Processing and Evaluation of Proximate Composition and Sensory Characteristics of Ogiri Made From Melon Seed, Fluted Pumpkin Seed and Castor Oil Seed

Okoroafor, C. N[1]; Nwachukwu, C. N[2]

[1]Department of Human Nutrition and Dietetics, Ambrose Alli University P.M.B. 14, Ekpoma, Edo State, Nigeria

[2]Department of Food Science and Technology, Imo State University, Owerri, Imo State, Nigeria

DOI: https://doi.org/10.51584/IJRIAS.2026.11090105

Received: 26 September 2026; Accepted: 01 October 2026; Published: 16 October 2026

ABSTRACT

The proximate composition and sensory quality of *ogiri*, a fermented soup condiment produced from melon seed, castor oil seed and fluted pumpkin seed, were evaluated. *Ogiri* samples were produced from the three seed types and analyzed for moisture, ash, crude fibre, fat, protein and carbohydrate contents using standard analytical methods. Sensory evaluation was conducted on soups prepared with the respective *ogiri* samples using 25 semi-trained panelists. The soups were evaluated for colour, taste, aroma, mouthfeel and overall acceptability using a 9-point hedonic scale. Samples were coded as Sample A (melon seed *ogiri*), Sample B (castor oil seed *ogiri*) and Sample C (fluted pumpkin seed *ogiri*). The results showed that moisture content ranged from 6.24% in Sample B to 10.17% in Sample C, while ash content ranged from 2.33% in Sample B to 3.03% in Sample A. Crude fibre content ranged from 2.84% in Sample C to 7.16% in Sample B, fat content from 22.36% in Sample C to 44.18% in Sample B, and protein content from 18.14% in Sample C to 24.15% in Sample B. Carbohydrate content ranged from 15.94% in Sample B to 43.92% in Sample C. Sensory evaluation showed that Sample C recorded the highest appearance score (7.45), although this did not differ significantly ($p > 0.05$) from the other samples. Sample B recorded the highest scores for taste (7.20), aroma (6.90), mouthfeel (7.20) and overall acceptability (7.70). All the soup samples were generally accepted by the panelists, with the soup prepared from castor oil seed *ogiri* (Sample B) recording the highest overall acceptability. The findings demonstrate that melon seed, castor oil seed and fluted pumpkin seed can be used for the production of *ogiri* with appreciable nutritional and sensory qualities. Castor oil seed *ogiri* showed particularly high protein, fat and fibre contents and produced a soup with favourable sensory characteristics. The study therefore indicates that the choice of seed used in *ogiri* production can influence both its nutritional composition and sensory acceptability.

Keywords: *Ogiri*, melon seeds, castor oil seeds, fluted pumpkin seeds, proximate composition, sensory evaluation.

INTRODUCTION

Ogiri condiment is an important food additive associated with the Igbo people of the South East region of Nigeria. It is a product of fermentation of oils seeds such castor oil seed (*Ricinus communis*), melon seeds (*Cucumeropsis mannii*) or other varieties, fluted pumpkin seed (*Telfairia occidentalis*), sesame seeds *(Sesamum indicum)* (Ojinnaka and Ojimelukwe, 2012), among other raw materials. Production of *Ogiri* involves the traditional method of uncontrolled solid substrate fermentation resulting in extensive hydrolysis of the protein and carbohydrate component (Achi, 2005). The unpredicted variability in *Ogiri* condiment quality as a result of varying environmental factors (Ogueke *et al*., 2013). It is a food flavouring condiment used in sauces and stews that serve as accompaniment to starchy root and vegetable diets. It is also added to other preparations as seasoning e.g. in boiled meat and staple foods such as ikokore – a Nigerian local pottage. It is consumed in the Eastern, South-Western and Middle belt regions of Nigeria (Weber *et al*., 2016).

