Production, Nutritional, Sensory and Storage Profile of Ogiri From Castor Oil Seed

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Abstract

'Ogiri', fermented seeds of the castor oil plant Ricinus communis was produced and this was compared with the commercially prepared product. The proximate compositions of the various ogiri condiments were moisture content, 12.8% and20.47%, protein 29.32% and 23.74%, fat 24.72% and 31.83%, ash 2.15% and 2.90%, crude fibre 0.86% and 0.88%, and nitrogen free extract 30.09% and 20.and 20.18% respectively. The values for the raw castor seeds were 2.60%, 7.05%, 55.02%, 1.91%, 1.02% and 30.40% for each respective parameter above. The result for ascorbic acid of the laboratory prepared ogiri condiment, the commercially available ogiri condiment and the raw castor oil seed are 16.36mg/100g, 22.80mg/100g and 26.40mg/100g respectively. Sensory studies indicated that significant differences existed for texture and overall acceptability between the laboratory prepared ogiri condiment and the commercially available types at p<0.05. the physical (storage) profile of the laboratory prepared ogiri condiment at ambient tempreture was normal for taste and aroma and no growth was observed when stored for 20 days.

Introduction

Castor bean is a poisonous seed of the castor bean plant, *Ricinus communis.* Ogiri (a fermented condiment) from the castor oil seed and are popular in the mid-west and eastern parts of Nigeria and Sierra-Leone (Odunfa, 1985).

The castor oil plant, probably indigenous to the south-eastern Mediterranean region and parts of east Africa is today widespread throughout the tropical regions of the world. Ordinarily, the castor oil bean is inedible because the seed contains a toxic protein, recin, and other toxic constituents, recinine and recinoleic acid, but this was removed by fermentation (Odunfa, 1985).

Fermented products continue to remain of interest since they do not require refrigeration during distribution and storage. The traditional condiments have not attained world-wide commercial status due to the short shelf-life, objectionable packaging materials, stickiness and the characteristic putrid odour (Arogba, 1995). Fermented condiments often have a stigma attached to them as they are considered as food for the poor.

The Igbo man is one of the most traveled tribe in Nigeria and always does so with their pattern of life and cuisine that they eat and as a result they tend to introduce their lifestyle to any community they settle in. Ogiri, being their main condiment is thus introduced to various communities within Nigeria and to other countries of the world.

In Nigeria as with most African countries, the problem of food security is not just that of inadequacy of food but it is also a problem of loss of food due to spoilage. Lack of adequate food preservation methods is a major problem contributing to food insecurity in Africa. The high costs and infrastructural requirement of many advanced food preservation methods such as refrigeration, freezing, canning and irradiation have greatly reduced their application in the developing world (Cooke *et al*., 1987). This implies that promoting fermentation and fermentation technology in africa, is helping to promote food security in Africa.

As a consequence of this, this study attempts to develop a convenient ogiri condiment from the seeds of the castor oil plant thatis of acceptable quality.

The specific objectives of the study are

•To produce an improved ogiri condiment that is acceptable to consumers.
•To assess the nutritional quality of the condiment produced compared with those of the market sample.
•To assess its acceptability by comparing the ogiri condiment produced in the laboratory with those commercially available in the markets.
•To assess its storage profile.

Literature Review

The term “ogiri” generally refers to oily pastes made from oil seeds in West Africa and are used as soup condiments because they are generally with strong aroma. The fact that these pastes are called by the same name by different ethnic groups is indicative of a common origin. The different ogiri are shown in table 1 below. The art of making ogiri in Sierra Leone was most probably introduced by the free slaves, mostly of Yoruba origin who settled there (Odunfa, 1985).

Table1. Fermented Vegetable Protein Used in West Africa

Product	Area of Production	Substrate	Microorganisms
Iru	Northern West Africa	Locust bean, (*Parkia biglobosa*)	*Bacillus subtilis, B. licheniformis, Staphylococcus saprophyticus*
Ogiri	South western Nigeria	Melon seeds (*Citrullus vulgaris*)	*Bacillus spp.* Predominates
Ogiri- Nwan	South eastern Nigeria	Fluted pumpkins beans (*Telferia occidentale*)	Proteolytic *Bacillus spp.*
Ogiri- Igbo (same as ogiri-agbor)	Southern Nigeria	Castor oil seed (*Ricinus communis*)	Various *Bacillus spp., B. subtilis, B. megaterium,* and *B. firmus.*
Ogiri-saro	Sierra Leone	Sesame seed (*Sessamum indicum*)	*Bacillus spp.*
Ugba	Eastern Nigeria- Igbos	Oil bean (P*entaclethra macrophylla*) cotton seeds are uused in some localities	*Bacillus subtilis, Staphylococcus* and *Micrococcus spp.*

