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Production and Quality Assessment of Local Condiment 'Ogiri' from Watermelon Seed (*Citrullus lanatus*) and Melon (*Citrullus vulgaris*)

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Abstract

Ogiri, a traditional food condiment was prepared from watermelon seed+melon seed (50:50), 100% melon seed, 100% watermelon seed and were investigated for their physicochemical properties. Results from the fermented mass showed that ogiri from watermelon seed+melon had pH 7.2, melon ogiri (7.57), watermelon seed ogiri (7.82), TTA values (1.31%-1.85%) while total viable count ranged from 5.3x108 cfu/g-3.0 x109 cfu/g. Proximate composition of ogiri samples include; moisture content (50.93%-52.84%), ash (1.06%-1.81%), protein (17.85%-21.97%), fat (22.01%-27.44%), fibre (1.08%-1.27%) and carbohydrate (0.10%-2.22%). Melon ogiri was found to be richer in phytate (48.64 mg/g), saponin (11.59%), flavonoid (5.16%) while higher content of tannin (0.25 mg/100g) and total phenol (2.23 mg/100g) were detected in watermelon seed ogiri. Results further showed that all the ogiri samples exhibited free radical scavenging ability (5.09%-11.14%). Consumer acceptability scores revealed that melon ogiri was more acceptable than watermelon seed+melon ogiri and watermelon seed ogiri, but all samples were rated above average. It may be concluded that watermelon seed can be employed in ogiri production instead of discarding it as a waste.

Keywords: 'Ogiri'; Physicochemical properties; Watermelon seed

Introduction

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 [1]. 'Iru' or 'Dawadawa' are obtained from fermented African locust bean seed, while the seeds of melon *Citrullus vulgaris* are fermented to produce 'Ogiri' [2,3]. 'Ogiri' possesses very strong pungent odour and organoleptic properties which depend on microbial activities on the melon seed during the traditional solid substrate fermentation. Watermelon is a well-known cucurbit crop contributing about 7% to world vegetable production [4]. Members of *Cucurbitaceae* family contain bioactive compounds which include; cucurbitacin, triterpenes, sterols and alkaloids [5]. Watermelon seed is reported to be very rich in protein (35%), oil (50%), dietary fiber (5%), essential and non-essential amino acids, vitamins, antioxidants, minerals and phytochemicals [6,7]. The seed have been employed in production of cookies [8-10]. However, watermelon seeds can still be regarded as underutilized and discarded as waste which may constitute nuisance and a source of pollution.

Several research findings have been reported on production of 'Ogiri' from a number of legumes and oil seed crops [1,11-16]. We therefore carry out this work to investigate the physicochemical property and quality assessment of 'Ogiri' produced from fermented melon, watermelon seed and mixture of watermelon seed and melon.

Materials and Method

Sample Procurement and Preparation

Fresh watermelon (*Citrullus lanatus*) and shelled melon seeds (*Citrullus vulgaris*) were bought from a Sasa market in Akure, Ondo State, Nigeria. All other chemicals used in this research were of analytical grade. Watermelon fruits were sliced open and the seeds were manually separated from the pulp. The seeds were washed with portable water to remove adhering pulp, dried at 45 °C in an oven for 1 hour and were manually shelled to obtain the dehulled seed. (Table 1) shows the proportion of watermelon seed and melon seed subjected to natural fermentation to produce 'Ogiri'.

Samples	Watermelon seed (g)	Melon seed (g)
WM	50	50
M	0	100
W	100	0

Table 1: Composition of samples.

Preparation of 'Ogiri' was done according to the method described by Omafuvbe, et al. [13], David, et al. [16]. Samples WM, M, and W, were separately washed and boiled for 1 hour in 10 times its volume of water. Then the water was drained and replaced with another after which the seeds were boiled for 4 hours until the seeds became soft. Samples were transferred into a calabash lined with *Thaumatococcus danielii* and wrapped with jute bag for 5 days. After fermentation, samples were dried at 50 ˚C in the oven, milled in a kitchen blender, packaged in airtight containers, labeled and kept in the refrigerator for further analyses.

pH and Total Titratable Acidity Determination

Two grams of 'Ogiri' made from watermelon seed, watermelon seed+melon and melon was homogenized in a blender with 20 ml of distilled water and the pH of the homogenate was read using a pH meter (Model 401). Total titratable acidity was determined by dissolving 2 g of the fermented mass into 20 ml distilled water and titrated against 0.1 M NaOH using phenolphthalein as an indicator. The result was expressed as percentage lactic acid present in 'Ogiri' sample [17].