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue IX September 2026

Melon seed (*Cucumeropsis mannii*) are major soup ingredients and they are used as a thicker and flavour component of soups. They can contribute substantially towards obtaining a balanced diet (Fokou, Achu, Chaungues, 2014). Melon seeds are generally rich source of oil which can generally processed to yield condiments such as "ogiri". Melon seeds have high fat contents, thus the seed classified as excellent sources of dietary oil. Melon seed are popularly known as "egusi" in Nigeria is consumed in various forms such as egusi soup, melon snacks (ball) and fermented melon seed (Ogiri) (Achinewhu, 2017). The melon seed contain a seed coat (testa/hull) which forms its outer covering and it is derived from the integument tissue, originally surrounding the ovule. The seed coat in the mature melon seed is a transparent and very thin layer. It is a multifunctional organ that plays an important role in embryo nutrition during seed development and in protection against detrimental agents from the environment afterwards (Weber *et al*., 2016).

Fluted pumpkin (*Telfairia occidentalis*) belongs to the family of Cucurbitaceae that is widely eaten either as seed or leafy vegetable in Nigeria (Akwukwaegbu *et al.,* 2016). It is widely grown in the South Eastern part of Nigeria, South Africa and tropical regions of Africa with annual rainfall. Cucurbitaceous family includes crops like cucumbers, water melons, squashes and luffas melons. The term fluted is used to describe the shape of the female flowers which matures to fruits that are berry-like in structure with many seeds (Renner *et al.,* 2017). Seeds are fundamental part of human diet and are widely referred to as vital food. The nutritional relevance of seeds cannot be over emphasized. Seeds are anticipated to be good sources of unsaturated fats, highly nutritive and supplies large amount of energy. Studies highlighted that the amount of energy provided by 1 gram of fat from digested seed is more than twice the amount from proteins and carbohydrates (Brain and Alan, 2019). Fermentation of fluted pumpkin seeds produces "Ogiri", a local product peculiar to the South Easterners. Fluted pumpkin seeds can equally be utilized in diet formulation and production of marmalade (Alais and Linden, 2022).

Castor oil seed (*Ricinus communis*) is a tropical crop, highly nutritious, adopted to drought-prone areas. The crop is neglected by both the researchers and policy makers. Castor oil seed (*Ricinus communis*) can be equally used in production of locally fermented food condiment ("Ogiri"). *Ogiri* condiment production from castor oil seed (*Ricinus communis*), typically involves the following steps (1) dehulling of the seeds (2) Washing and wrapping of the de-hulled seeds in plantain leaves (3) Boiling of the wrapped de-hulled seeds for 9-18 hours. (4) cooling and fermentation of the wrapped, boiled de-hulled seeds at a steady temperature (35°C) and humidity for 3-4 days (5) unwrapping and milling into a paste using a mortar and pestle (6) packaging on a fresh blanched leaves (7) ageing under the sun for 2-3 days before consumption. The anti-nutritional factors in the oilseeds are reduced through fermentation, while flavour compounds, digestibility and nutritive value are improved and developed (Ahaotu *et al*., 2020).

MATERIALS AND METHODS

Materials

Melon seed, pumpkin seed and castor oil seed were purchased from Relief market in Owerri, Imo State. The reagents and equipment used in the production of the ogiri sample was obtained from the laboratory of Human Nutrition and Dietetics, Ambrose Alli University Ekpoma, Edo State.

Sample Processing

Melon seed ogiri processing

Undehulled melon seeds were properly and severally and boiled for 4 hours, cooled and dehulled. The seeds were then soaked in water overnight and wrapped tightly. The wrapped seeds were subsequently boiled for 2 hours, place on a wire mesh over flame in order to reduce the moisture content for 1 hour. Thereafter, the wrapped seed were left to ferment at the prevailing ambient temperature (28°C) for 3 days (primary fermentation). At the end of the fermentation period, the seeds were pounded in a mortar with pestle into a paste. The paste was then wrapped in a packaging material and left to ferment for another 3 days (secondary fermentation) as shown in Fig. 1.1.

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Fluted pumpkin seed ogiri processing

Fluted pumpkin seeds were properly and severally and boiled for 4 hours, cooled and dehulled. The seeds were then soaked in water overnight and wrapped tightly. The wrapped seeds were subsequently boiled for 2 hours, place on a wire mesh over flame in order to reduce the moisture content for 1 hour. Thereafter, the wrapped seed were left to ferment at the prevailing ambient temperature (28°C) for 3 days (primary fermentation). At the end of the fermentation period, the seeds were pounded in a mortar with pestle into a paste. The paste was then wrapped in a packaging material and left to ferment for another 3 days (secondary fermentation) as shown in Fig. 1.2.