Source: Odunfa, 1985

Fermentation Process

- The process by which ogiri is produced is termed “fermentation”. Fermentation is the process of anaerobic or partial anaerobic oxidation of carbohydrate material, during this process, enzymes elaborated by microorganism breakdown carbohydrate or carbohydrate-like material (Odunfa, 1985).
- Aniche *et al.,* (1993) reported that the microorganisms involved in the fermentation of castor oil bean for ogiri production are *Bacillus subtilis* and there were mostly predominant. Other species were *B. licheniformis, B. megaterium, and B. firmus.* All the *Bacillus* species were proteolytic and were capable of fermenting castor oil seed and producing the characteristic ogiri aroma in pure culture. The optimum pH for growth of these organisms determined by Aniche *et al.,* (1993) as 7-8 while the optimal tempretures were 30ºC for *B. subtilis and B. megaterium* and 45ºC for *B. firmus. Odunfa,* (1981) also reported similar results. However, Ogundana (1981) claimed to isolate some *Absidia corymbifera* and *Geotrichum candidum.* This looked doubtful because of the low oxygen tension and the alkaline pH of the fermenting mash which would necessarily discourage fungal growth.
- Anosike and Egwuatu, (1981) compared the fermented and unfermented seeds of castor oil plants and showed that the free amino acids – phenylalanine, tryptophan, tyrosine, serine, glutamic acid, cysteine and glutamine were present in the fermented seeds but absent in the unfermented seeds. Again, the fermented seeds contained more unsaturated fatty acids than unfermented seeds. These workers also reported that the activities of microorganisms during fermentation are probably responsible for the characteristic flavour of foods seasoned with ogiri.

Changes in Food as a Result of Fermentation

During controlled fermentation, as practiced in the food industry, the activity of microorganisms resulting from the existence of favourable environment leads to the breakdown of complex components of food molecules into simpler ones. These substances get metabolized into end products and released to the environment. Carbohydrates, protein and fats are the major components in food that are metabolized by microbes (Oyewole, 1990).

When carbohydrate or carbohydrate-like compounds are attacked by microorganisms and products such as alcohol, acid, aldehydes and ketones are released into the environment, since those compounds are only slighty more oxidisable than the original compound, they can therefore yield energy upon further oxidation. Microorganisms need a source of nitrogen for normal growth which is met by proteins in the food. Thus, microbes attack proteins in foods through proteolysis which breaks down proteinous materials to release foul smelling odour by putrefaction and smaller molecular compounds like amino acids (Oyewole, 1990). Also, according to the same author, it has reported by some workers that microbial growth encourages the synthesis of several vitamins and amino acids in order that fermented product should have an increased nutritive value than the parent substrate.

According to Achi, (2005), the pulp of Africa locust bean had more protein and ash, while the oil bean seeds had less lipids and non protein nitrogen (NPN). He further added that fermentation times had varied effects on mineral levels and that the 4 days fermentation period increased zinc, sodium and phosphorus levels except for the sodium contents in Africa locust beans.

Aniche *et al*., (1993), reported that the toxicological evaluation of the fermented ogiri from castor oil bean by the chicken embryo bioassay, showed that the initial toxicity of the beans decreased significantly but was not completely removed.

Heat processing is one of the most important methods developed by man for extending the storage life of food stuff. Due to this extended storage life, food which are abundantly available during relatively short harvesting periods are made available throughout the year. Heat processing however has a detrimental effect on nutrients since thermal degradation of nutrients can and does occur (Dirar, 1993). Thus, the decrease in the nutrient content of the food stuff as a result of the thermal process depends on the severity of the process.

Ogiri is preserved locally by wrapping in banana or plantain leaves or it is exposed to the air to sun-dry, or to heat from a fireplace, or placed beneath an earthenware pot and dried or even wrapped in cellophane or paper (Onyeibe, 2007).

Materials and Methods

- The castor oil seeds were obtained from the markets in Aniocha South local government area of Delta state, Nigeria. Similarly, ogiri made from these seeds were also bought from there and taken to the laboratories in Zaria and Kaura Namoda for production and analysis.

Figure 2: Flow Chart Showing the Laboratory Processing of Ogiri

- Castor oil seeds
- ↓
- Dehulling
- ↓
- Sorting and grading
- ↓
- Cleaning (Washing with water)
- ↓
- Boiling (18 hours)
- ↓
- Cooling
- ↓
- Fermentation for (4 days)
- ↓
- Milling/ Pounding/ Mashing
- ↓
- Addition of ash
- ↓
- Mixing
- ↓
- Ogiri paste
- ↓
- Fermentation (for 4 days)
- ↓
- Mixing with starch
- ↓
- Cutting and molding into sizes
- ↓
- Dehydration at 70^{o}C (for 17 hours)
- ↓
- Packaging
- ↓
- Ogiri – Igbo

- Source: Odunfa (1985)

Determination of Proximate Composition

The determination of moisture, protein, fat, ash, and crude fibre followed the AOAC (1980) methods.