Determination of Total Plate Count of 'Ogiri' Samples

The total plate count was determined following the standard method of the American Public Health Association [18]. Twenty-five grams of 'Ogiri' was mashed using a sterile mortar and pestle. It was transferred into 225 mL of sterile diluents, mixed thoroughly and serial dilution was performed. 1 mL of the mixture was taken from the appropriate dilutions and dispensed into sterile Petri dish while 20 ml sterilized nutrient agar was added and swirled for proper mixing. It was allowed to gel and plates were incubated at 37 ˚C in inverted position.

Determination of Proximate Composition of 'Ogiri'

The proximate analysis of fermented mass which include; moisture, total ash, crude fat, crude protein, and crude fibre was carried according to the method described by AOAC [17].

Determination of Antioxidant and Phytochemical in Ogiri Samples

Total Phenolic Compound Determination

About 0.5 ml of the extract from 'Ogiri' sample was added to 0.5 ml of Folin-Ciocalteau reagent after which 7.5% solution of sodium carbonate was added. The mixture was stirred and allowed to stand for 30 min, the absorbance was measured at 765 nm using a model UV/VIS 1201 spectrophotometer (Shimzdau, Kyoto, Japan). A blank was prepared by replacing the sample with water and was used as a reference. The result was expressed as mg of gallic acid per gram [19].

Determination of Flavonoid in 'Ogiri'

About 1 g of 'Ogiri' was weighed into a conical flask with 50 ml of 80% methanol. The content was subjected to extraction by placing it on a hot plate at a low temperature for 30 min. About 0.2 ml of the extract was added to 0.3 ml of 5% $NaNO_3$, 5 min later, 0.6 ml of 10% $AlCl_3$ was added and after 6 min, 2 ml of 1M NaOH was added to the mixture together with 2.1 ml of distilled water. Absorbance was measured at 510 nm against the reagent blank and flavonoid was expressed as mg rutin equivalent [20].

Determination of DPPH Free Radical Scavenging Ability of 'Ogiri'

Ability of 'Ogiri' sample to scavenge free radical was determined by subjecting it to test with 1,1Diphenyl-2-Picryhydrazyl (DPPH) [21]. One millilitre of the extract was mixed with 1 ml of 0.4 Mm methanolic solution of DPPH radicals. The reaction mixture was left in the dark for 30 min and the absorbance was read at 517 nm. The DPPH free-radical-scavenging ability of the sample was calculated.

Determination of Tannin Content of 'Ogiri'

About 0.2 g of 'Ogiri' sample was added into 10 ml aqueous acetone, bottles were then covered, placed in an ice bath shaker for 2 hours at 30 ˚C, centrifuged and the supernatant was kept in ice. About 0.2 ml of this was dispensed into the test tube and 0.8 ml of distilled water was added. Standard tannic acid solution, 0.5 ml of Folin Ciocateau reagent and 2.5 ml of 20% Na_2CO_3 were added to the mixture. The solutions were vortex, placed in the incubator for 40 min at room temperature and absorbance was read at 725 nm against a reagent blank [22].

Determination of Phytate Content of 'Ogiri':

Four grams of 'Ogiri' was soaked in 100 ml of 2% HCl for 3 hours and filtered through a No 1 Whatman filter paper. Twenty-five milliliter of the filtrate was taken and 5 ml of 0.3% of ammonium thiocyanate solution was added as indicator, after which 53.5 ml of distilled water was added to give it the adjust the acidity. This was titrated against standard iron (lll) chloride solution that contained about 0.00195 g of iron per milliliter until a brownish yellow colour was observed [23].

Determination of Saponin Content of Ogiri

About 2 g of sample was weighed into a beaker while 100 ml of N-butanol acid was added and the mixture was placed in the shaker for 5 hours to ensure proper mixing. It was filtered with No 1 Whatman filter paper into a beaker containing 20 ml of 40% saturated solution of magnesium carbonate. The mixture obtained was again filtered to obtain a clean clear solution. One milliliter

of this was added to 2 ml of 5% iron (III) chloride ($FeCl_3$). It was allowed to stand for 30 min for the development of color and the absorbance was read against the blank at 380 nm [24].

Sensory Evaluation of Ogiri Samples

'Ogiri' samples were subjected to consumer acceptability test using twenty-two panelists. Samples were evaluated for appearance, colour, taste, odour and overall acceptability using a nine-point Hedonic scale where 1 represents "Extremely dislike" and 9 "Extremely like" respectively [25].

Statistical Analysis

Results were expressed as the means of three separate determinations. The data were subjected to Analysis of Variance (ANOVA) using the Statistical Package for Social Statistics (SPSS version 12). Means were separated using the Duncan's new multiple range test.