Castor oil seed ogiri processing

Undehulled castor oil seeds was properly and severally and boiled for 4 hours, cooled and dehulled. The seeds were then soaked in water overnight and wrapped tightly. The wrapped seeds were subsequently boiled for 2 hours, place on a wire mesh over flame in order to reduce the moisture content for 1 hour. Thereafter, the wrapped seed were left to ferment at the prevailing ambient temperature (28°C) for 3 days (primary fermentation). At the end of the fermentation period, the seeds were pounded in a mortar with pestle into a paste. The paste was then wrapped in a packaging material and left to ferment for another 3 days (secondary fermentation) as shown in Fig. 1.3.

Proximate Analysis

The standard method of the Association of Analytical Chemists (AOAC, 2015) was used for the analysis of the proximate composition of the samples.

Sensory Analysis

A total of 25 semi-trained panelists participated in the sensory evaluation of the "Ogiri" condiment samples. The samples were incorporated into soup and evaluated for colour, flavour, mouthfeel, taste, and overall acceptability. The prepared soups were served to the panelists in a randomized order to minimize bias. Clean drinking water was provided for rinsing the mouth between samples to minimize carry-over effects and cleanse the palate. The panelists evaluated each sample using a 9-point hedonic scale, where 9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like nor dislike, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much, and 1 = dislike extremely. The sensory scores obtained from the panelists were used to determine the level of acceptability of the different "Ogiri" condiment samples (Iwe 2014).

Statistical Analysis

Data obtained from the proximate composition analysis and sensory evaluation were subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS), version 20.0 (IBM Corp., USA 2011). Results were expressed as mean ± standard deviation. Where the assumptions of normality and homogeneity of variances were satisfied, a one-way analysis of variance (ANOVA) was used to determine whether significant differences existed among the three ogiri samples. Where the ANOVA indicated a significant difference, an appropriate post-hoc multiple-comparison test, such as Tukey's honestly significant difference (HSD) test, was used to identify the samples that differed significantly. Statistical significance was assessed at $p < 0.05$. Exact p-values were reported where available.

RESULTS AND DISCUSSION

Proximate Composition of the Ogiri Samples

The proximate composition of *ogiri* produced from melon seed, castor oil seed and fluted pumpkin seed is presented in Table 2. The moisture content of the *ogiri* samples ranged from 6.24% in castor oil seed *ogiri* (Sample B) to 10.17% in fluted pumpkin seed *ogiri* (Sample C). The moisture content of Sample C did not differ significantly ($p > 0.05$) from that of melon seed *ogiri* (Sample A). The ash content ranged from 2.33% in Sample B to 3.03% in Sample A. Crude fibre content ranged from 2.84% in Sample C to 7.16% in Sample B, while fat content ranged from 22.36% in Sample C to 44.18% in Sample B. The crude protein content ranged from 18.14%

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in Sample C to 24.15% in Sample B, with the value for Sample B not differing significantly ($p > 0.05$) from that of Sample A. Carbohydrate content ranged from 15.94% in Sample B to 43.92% in Sample C.

The moisture contents recorded in the present study were considerably lower than the values of 43.53–50.84% reported by Ukaegbu (2016) and 27.00–31.00% reported by Ishiwu and Tope (2015) for *ogiri* samples. The differences may be associated with variations in the raw materials, processing conditions, fermentation duration, drying procedures and storage conditions. Fermentation and subsequent processing can substantially influence the moisture content of fermented seed-based condiments. Similar observations concerning the effects of processing and fermentation on the composition of *ogiri* have been reported by Achi (2005), Enujiugha (2009), Omafuvbe *et al.* (2004), Chukwu *et al.* (2010) and Odebunmi *et al.* (2010). Sample B, which recorded the lowest moisture content (6.24%), may have better storage stability than Samples A and C, provided that other storage conditions are adequately controlled. Lower moisture content generally reduces the amount of water available for microbial growth and chemical deterioration. Chukwu *et al.* (2010) similarly reported that products with lower moisture contents generally exhibit improved storage stability.

