Comparative study of quality attributes and acceptability of ogiri: a condiment made from melon seeds, soya beans and African yam beans

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Abstract: Condiment has been in use from time immemorial to impact or improve food flavour and acceptability among ethnicity. This study investigated quality attributes and acceptability of 'ogiri', a condiment made from melon seeds, soya beans and African yam beans (AYB). Ogiri was produced from melon seeds, soya beans and African yam beans using the traditional processing method. Laboratory analyses were carried to evaluate proximate and chemical composition, antioxidant, microbial load, and sensory characteristics of the samples. The results showed a decrease in the moisture content of the samples after fermentation into ogiri was observed in the undehulled boiled seeds. The protein contents (%) were 9.86, 6.88 and 10.32 for dehulled boiled seeds; 9.97, 6.91 and 10.22 for undehulled boiled seeds, respectively. The fat contents (%) were 40.27, 26.88 and 12.00 for dehulled boiled seeds; 39.24, 27.02 and 11.38 for undehulled boiled seeds, respectively. The total energy supply by melon Ogiri was higher than soybean and AYB Ogiri. Flavonoid, alkaloids and total carotene content of melon Ogiri was higher than soybeans and AYB, while soybean Ogiri has more total phenol than melon and AYB Ogiri. Microbial load of AYB was lower than soybean and melon Ogiri, respectively. Sensory attributes showed that significant differences ($p<0.05$) existed among the various samples of the ogiri. Colour of melon ogiri was the most preferred by the judges followed by samples from soya beans and AYB, respectively. Melon ogiri gave the preferred aroma ($P<0.05$), while soybean Ogiri has the higher overall acceptability. The study showed that both melon and soybean Ogiri if hygienically produced would be accepted for Ogiri production.

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Key words: Condiment, food flavour, ogiri, overall acceptability, quality attributes.

Introduction

Food plants are the most important dietary sources for meeting the nutritional needs of majority of the population in Nigeria (Achi, 2013; Okafor *et al.,* 2015). Enujiugha (2009) reported that in spite of the variety and diversification to diets, malnutrition would only be curbed if indigenous food production, capacity and knowledge of the nutritional value of some local foods and their production improve drastically. Among these local foods include seasonings; over 500 seasonings are made up from plants; some are cultivated while some are grown wild (Iwuoha and Eke, 1996; Achi, 2013). Seasoning, such as condiment, herb and spice are something used to add taste or flavour to food. There are over 2,000 known food seasonings in Africa and most of them are derived from plants and valued for their bulking effects, while others may be used for garnishing or spicing foods (Chukwu *et al*., 2010; Okafor *et al.,* 2015). Seasonings are of two types; fermented food seasonings or local seasonings are those food seasonings which undergo traditional food processing method that involves biochemical changes brought about by microbes inherent in grain or derived from a starter culture and their enzymes (Beaumont 2002; Sanni *et al*., 2002; Achi, 2005).

Traditional fermented seasonings used in Nigeria includes African oil bean (*Pentadethra macrophylla*), ogiri (a fermented melon, soybean, or African yam bean paste), African locust bean (Dawadawa), and Okpeye (*Prosopis africana*) (Achi, 2013; Okafor *et al.,* 2015). Traditional preparation of Ogiri from selected legumes (melon seed, soya bean, African yam bean) is by the method of uncontrolled solid state fermentation (Achi, 2005) and it involves boiling the raw seeds after which they are dehulled, and then boiled again to soften seeds for fermentation. The softened seeds are wrapped in leaves, kept in sacks and 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 of the selected legumes (melon seed, soya bean, African yam bean) from the cotyledons and it requires an abrasive action. This abrasive removal of the testa/hulls is carried out manually and because of its tedious nature, the locals have resorted to dehulling the boiled seeds with the aid of the bare feet as this is easier and faster. However, this method of dehulling may introduce a myriad of organisms into the seed prior to fermentation (some of which could be pathogenic and/or spoilage). This development coupled with an unhygienic fermentation and environment of preparation could result in the production of an ogiri with variable quality and unacceptable aroma, short shelf-life and one that can pose health hazards to the consumers (Achi, 2013; Okafor *et al.,* 2015).