Results and Discussion

pH and Total Titratable Acidity (TTA) of 'Ogiri' Samples

The pH of ogiri made from watermelon seed+melon, melon and watermelon seed ranged from 7.42-7.82 and the TTA were from 1.31%-1.85% (Table 2). pH of 'Ogiri' samples in this study were found to be within the ranges reported in the literatures [1,16]. The pH of 'Ogiri' from watermelon seed displayed the highest value (7.82) and was significantly different from ogiri from watermelon seed+melon (7.42) and ogiri from melon (7.57). This may be explained from the fact that protein content of watermelon seed (35.7%) is higher than that of melon (23.4%) as reported by El-Adawy, et al. [6] and Ojieh, et al. [26] respectively. Alkaline pH recorded from fermented oil seeds have been attributed to higher protein contents of the seeds. Ammonia is released as a result of the proteolytic activity taking place during fermentation which raises the pH of the condiment and resulted in a strong odour and flavor desired [1,11].

Ogiri samples	pH	TTA (%)
Watermelon+melon ogiri(50:50)	7.42 ± 0.00^{b}	1.31 ± 0.03^{b}
Melon ogiri (100%)	7.57 ± 0.02^{b}	1.71 ± 0.10^{a}
Watermelon ogiri (100%)	7.82 ± 0.06^{a}	1.85 ± 0.03^{a}
Mean with the same superscript within the column are not significantly different at p>0.05.		

Table 2: pH and total titratable acidity of 'Ogiri' from watermelon seed+melon, melon and watermelon seed.

Microbial Count for 'Ogiri'

Table 3 shows the total plate count on nutrient agar for ogiri from watermelon+melon ($5.3x10^8$ cfu/g), melon ogiri $7.0x10^8$ cfu/g, ogiri from watermelon ($3.0x10^9$ cfu/g) and fungal count ($3.5x10^6$ cfu/g-$5.5x10^6$ cfu/g). Azu [27] described total viable count as the total number of living cells in a substrate. The desired flavour and aroma obtained from local fermented condiments can be attributed to the proteolytic action of the microorganisms on the oil seed. In local fermented foods, microorganisms play major roles in the preparation and preservation of the food products [15]. Fermented foods possess several nutritional benefits to the consumer and as well protect the food against food spoilage organisms [28].

Ogiri samples	Total viable count	Fungal count
Watermelon+melon ogiri (50:50)	$5.3x10^8$	$3.5x10^6$
Melon ogiri (100%)	$7.0\ x10^8$	$5.5x10^6$
Watermelon ogiri (100%)	$3.0\ x10^9$	$3.5x10^6$

Table 3: Microbial count (cfu/g) for 'Ogiri' from watermelon seed+melon, melon and watermelon seed.

Proximate Composition of Watermelon Seed+Melon, Melon and Watermelon Seed Ogiri

The moisture content of ogiri samples are significantly different with highest moisture content of 52.84% from watermelon seed ogiri, 51.83% from melon ogiri and 50.93% from ogiri made from watermelon seed+melon (Table 4). The percentage ash content ranged from 1.06%-181%. Ogiri from the mixed seeds had the highest ash content of 1.81% and ogiri made from watermelon seeds had the lowest ash content of 1.06%. The values recorded in this study are lower than those reported by David, et al. [16]. Protein content of the watermelon seed was the highest (21.97%), followed by ogiri from watermelon seed+melon (17.95%) and 17.85% from melon ogiri.

Samples	Moisture	Ash	Protein	Fat	Fiber	Carbohydrate
WM	50.93±0.02^{c}	1.81±0.00^{a}	17.95±0.00^{b}	26.01±0.04^{b}	1.08±0.02^{b}	2.22±0.03^{a}
M	51.83±0.00^{b}	1.51±0.01^{b}	17.85±0.02^{b}	27.44±0.01^{a}	1.27±0.00^{a}	0.10±0.00^{c}
W	52.84±0.01^{a}	1.06±0.00^{c}	21.97±0.00^{a}	22.01±0.01^{c}	1.24±0.01^{a}	0.88±0.02^{b}
Means with the same superscript within the column are not significantly different at p>0.05. WM= Watermelon seed+melon (50:50); M=Melon (100%); W=Watermelon (100%)						

Table 4: Proximate composition (%) of ogiri from watermelon seed+melon, melon and watermelon seed.