The ash content provides an indication of the total mineral residue present in a food after incineration. Sample A, produced from melon seed, recorded the highest ash content (3.03%), whereas Sample B had the lowest value (2.33%). The relatively higher ash content of Sample A may suggests a comparatively greater contribution of mineral constituents from melon seed. However, ash content represents total mineral matter and does not by itself indicate the concentration of individual minerals. Foods with appreciable ash contents may provide various mineral elements required for normal physiological functions and growth. The ash values obtained in the present study were comparable with the 2.46–3.21% reported by Akinsola *et al.* (2017) for *ogiri* produced from melon seed, soybean and African yam bean. The result therefore indicates that the fermentation process did not eliminate the mineral residue substantially. Ash content remains a useful preliminary indicator in the nutritional assessment of food products.

The crude fibre content ranged from 2.84% in Sample C to 7.16% in Sample B, with castor oil seed *ogiri* recording the highest value. The relatively higher fibre content of Sample B may be associated with the inherent composition of the castor oil seed and the effects of processing and fermentation. Dietary fibre is important in maintaining normal gastrointestinal function and has been associated with several health benefits, including improved bowel function and better regulation of blood glucose and blood lipid levels. Ishiwu and Tope (2015) reported that dietary fibre in fermented seed products may contribute to their nutritional value. The values obtained in the present study were comparable with the 2.59–7.50% range reported by Ukaegbu (2016) for selected *ogiri* samples in Anambra State. The relatively high fibre content of Sample B may therefore contribute positively to its nutritional quality.

The crude protein content of the *ogiri* samples ranged from 18.14% in Sample C to 24.15% in Sample B. Sample B recorded the highest protein content, followed by Sample A, while Sample C had the lowest value. The relatively high protein contents observed in Samples A and B may be attributed partly to the protein composition of the seeds used in their production. Seed-based fermented condiments are generally recognized as important sources of plant protein (Okafor *et al.*, 2015). Akinsola *et al.* (2017) reported appreciable protein contents in melon seed, soybean and castor oil seed. Furthermore, fermentation may influence the apparent protein content of fermented foods through microbial synthesis, concentration effects resulting from the utilization of other food components, and enzymatic hydrolysis of complex proteins. Ishiwu and Tope (2015) reported an increase in crude protein during fermentation of *ogiri*. Proteolytic microorganisms can hydrolyse complex proteins into peptides and free amino acids, some of which contribute to the characteristic flavour and aroma of fermented condiments (Enujiugha, 2009). The relatively high protein contents recorded in Samples A and B indicate that these products could contribute to dietary protein intake in addition to their primary role as flavouring agents.

Fat content varied considerably among the samples, ranging from 22.36% in Sample C to 44.18% in Sample B. The highest fat content was recorded in castor oil seed *ogiri* (Sample B), followed by melon seed *ogiri* (Sample A), while fluted pumpkin seed *ogiri* (Sample C) recorded the lowest value. This variation is expected because the seeds used in producing *ogiri* differ in their inherent lipid composition. The high fat content of Samples A and B indicates their potential contribution to dietary energy, since fat provides a concentrated source of energy. Dietary lipids also facilitate the absorption of fat-soluble vitamins and contribute to desirable sensory

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characteristics such as flavour and mouthfeel. However, the nutritional implications of the fat content depend not only on the quantity but also on the fatty acid composition of the product. Thus, the relatively high fat contents recorded in Samples A and B contribute to their energy density and may enhance certain sensory properties of the fermented condiment.