Various studies have been documented on ogiri, viz: microbiology and amino acid composition of ogiri (Odunfa, 1981; Achi, 2013; Okafor *et al.,* 2015), the biochemical changes taking place during the production of ogiri (Odunfa, 1983; Achi, 2013; Okafor *et al.,* 2015). Microbiology of ogiri production (Odunfa, 1981, 1983, 1985; Barber and Achinewu, 1992; Aniche, 1993; Achi, 2013, Okafor *et al.,* 2015) and soluble nutrient production during the fermentation of selected legumes (melon seed, soya bean, African yam bean) varieties into ogiri using different leaf types (Achinewhu, 1983; Aniche, 1993; Achi, 2005) to mention a few. However, there has been no work documented on the ogiri obtained from soya beans and African yam beans and hence, the need for the dehulling process of boiled selected legume seeds during ogiri preparation, considering its unhygienic nature as carried out by the traditional producers (Achi, 2013). Research have shown that local spices includes condiments are more nutrients dense and serve more functional food than industrially produced seasoning. It is imperative therefore, to compare quality attributes and acceptability of “ogiri” made from melon seed, soybean and African yam beans.

Materials And Methods

Source of seeds and preparation of ogiri

The seeds of melon, and soybean were procured from Owode (local) market, Offa, Kwara State, while African yam bean was obtained from experimental farm field, Federal Polytechnic, Offa, Kwara State, Nigeria.

Preparation of ogiri

The seeds were sorted to remove grit, dirt and winnowed. The sorted seeds were washed and boiled for one hour in 10 times its volume of water. Then the water was drained and replaced with another after which the seeds were boiled again for about six hours until the seeds were soft. The seeds of melon seed, soybean, and African yam bean were transferred into leaves and wrapped with jute bag respectively for five days. The samples were milled (using locally made attrition machine) to paste and kept at – 4^{o}C for further analyses.

Chemical analysis of the Ogiri samples

Proximate composition (moisture, crude protein, fat, crude fibre and ash contents) of the samples were determined by using AOAC method (2002), while carbohydrate or nitrogen free extract content samples was calculated by difference.

Antioxidants determination

Lycopene, total flavonoids, total phenol, total carotene, and alkaloids were determination using the method described by Pearson (1991).

Microbial load determination

The method of Harrigan and MacCance (1982) was used to determine the total plate counts, while coliform counts were determined according to Hartman (1985) method. The method of Raper and Fennell (1973) was used to determine the mould count, while the method of AOAC (2002) was used to determine the incidence of *enterobacter species* in the samples.

Sensory Evaluation

Sensory evaluation of Ogiri produced from the melon seed, soybean, African yam bean samples was determined using the method of Iwe (2002). Twenty semi-trained panellists consisted the students and workers of Federal Polytechnic Offa, Nigeria who are conversant with condiment were selected and briefed about the aim of the experiment. The panellists were instructed to rate the samples for colour, aroma, texture and overall acceptability. The ratings were presented on a nine-point Hedonic Scale ranging from like very much (9 points) to dislike very much (1 point).

Statistical analysis

The data were collected in triplicates and means were compared statistically with IBM SPSS (Version 21.0). One-way ANOVA was done using Duncan’s Multiple Range Test ($p \leq 0.05$) to study the difference between means.

Results And Discussion

Table 1 showed the results of proximate composition of ogiri obtained from dehulled boiled seeds and undehulled boiled seeds of melon seeds, soya beans and African yam beans which were fermented. The values obtained moisture contents (%) were44.78, 60.53 and 66.00 for dehulled boiled seeds and 44.70, 60.22 and 65.10 for undehulled boiled seeds, respectively. A decrease in the moisture content of the samples after fermentation into Ogiri was observed in the undehulledboiled seeds. The moisture contents of the ogiri samples were very high but samples from melon had lower moisture contents than other samples. This agreed with previous works of Odunfa, 1985, Achi, 2005, Enujiuwa, 2009, Achi, 2013 and Okafor *et al.,* 2015. The protein contents (%) were9.86, 6.88 and 10.32 for dehulled boiled seeds and 9.97, 6.91 and 10.22 for undehulled boiled seeds respectively. Ogiri samples from African yam beans either dehulled or undehulled had highest crude protein followed by melon seeds and soya beans with the least values, however, these values were lower than those of the unprocessed seeds of the three legumes. The results agreed with the findings of Enujiuwa, 2009, Achi, 2013 and Okafor, *et al.,* 2015 and ogiri as a condiment could be used to improve protein intake in Nigeria and thereby help in reducing protein deficiency.

