reported by [24] in their study on *ogiri* produced from pumpkin seed. However, phosphorus content found across all samples in this study is lower than the value (37.90mg/g) reported by [25]. This variation could be due to different seeds used in the preparation of *ogiri*. Phosphorus is found in every cell; important for healthy bones and teeth, and part of the system that maintains acid-base balance [40].

The vitamin composition of ogiri produced from castor, egusi, sesame and pumpkin seeds. The Vitamin A as seen in the table range from 2.957 IU/100g to 7.576 IU/100g, CAS (castor ogiri sample) was observed to have the highest value of 7.576 IU/100g while the least was found in SES (sesame ogiri sample) with value recorded to be 2.957 IU/100g. EGU (egusiogiri sample) was noted have a value of 4.218 IU/100g while the PUM was noted to have value of PUM (pumpkin ogiri sample). PUM was also found to have the highest value for vitamin E with value of 8.270 mg/100g, next to it was CAS with value 6.910 mg/100g. The least value was noted in sample EGU vitamin content of 3.518 mg/100g, followed by SES with vitamin content of 3.808 mg/100g respectively. The result reported in this study is lower in comparison to the result reported by [41] for Ogiri produced from Melon and Groundnut Seeds.

Antioxidant composition of the samples

Alkaloids are bitter-tasting compounds which are mostly toxic and widespread in nature, found in many plants, especially medicinal plants [42]. These nitrogen-containing organic compounds have been found in various plants and have significant roles in plant defence mechanisms [43]. The content of alkaloids in different seed sources of Ogiri was investigated, revealing that the CAS was significantly high in (39.23), this significant difference in alkaloid content suggests that the seeds' sources could influence the alkaloid profile of Ogiri. Flavonoids are a diverse group of plant secondary metabolites that possess various biological activities, including anti-oxidant, anti-inflammatory, and anti-cancer properties [44]. They are known for their ability to scavenge free radicals and protect cells from oxidative damage [45]. In a study on the seed sources of Ogiri, the EGU sample demonstrated the highest flavonoid content (35.16), followed by PUM (41.07), CAS (22.71), and SES (16.84). This value was higher that the values reported by [28] who revealed a lower values of flavonoids in samples of solid state fermented castor bean seeds using Pleurotus ostreatus. This could be attributed to the activities of microbial enzymes produced during fermentation which are able to hydrolysed and break down plant cell walls, leading to the reduction in flavonoids [46]. Which aligns with the high Flavonoid content observed in the Ogiri from Melon Seed (EGU). They possess strong anti-oxidant properties and are known for their ability to neutralize free radicals and protect cells from oxidative stress [47]. In the study, Ogiri from Pumpkin Seed (PUM) had the highest polyphenol content (106.82+0.01b), followed by Ogiri from Melon Seed (EGU), Ogiri from Castor Seed (CAS), and Ogiri from Sesame Seed (SES) cite a study by [48] that investigated the anti-oxidant properties of different seeds, including Ogiri seeds. Their results showed that Ogiri seeds had a high total phenolic content, which is consistent with the high Phenol content observed in the Ogiri from Sesame Seed (SES). This study reveals that Ogiri produced from Sesame Seed (SES) had the highest steroid content (0.92+0.00c) Steroids are a group of organic compounds with a specific four-ring structure. They have various biological functions, including hormone regulation and anti-inflammatory effects [49]. In this study, the vales obtained from Terpenoid was significantly higher in Ogiri produced from pumpkin seed and significantly lower in Ogiri produced from sesame seed. Terpenoid are a large and diverse group of organic compounds derived from isoprene units. They exhibit a wide range of biological activities, including anti-oxidant, anti-inflammatory, and anti-cancer properties [50].

Conclusion

This study revealed Ogiri being one of the traditional and ancient condiment used in soup sweetening can be produced from other leguminous plants not limited to melon seed only. Although, the nutrients and antioxidant properties of the “Ogiri” samples vary proportionately. But EGU sample still content the highest protein and fat content while sesame seed was richer in fibre. Mineral constituent such as sodium, calcium and magnesium were richer in EGU while Zinc and potassium find more expression in SES sample. CAS sample i.e Castor seed was more in phosphorus and vitamin A. PUM was significantly higher in polyphenol, vitamin E and steroid The results can guide farmers, processors, and consumers in making informed decisions regarding seed selection and Ogiri preparation.

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