The carbohydrate content of the samples ranged from 15.94% in Sample B to 43.92% in Sample C. Sample C, produced from fluted pumpkin seed, recorded the highest carbohydrate content, whereas Sample B recorded the lowest. The relatively lower carbohydrate contents observed in Samples A and B are consistent with findings reported by Sanful and Darko (2010) and Ishiwu and Tope (2015) for fermented seed- and legume-based products. The reduction in carbohydrate content during fermentation may be associated with the utilization of readily available carbohydrates by fermenting microorganisms as sources of carbon and energy for growth and metabolic activities. Microbial enzymes may also hydrolyse complex carbohydrates into simpler compounds, which are subsequently metabolized during fermentation (Asibuo *et al.*, 2008). Consequently, differences in carbohydrate content among the samples may reflect differences in the original seed composition as well as the extent and conditions of fermentation.

Overall, the results demonstrate that the type of seed used in the production of *ogiri* influenced its proximate composition. Castor oil seed *ogiri* (Sample B) was characterized by the lowest moisture content and the highest crude fibre, fat and protein contents, whereas fluted pumpkin seed *ogiri* (Sample C) recorded the highest moisture and carbohydrate contents and the lowest protein, fat and fibre values. These differences suggest that the choice of seed can influence the nutritional composition, storage characteristics and potential functional qualities of *ogiri*.

Sensory Scores of Soup Prepared with the Ogiri Samples

The sensory scores of soups prepared with *ogiri* produced from melon seed, castor oil seed and fluted pumpkin seed are presented in Table 3. The results showed that the highest appearance score (7.45) was recorded for Sample C, the soup prepared with fluted pumpkin seed *ogiri*. However, the appearance score did not differ significantly ($p > 0.05$) from those of Samples A and B. Sample B, the soup prepared with castor oil seed *ogiri*, recorded the highest scores for taste (7.20), aroma (6.90), mouthfeel (7.20) and overall acceptability (7.70). These scores differed significantly ($p < 0.05$) from the corresponding scores recorded for some of the other samples.

The results further indicated that all the soup samples received relatively high sensory ratings for appearance, taste, aroma, mouthfeel and overall acceptability, suggesting that the three types of *ogiri* produced soups that were generally acceptable to the panelists. For appearance, Sample C had the highest score (7.45), indicating greater preference for its visual characteristics, although the difference among the samples was not statistically significant ($p > 0.05$). The relatively similar appearance scores suggest that the type of seed used in producing the *ogiri* had limited influence on the visual acceptability of the soups.

With respect to taste, Sample B recorded the highest score (7.20), indicating greater preference for the taste of soup prepared with castor oil seed *ogiri*, while Sample C recorded the lowest score. Taste is an important determinant of food acceptability because it contributes substantially to the overall sensory perception of a product. The higher taste score obtained for Sample B may be associated with the characteristic flavour compounds generated during fermentation and the relatively high fat content of castor oil seed *ogiri*. Lipids can contribute to flavour perception and mouth-coating properties and may enhance the palatability of fermented food products.

A similar pattern was observed for aroma. Sample B recorded the highest aroma score (6.90), suggesting that the characteristic aroma developed in the castor oil seed *ogiri* was more favourably perceived by the panelists. The aroma of fermented seed-based condiments is influenced by the raw material, fermentation conditions and metabolic activities of microorganisms during fermentation. The production of volatile compounds during fermentation can contribute to the characteristic aroma associated with *ogiri*.

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For mouthfeel, Sample B also recorded the highest score (7.20). The higher mouthfeel score may be related to the relatively high fat content of castor oil seed *ogiri*. Fat can influence the lubricity, smoothness and mouth-coating properties of foods and may consequently contribute to their sensory acceptability. Sample C, which had the lowest fat content among the *ogiri* samples, received a comparatively lower mouthfeel score.

The overall acceptability scores showed that all the soup samples were generally acceptable to the panelists. Sample B recorded the highest overall acceptability score (7.70), followed by Sample A, while Sample C recorded the lowest score. The relatively high acceptability of Sample B may be associated with its favourable ratings for taste, aroma and mouthfeel. The result suggests that although appearance is an important sensory attribute, the combined effects of taste, aroma and mouthfeel may have contributed more substantially to the overall acceptance of the soups.