Determination of Nitrogen Free Extract (NFE)

The nitrogen free extract was determined by difference obtained by subtracting 100 from all the nutrients measured earlier.

$$\% \text{ NFE} = 100 - (\% \text{ moisture} + \% \text{ protein} + \% \text{ ash} + \% \text{ lipid} + \% \text{ crude fibre})$$

Determination of Ascorbic Acid

5g of the sample weight was taken into a beaker, 100ml of distilled water was added to release vitamin C. 5ml of the the filtrate was taken and 20ml of distilled water was added as wellas 1ml of 1% starch. It was titrated rapidly with an accurately standardised 0.01N iodine solution containing 16g potassium iodide per litre. Each milliliter of iodine is equivalent to 0.88mg of ascorbic acid in lactone form.

The concentration of ascorbic acid is determined as follows

$$\text{Ascorbic acid (mg/100g)} = \frac{Tv \times 0.88}{5} \times 100$$

Where,

Tv = Titre value

0.88 = Millilitre of iodine equivalent to 0.88mg ascorbic acid

5 = Millilitres of filtrate taken

100= % conversion

Sensory Evaluation

12 panelists conversant with the condiment were selected and briefed about the aim of the test and how it should be be conducted . they were also instructed on the attributes of the samples to be assessed on their questionnaires. The panelists who were drawn from Federal polytechnic Kaura Namoda were then presented with samples labeled BSF and AZD representing the prepared dehydrated ogiri condiment and the market undehydrated ogiri condiment respectively in the sensory evaluation laboratory of the department of Food Science and Technology. The attributes of the samples to be evaluated were

- Colour
- Texture
- Aroma
- Taste
- Overall acceptability

The score sheet that was designed required the panelists to indicate their preference based on the 9-point hedonic scale. The results obtained were analysed statistically to determine significant difference using the student's t test.

Physical Storage Profile

The laboratory prepared dehydrated ogiri condiment was further subjected to storage for 20 days. After every 4 days, 6g of the samples were weighed to determine either weight loss or gain and then examined for signs of mold growth or taste or aroma changes.

Results and Discussion

Table 2: Proximate Composition of Raw and Fermented Castor Oil Seed (*Ricinus communis*)[1]

	Moisture (%)	Fat (%)	Ash (%)	Protein (%)	N.F.E (%)	Crude Fibre (%)	Vitamin C (mg/100g)
Prepared (Dehydrated) Ogiri Condiment	12.86	24.72	2.15	29.32	30.09	0.86	19.36
Market (Undehydrated) Ogiri Condiment	20.47	31.83	2.90	23.74	20.18	0.88	22.80
Raw Castor Oil Seed	2.60	55.02	1.91	7.05	32.40	1.02	26.40

[1]Each result represents means of triplicate samples

From the table, ogiri condiment of low moisture content (12.86%) compared favourably with the market undehydrated ogiri having 20.47% moisture. This value falls below the reported values of ogiri made from melon seeds and those made from African locust beans as 44.1 % and 52.0 % respectively by Omafuvbe *et al.,* (2004). This implies that, the dehydrated ogiri will have longer shelf-life because of reduced microbial spoilage occasioned by the depressed moisture content.

The protein content of the dehydrated ogiri (29.32%) is higher than the market undehydrated ogiri with 23.74%. reasons for this may not be unconnected to improved fermentation process which the castor bean seed may have undergone. Steinkraus (1995) had reported that fermentation leads to enrichment of food nutrients.

Achi (2005) observed that a 4 days fermentation period for castor oil seeds caused the highest increases in protein and tannin as well as decreases in ash, lipids and also non-protein nitrogen (NPN). This agrees generally with the result obtained in the study.

The vitamin C content of the prepared dehydrated ogiri condiment was 19.36mg/100g while those for the raw castor oil seed and the market undehydrated ogiri condiment were 26.40mg/100g and 22.80mg/100g respectively. It seems that because of the heat labile nature of vitamin C, the reduced value of ascorbic acid may not be unconnected to the drying process. However, this loss only represents15% less than that of the undehydrated market ogiri. Dirar, (1993) also agrees when he reported that heat processing has a detrimental effect on nutrients.