The decrease observed in crude protein content of ogiri from the three legumes had been attributed to a high proteolytic activity of the fermenting organisms, generating free amino acids (Dakwa *et al*., 2005; Dajanta *et al*., 20011). However, some of the free amino acids might have been used up in cell generation and possibly for aroma, flavour and texture development in a reaction with other components. Steinkrans (1985) reported that in most fermented high-protein products, the extent of protein hydrolysis was one of the most important factors in texture and flavour changes. Also, an increase was observed in the NFE levels of the samples from the three legumes.

The fat contents (%) were40.27, 26.88 and 12.00 for dehulled boiled seeds and 39.24, 27.02 and 11.38 for undehulled boiled seeds respectively. These values were lower than those of their corresponding unprocessed seeds. In addition, the decrease observed in fat content may also be attributed to the breakdown of fat into free fatty acids, some of which might have been used in flavour and aroma development when in reaction with other components of the mash to form esters which produced the characteristics aroma of the food. Kim and Lee (2003), Han *et al*. (2004), and Achi (2005; 2013) reported beneficial effects of lipase in the development of characteristics flavour and aroma of foods, while Kpikpi *et al*. (2009) reported that an increase in lipase activity was observed in the fermentation of boiled melon seeds. However, it was observed that undehulled samples had higher crude fibre and ash when compared with the same ogiri obtained from the dehulled boiled seeds. This may be attributable to the high crude fibre contents of the seed coat.

Table 1: Chemical composition of the ogiri samples

Proximate components (%)		Melon Ogiri	Soybean ogiri	AYB ogiri
Moisture	Dehulled seeds	44.78±2.01^{a}	60.53±3.89^{a}	66.00±0.67^{a}
	Undehulled seeds	44.70±1.23^{a}	60.22±2.45^{a}	65.10±3.41^{a}
Crude protein	Dehulled seeds	9.86±0.09^{a}	6.88±0.12^{a}	10.32±0.41^{b}
	Undehulled seeds	9.97±0.38^{a}	6.91±0.34^{a}	10.22±0.56^{a}
Crude fat	Dehulled seeds	40.27±1.40^{a}	26.88±0.23^{a}	12.00±0.34^{b}
	Undehulled seeds	39.24±2.82^{a}	27.02±0.05^{b}	11.38±0.11^{a}
Crude fiber	Dehulled seeds	2.06±0.02^{a}	1.22±0.01^{a}	1.79±0.36^{a}
	Undehulled seeds	2.48±0.33^{b}	1.31±0.14^{b}	1.83±0.00^{a}
Total Ash	Dehulled seeds	2.46±0.42^{a}	2.66±0.54^{a}	3.21±0.07^{b}
	Undehulled seeds	2.79±0.10^{b}	2.65±0.22^{a}	3.11±0.05^{a}
NFE	Dehulled seeds	4.57±0.87^{a}	11.83±0.30^{a}	6.68±0.09^{a}
	Undehulled seeds	5.32±0.02^{b}	11.89±0.38^{a}	8.36±0.47^{b}

All data are means of triplicate results; means with the same superscripts are not significantly difference at p>0.05.