The sensory preference observed for Sample B may also be related to the proximate composition of the corresponding *ogiri*. Castor oil seed *ogiri* recorded comparatively high protein (24.15%) and fat (44.18%) contents. These components may contribute to flavour development and mouthfeel, although sensory preference cannot be attributed to proximate composition alone because fermentation-derived volatile and non-volatile compounds also influence the sensory characteristics of *ogiri*. Overall, the findings demonstrate that the seed type used in *ogiri* production can influence the sensory characteristics and acceptability of the resulting soup.

CONCLUSION

This study evaluated the proximate composition of *ogiri* produced from melon seed, castor oil seed and fluted pumpkin seed, as well as the sensory characteristics of soups prepared from the respective *ogiri* samples. The findings showed that the three *ogiri* samples contained appreciable amounts of protein, fat, ash and crude fibre, although their proximate compositions varied according to the seed used. Castor oil seed *ogiri* (Sample B) recorded the highest protein (24.15%), fat (44.18%) and crude fibre (7.16%) contents, while melon seed *ogiri* (Sample A) recorded the highest ash content (3.03%). Fluted pumpkin seed *ogiri* (Sample C) recorded the highest moisture (10.17%) and carbohydrate (43.92%) contents.

The sensory evaluation showed that all the soups prepared from the different *ogiri* samples were generally acceptable to the panelists. Soup prepared with castor oil seed *ogiri* (Sample B) recorded the highest scores for taste, aroma, mouthfeel and overall acceptability, with an overall acceptability score of 7.70, while soup prepared with fluted pumpkin seed *ogiri* (Sample C) recorded the highest appearance score (7.45). The findings indicate that castor oil seed can serve as a suitable raw material for the production of *ogiri*, particularly based on the favourable nutritional composition and sensory acceptance observed in this study. However, the differences in sensory preference should be interpreted in relation to the specific processing and fermentation conditions used.

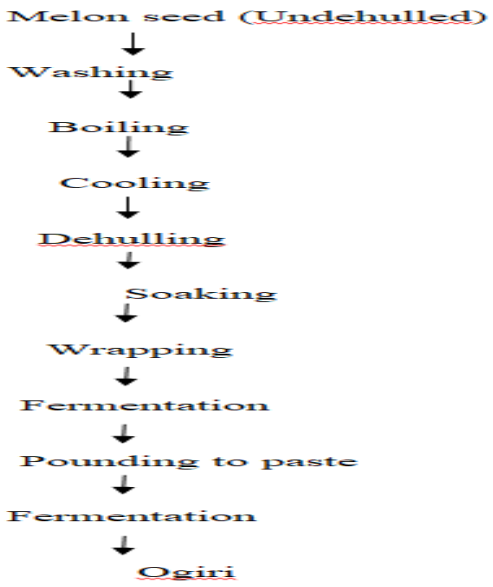


Fig 1: Production of Ogiri from Melon seeds

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Plate 1: Melon Seed Ogiri

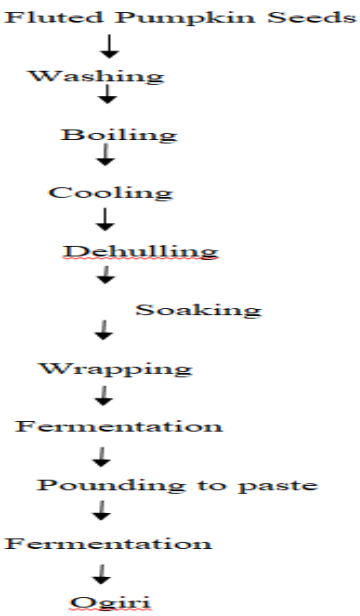


Fig 2: Production of Ogiri from Fluted Pumpkin seeds



Plate 2: Fluted Pumpkin Seed Ogiri

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Plate 3 Castor Oil Seeds Ogiri