It was observed that there were reductions in the protein content of seeds during fermentation as reported by David, et al. [16]. The changes in nutrient composition during ogiri production could have been as a result of the enzymatic activities of the fermenting organisms [14]. In addition, the decrease in amount of soluble protein and carbohydrate correlated with increase in population of *Bacillus spp.*, which may suggest utilization of nutrient by the organism [16]. Fat content of ogiri samples ranged from 22.02%-27.04% and significantly different. This could be as a result of differences in the fat content of the seeds [29]. The decrease in the fat content of ogiri may be as a result of leaching of oil into the water during boiling of the seeds as reported by Odunfa [11]. Furthermore, during fermentation, microorganisms break down fat into free fatty acids some of which might have been responsible for the flavor and aroma exhibited by the condiment [14].

Antioxidant and Phytochemical Properties of Ogiri

The results of phytochemical content of ogiri revealed that they have high amount of phytate (15.69 mg/g-48.64 mg/g), saponin (6.34%-11.50%) but low tannin (0.12 mg/g-0.25 mg/g) (Table 5). Antioxidant properties of ogiri samples showed that total phenol content ranged from 1.04 mg/100 g-2.23 mg/100g, flavonoid (3.85%-5.16%) and ability to scavenge free radicals (DPPH) were from 5.09%-11.14%. Watermelon ogiri had highest value of total phenol (2.23 mg/100 g), melon ogiri yielded highest content of flavonoids (5.16%) and ability to scavenge free radicals (11.14%). It may be explained that the ability of melon ogiri to exhibit highest free radical scavenging property could be related to the amount of bioactive compounds obtained from it compared to other ogiri samples. Polyphenolic compounds present in a substance determines its ability to exhibit antioxidant activities [30-32]. From this work, ogiri from melon and watermelon seed may be considered as functional foods.

Samples	Watermelon+melon ogiri (50:50)	Melon ogiri (100%)	Watermelon ogiri (100%)
DPPH (%)	5.58±0.01^{b}	11.14±0.03^{a}	5.09±0.01^{c}
Flavonoid (%)	3.85±0.02^{c}	5.16±0.01^{a}	5.06±0.00^{a}
Total Phenol (mg/100g)	1.04±0.01^{c}	1.77±0.02^{b}	2.23±0.00^{a}
Phytate (mg/g)	27.16±0.02^{b}	48.64±0.01^{a}	15.69±0.02^{c}
Tannin (mg/100g)	0.12±0.00^{c}	0.20±0.01^{a}	0.25±0.01^{a}
Saponin (%)	8.11±0.01^{b}	11.50±0.02^{a}	6.34±0.00^{c}
Means with same superscript within the row are not significantly different at p>0.05			

Table 5: Antioxidant and phytochemical properties of ogiri from watermelon seed+melon, melon and watermelon seed.

Consumer Acceptability of Ogiri Samples

Table 6 revealed the sensory attributes of ogiri from watermelon+melon, melon and watermelon seed. In terms of colour, ogiri melon (6.20) had the highest score followed by that of melon+watermelon (5.13) while the least acceptable was watermelon seed ogiri (3.07). Ogiri watermelon+melon was scored highest in flavour (8.12), followed by ogiri melon (7.80) while ogiri from watermelon seed was 6.02. For taste, melon ogiri (5.92) was the most acceptable, watermelon ogiri (5.80) and the least was watermelon seed+melon ogiri (5.54). Sensory score for overall acceptance showed that the highest score was recorded for melon ogiri (7.04), followed by watermelon seed+melon ogiri (6.37) and watermelon seed ogiri (5.84). Consumer acceptability of watermelon ogiri is similar to the result obtained when velvet bean was fermented to produce iru and compared with iru from locust bean [33].

Attributes	Watermelon+melon ogiri (50:50)	Melon ogiri (100%)	Watermelon ogiri (100%)
Colour	5.13 ± 1.02^{b}	6.20 ± 1.21^{a}	3.07 ± 1.14^{c}
Flavor	8.12 ± 1.32^{a}	7.80 ± 1.03^{a}	6.02 ± 1.20^{b}
Taste	5.54 ± 1.12^{a}	5.92 ± 1.22^{a}	5.80 ± 1.15^{a}
Overall acceptability	6.37 ± 1.42^{b}	7.04 ± 1.32^{a}	5.84 ± 1.11^{c}
Means with same superscript within the row are not significantly different at $p>0.05$			

Table 6: Consumer acceptability of ogiri from watermelon seed+melon, melon and watermelon seed.

Conclusion

Data obtained from these findings revealed that watermelon seed can be employed in the production of ogiri instead of discarding it as a waste. Result showed that watermelon seed expressed the same attributes during fermentation of ogiri when compared with melon ogiri. In addition, watermelon seed ogiri had a protein and total phenol content higher than that of melon seed ogiri. Overall acceptability scores from the sensory evaluation showed that melon ogiri was preferred while watermelon seed ogiri was scored above average. It can be concluded that ogiri from watermelon seed and melon seed can further be investigated as functional foods.

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