Table 2: Antioxidant content of the ogiri samples

Antioxidants		Melon Ogiri	Soybean ogiri	AYB ogiri
Lycopene (µg/kg)	Dehulled seeds	0.75±0.10^{a}	ND	ND
	Undehulled seeds	0.75±0.08^{a}	ND	ND
Flavonoids (µg/kg)	Dehulled seeds	660.07±1.50^{b}	369.71±3.27^{a}	66.01±1.83^{a}
	Undehulled seeds	658.88±4.12^{a}	378.49±4.39^{b}	66.41±1.55^{b}
Total Phenol (µg/kg)	Dehulled seeds	651.49±2.95^{a}	1454.37±2.32^{b}	239.60±4.10^{b}
	Undehulled seeds	664.10±2.77^{b}	1396.67±2.07^{a}	233.71±5.53^{a}
Total carotene (%)	Dehulled seeds	8.77±0.73^{b}	5.11±0.49^{a}	2.86±0.10^{b}
	Undehulled seeds	8.49±0.48^{a}	5.19±0.10^{b}	2.69±0.18^{a}
Alkaloid (%)	Dehulled seeds	4.99±0.19^{b}	2.77±0.00^{a}	2.95±0.00^{b}
	Undehulled seeds	4.77±0.28^{a}	2.86±0.32^{b}	2.78±0.20^{a}

All data are means of triplicate results; means with the same superscripts are not significantly difference at p>0.05. ND: not determined; AYB: African yam beans.

Table 2 showed the results of lycopene, flavanoids, total phenol, total carotene and alkaloid content during fermentation of dehulled and undehulled boiled melon seeds, soya beans, African yam beans into ogiri. There was steady pH increase throughout the period of fermentation and this was in accordance with the observations of Omafuvbe *et al.* (2004) in *iru* and *ogiri* production, and Odunfa (1981) in ogiri production, respectively. During the natural fermentation of the three legumes (*melon seeds, soya beans, African yam beans*) to produce ogiri, different groups of microorganisms were isolated, characterized and counted.

The occurrences of these isolates in samples of the three legumes (*melon seed, soya bean, African yam bean*) at the different periods of fermentation are presented in Table 3. The isolated organisms increased in number as fermentation progressed. The mould count of samples from melon seeds was significantly higher than that of samples from soya beans and from African yam beans. Also, *Enterobacteria* species and Coliform count became decreasingly obvious from samples from melon seeds to samples from soya beans and from African yam beans. However, there were fluctuations in the values of total plate count in Samples from melon seeds, soybean and African yam beans.

Table 3: Microbiological load of the ogiri samples

Microbial count C x 10^5cfu/ml	Melon ogiri	Soybean Ogiri	AYB ogiri
Total plate count	6.3 ± 0.11^c	4.9 ± 0.19^c	8.1 ± 0.18^c
Coliform count	2.8 ± 0.00^b	1.2 ± 0.22^a	1.1 ± 0.00^a
Mould count	1.2 ± 0.18^a	2.1 ± 0.16^b	4.3 ± 0.12^b
*Enterobacteria*spp	7.4 ± 0.21^d	5.2 ± 0.42^d	4.3 ± 0.22^b

All data are means of triplicate results; means with the same superscripts are not significantly difference at p>0.05. C: Microbial count.

The sensory evaluation, Table 4 showed that significant differences exist among the various samples of ogiri from melon seeds, soya beans and African yam beans. Among the ogiri samples, the colour of ogiri (melon seeds) was the most preferred by the judges followed by samples soya beans and the least samples from African yam beans. The colour may have been developed by the microbial activity during the fermentation process. Samples from melon seeds gave the preferred ogiri aroma at ($P \leq 0.05$).

Table 4: The sensory evaluation of ogiri made from melon seeds, soya beans and African yam beans

Sensory parameters	Melon Ogiri	Soybean ogiri	AYB ogiri
Colour	7.8 ± 0.13^d	6.2 ± 0.10^c	5.7 ± 0.19^b
Aroma	7.3 ± 0.00^c	5.6 ± 0.09^a	5.2 ± 0.15^a
Texture	6.7 ± 0.21^a	6.1 ± 0.10^b	6.0 ± 0.22^c
Overall acceptability	7.1 ± 0.30^b	6.4 ± 0.00^d	6.2 ± 0.17^d

All data are means of triplicate results; means with the same superscripts are not significantly difference at p>0.05.

Conclusion

The study showed that ogiri from melon seeds, soya beans and African yam beans has high protein and fat content which may improve the nutrition of children and other vulnerable groups if judiciously used. It was also observed that there was a significant increase in other soluble nutrients liberated during fermentation of melon seeds, soya beans and African yam beans for ogiri production, thereby increasing the digestibility and absorption of the products.

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