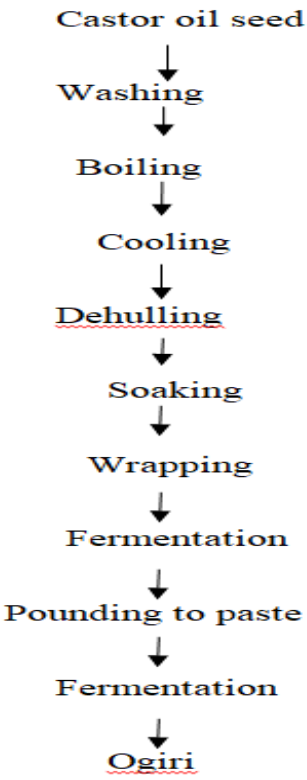


Fig 3: Flow Chart for the Production of Ogiri from Castor Oil seeds

Table 1: Sample Formulation Ogiri Made from Melon, Castor oil and Fluted Pumpkin Seeds

Sample	Melon Seed	Castor Oil Seeds	Fluted Pumpkin Seed
A	100	0	0
B	0	100	0
C	0	0	100

Table 2 Proximate composition of the ogiri samples

Sample	Moisture	Ash	Parameters (%) Fibre	Fat	Protein	Carbohydrate
A	10.06^{a}±0.05	3.03^{a}± 0.04	3.07^{b}± 0.04	28.27^{b}± 0.04	23.90^{a}± 0.05	31.67^{b}± 0.04
B	6.24^{b}±0.05	2.33^{c}± 0.04	7.16^{a}± 0.08	44.18^{a}± 0.02	24.15^{a}± 0.07	15.94^{c}± 0.08
C	10.17^{a}±0.01	2.57^{b}± 0.02	2.84^{b}± 0.04	22.36^{c}± 0.05	18.14^{b}± 0.04	43.92^{a}± 0.01

Means are values of triplicate determinations. Mean values with different superscripts in the same row are significantly different ($p<0.05$).

Keys

A - Melon seed ogiri

B - Castor oil seed ogiri

C - Fluted pumpkin seed ogiri

Table 3 Sensory scores of the soup samples

Sample	Appearance	Taste	Parameters Aroma	Mouthfeel	General Acceptability
A	7.40^{a}± 0.13	6.80^{b}± 0.20	6.80^{a}± 0.22	7.00^{a}± 0.15	7.50^{a}± 0.15
B	7.20^{a}± 0.12	7.20^{a}± 0.30	6.90^{a}± 0.10	7.20^{a}± 0.10	7.70^{a}± 0.20
C	7.45^{a}± 0.15	5.60^{c}± 0.20	6.40^{b}± 0.14	6.00^{b}± 0.18	5.80^{b}± 0.20

Means are values triplicate determinations. Mean values with different superscripts in the same row are significantly different ($p<0.05$).

Keys

A - Melon seed ogiri

B - Castor oil seed ogiri

C - Fluted pumpkin seed ogiri

REFERENCES

1. Achi, O. K. (2005). Traditional fermented protein condiments in Nigeria. African Journal of Biotechnology, 4(13), 1612–1621. https://doi.org/10.5897/AJB2005.000-3212.
2. Achinewhu, S.C. (2017). Carbohydrate and fatty acid composition of fermented melon seed (citrullus vulgaris). Journal of Education Science and technology; 24:16-19.
3. Ahaotu, N. N., Echeta, C. K., Bede, N. E., Awuchi, C. G., Anosike, C. L., Ibeabuchi, C. J., & Ojukwu, M. (2020). Study on the nutritional and chemical composition of "Ogiri" condiment made from sandbox seed (Hura crepitans) as affected by fermentation time. GSC Biological and Pharmaceutical Sciences, 11(2), 105–113. https://doi.org/10.30574/gscbps.2020.11.2.0115.