Table 3: Sensory Evaluation Result of Prepared Dehydrated Ogiri Condiment and Market Undehydrated Ogiri Condiment

Attribute	Calculated T score[3]	Tabulated T score[3]	Remark
Texture	2.444	2.074	S.D[1]
Colour	1.053	2.074	N.S.D[2]
Aroma	1.282	2.074	N.S.D[2]
Taste	1.515	2.074	N.S.D[2]
Overall Acceptability	3.458	2.074	S.D[1]

[1]S.D: Significant difference at $P \leq 0.05$
[2]N.S.D: Not significant difference at $P \leq 0.05$
[3]Each result was calculated from 12 judges

Table 3 above shows the results of the student's t test conducted on the results of the organoleptic studies between the prepared dehydrated ogiri condiment and the market undehydrated ogiri condiment.

In terms of the texture of the two condiments, a signifificant difference exists between the two since the calculated T score of 2.444 > the tabulated T score of 2.074 at $P \leq 0.05$. Thus the texture profile of the prepared dehydrated ogiri condiment was preferred to that of the market undehydrated ogiri condiment.

For colour, no significant difference exists between the two condiments since the the calculated T score of 1.053 < the tabulated T score of 2.074 at $P \leq 0.05$. Thus the colour of the prepared dehydrated ogiri condiment was not superior to that of the market undehydrated ogiri condiment. The conclusion for the aroma and taste profiles of the prepared dehydrated ogiri condiment and the market undehydrated ogiri condiment
mirror those for the colour profiles since the calculated T score of 1.282< the tabulated T score of 2.074 and the calculated T score of 1.515< the tabulated t score of 2.074 for aroma and taste respectively.

The result for the overall acceptability shows that at $P \leq 0.05$, a significant difference exists between the prepared dehydrated ogiri condiment and the market undehydrated ogiri condiment because the calculated T score of 3.458> the tabulated T score of 2.074. Therefore, we conclude that the prepared dehydrated ogiri condiment was preferred to the market undehydrated ogiri condiment.

Table 4: The Physical storage profile of the prepared dehydrated ogiri Condiment at Room Tempreture

Parameters	Weight (g)	Mould growth (Physical observation)	Taste	Aroma
Days				
4	6	No growth	Normal	Normal
8	6	No growth	Normal	Normal
12	6	No growth	Normal	Normal
16	6	No growth	Normal	Normal
20	6	No growth	Normal	Normal

Table 4 shows the physical storage profile of the prepared dehydrated ogiri condiment. At the end of the storage period, the ogiri condiment still maintained its original weight. Also, the physical examination of the condiment for signs of moulds proved negative. Furthermore the examination of the ogiri condiment for changes in the taste and aroma also proved negative. Thus we conclude that drying the ogiri condiment prevented or discouraged microbial growth and had no deleterious effect on taste or aroma of the condiment when stored at room tempreture for 20 days.

Conclusions and Recommendation

- Results of proximate composition shows that the laboratory prepared dehydrated ogiri condiment had lower moisture content, reduced fat, ash, crude fibre and vitamin C contents over the market undehydrated ogiri condiment but this was counterbalanced by the increased protein and carbohydrate contents. From sensory evaluation studies, the laboratory prepared dehydrated ogiri condiments had a better texture and in terms of its overall acceptability was preferred over the market undehydrated ogiri condiment. This fact was further buttressed during storage studies which showed no growth of molds, no increased or decreased weight, no change in taste or aroma when the condiment was stored for 20 days.

- We therefore conclude that an improvement in the production of ogiri can be achieved if the condiment is produced according to the method followed for the laboratory processing of the condiment because it increases nutrient content particularly protein, has improved storage stability while maintaining flavour and aroma properties.

- Food fermentation continues to be important primarily in developing countries where the lack of resources limits the use of techniques such as vitamin enrichment of food and the use of energy and capital intensive processes for food preservation (Cooke *et al.,1987*). The onus thus lies in researchers' ability in developing equipments and processes that are of low cost and low energy utilization so that the drudgery associated with ogiri condiment processing would be eliminated. To achieve this, a collaborative approach is necessary between the researchers in institutions and research organs and national and international donor bodies or organs as well as government bodies and organs.

- Today, in Nigeria, the European Union (EU) in her global warming initiative has credited the Yobe state government with a carbon credit of ₦2 billion (about €10.74 million) because of the state government's plan to engage 100,000 farmers to cultivate in excess of 10,000ha of land to castor oil plant. This is because castor oil plant can has the ability to reduce carbon dioxide emissions to the atmosphere Idris, (2009).

- Thus increases the need for the collaborative effort of scientists to work in conjunction with governments and donor agencies to develop a means of utilizing the seeds for food so that the farmers can generate revenues from its cultivation as a means of reducing carbon dioxide emissions as well as provide appropriate foods for these essentially resource poor farmers increases and indeed becomes important if our goal of ensuring food security is to be achieved.