4. Akinsola, A. O., Idowu, O. A., Adeyeye, S. A. O., & Akanbi, G. O. (2017). Comparative study of quality attributes and acceptability of ogiri: A condiment made from melon seeds, soya beans and African yam beans. Researcher, 9(11), 90–94. https://doi.org/10.7537/marsrsj091117.13.
5. Akwukwaegbu P.I., Peters D.E., Wegwu, M.O. (2016). Proximate analysis and phytochemical screening of fluted pumpkin (Telfairia occidentalis) pod, American Journal of Food, Nutrition and Health, vol. 1, no. 1, pp. 1-6.
6. Alais, C. and Linden, G. (2022). Food Biochemistry. Aspen Publishers, Inc., Maryland, pp. 121-145.
7. AOAC (2015). Association of Official Chemists official methods of analysis 17th ed. The Association Washington, DC – 2005. Properties of Food Technol. 5:109.116.
8. Asibuo, J. Y., Akromah, R., Safo-Kantanka, O., Adu-Dapaah, H. K., Ohemeng-Dapaah, S., & Agyeman, A. (2008). Chemical composition of groundnut, Arachis hypogaea (L.) landraces. African Journal of Biotechnology, 7(13), 2203–2208. https://doi.org/10.5897/AJB08.113
9. Brain, F.A. and Alan, G.C. (2019). Food Sciences, Nutrition and Health, Edward Arnold, London, pp. 79-125.
10. Chukwu, O., Orhevba, B.A., and Mahmood, B.I. (2010). Influence of hydrothermal treatment on proximate compositions of fermented locust bean (dawadawa). J. Food Technol., 8(3); 99-101.
11. Enujiugha, V. N. (2009). Major fermentative organisms in some Nigerian soup condiments. Pak. J. Nutr. 8(3); 279-282
12. Fokou, B., Achu, M.B. and Chaungues, T.M. (2014). Preliminary nutritional evaluation of five species of egusi seeds in cameroon. Afro. Journal of Nutrition and Agricultural Development; 4:8.
13. IBM Corp. (2011). IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.
14. Ishiwu, C. N. and Tope, V. A. (2015). Effect of period of fermentation on nutrients of castor oil seed (Ricinus communis). Direct Research Journal of Agriculture Science; 3 (10):178-183
15. Iwe, M. O. (2014). Handbook of Sensory Methods and Analysis. Enugu, Nigeria: Rojoint Communication Services Ltd.
16. Odebunmi, E. O., Oluwaniyi, O. O., & Bashiru, M. O. (2010). Comparative proximate analysis of some food condiments. Journal of Applied Sciences Research, 6(3), 272–274.
17. Ogueke CC, Okoli AI, Owuamanam CI and Nwosu JN. (2013). Fermentation of melon seeds for "Ogiriegusi" as affected by fermentation variables using Bacillus subtilis. Malaysian Journal of Microbiology, 9(4), 79 – 288.
18. Ojinnaka, M. C., & Ojimelukwe, P. C. (2012). Effect of fermentation period on the organic acid and amino acid contents of Ogiri from Ricinus communis. Journal of Food Technology, 10(5–6), 140–150.
19. Okafor, D. C., Peter-Ikechukwu, A., Enwereuzoh, R. O., Uzoukwu, A. E., Nze, S. M., Agunwa, M. I., Anagwu, F., & Onyemachi, C. (2015). Effect of fermentation on the anti-nutritional factors and mineral composition of melon seed varieties for ogiri production. Food Science and Quality Management, 43, 98–111.
20. Omafuvbe, B. O., Falade, O. S., Osuntogun, B. A., & Adewusi, S. R. A. (2004). Chemical and biochemical changes in African locust bean (Parkia biglobosa) and melon (Citrullus vulgaris) seeds during fermentation to condiments. Pakistan Journal of Nutrition, 3(3), 140–145. https://doi.org/10.3923/pjn.2004.140.145
21. Renner, S.S., Scaefer H. and Koccyan, R. (2017). "Phytogenetics of cucumis (curcurbitaceae)," Journal of Food, Agriculture and Environment, vol. 4, no.1, pp. 155-156.
22. Sanful, R. E., & Darko, S. (2010). Utilization of soybean flour in the production of bread. Pakistan Journal of Nutrition, 9(8), 815–818. https://doi.org/10.3923/pjn.2010.815.818
23. Ukaeghu, H. (2016). Chemical composition of some selected ogiri samples in Anambra State The proceedings of the 2nd South Summit (ReFoST). Theme: Technology for nutrient diversification and Calorie Management in Beverages. Umuahia, June, 9th-11th 33-34.
24. Weber, H., Borisjuk, L. and Wobus, U. (2016). Controlling seed development and seed size in Viciafaba: a role for seed coat-associated invertases and carbohydrate state. Plant Journal; 10:823–834