THE EFFECT OF SELECTED PACKAGING MATERIALS AND STORAGE PERIOD ON THE QUALITY OF "*Madidi*" -A THICK PORRIDGE

Ajayi, Feyisola Fisayo*[1], Adgidzi, Eunice [2], Ogori, Friday[1]and Agbedejobi, Olufunke Omolade[3]
[1] Department of Home Science and Management, Federal University Gashua, Gashua, Yobe State
[2] Department of Home Science and Management, Nasarawa State University, Keffi, Nasarawa State
[3] Department of Food Science and Technology, Federal University of Agriculture, P.M.B 2240 Abeokuta, Ogun State
*E-mail: feyigld16@gmail.com

Abstract
The effect of packaging materials and storage period on the chemical composition, microbial load of Madidi- a thick porridge mad e from millet was investigated. The samples were packed in Madidi leave, plastic container, nylon, aluminum foil and banana leaves, respectively. The chemical and microbial analyses were determined at 0, 7 and 14 days of storage period. Sensory evaluation was done using 50 panelists. The samples were statistically analyzed using ANOVA and the means were separated by Duncan multiple test at p<0.05 significance level. The results obtained at day 0 are pH (4.19), TTA (0.40), Moisture content (9.78 %), ash (2.02 %), fibre (3.50 %), protein (3.89 %), fat (0.83 %) and carbohydrate (70.23 %). The chemical composition of samples in plastic container and nylon were significantly (p>0.05) higher than other samples. Madidi packed in leaves and plastic container had the highest microbial load. The result showed that the pH, TTA, Protein, fat, fibre, ash and carbohydrate decreased significantly, while the moisture content and microbial load increased after the storage period. The sensory evaluation showed that samples packed in plastic containers were highly accepted by the panelists at the end of the storage in terms of the sensory attributed evaluated.

Keywords: Madidi, chemical composition, microbial load, sensory attributes, packaging material, storage.

Received: 23.11.2018 Received in revised form: 16.03.2019 Accepted: 18.03.2019

1. INTRODUCTION

Madidi is a thick porridge, gel-like fermented starchy food item made from millet(Banigo& Muller, 1972). This fermented product is commonly consumed in the Northern part of Nigeria as either breakfast or weaning cereal. Porridges are produced primarily from cereals such as maize, sorghum, millet, acha (Adebola*et al*., 2016), they are predominantly eaten in developing countries, examples are ogi/akamu/agidi in Nigeria and Kenkey in Ghana (Ocheme&Chinma, 2008). *Madidi* is basically consumed as breakfast meal with soup (Bolaji*et al*., 2011) or beans cake (*akara/kose*), weaning of infants, and meal for hospitalized patients (Ogieho*ret al*., 2005), although, it is eaten by all population of both young and old (Blandimo*et al*., 2003).
Traditionally, *Madidi* production involves soaking of millet grains for 1-3 days in cold water, after which the soaked grains are wet milled into a paste and sieved. The smooth slurry is mixed with hot water, stirred until it gelatinizes and the gel-like food is wrapped in leaves and cooked into a thick porridge (Adebola *et al*., 2016). The physicochemical properties, product quality and shelf life of thick porridge are greatly influenced by the technique of milling (Hounhouigan*et al*., 1993), grain features and packaging materials used.
Madidi is conventionally wrapped in leaves and marketed (Adebola *et al*., 2016). Howbeit, little or no efforts are made on the aseptic condition of this local packaging. These wrapping materials are often kept in unhygienic condition, with little or no provision for washing before use and this could be a source of microbial contamination of the food (Adejumo& Ola, 2008). The role of packaging during processing of food cannot be overruled, it creates conditions for extending the shelf stability of food, it also shields the products from deterioration by eliminating micro-organisms and by reducing oxygen penetration, hence, creates a proper surrounding atmosphere for the food

product(Komolafe, 2005; Wasiu*et al*., 2013).Packaging materials commonly used by food processors are low-priced, easily accessible, with good visual properties, ductile strength and low permeability to moisture, gases and odours (Kadam *et al*., 2008).

The effect of some packaging material such as high density polyethylene (HDPE), Polypropylene (PP), plastic container, laminated paper board cartoons on the functional, physicochemical properties and shelf stability of food products has been reported by several authors (Adetuyi *et al*., 2009; Ekwu&Ikegu, 1998; Fadamiro&Odeyemi, 1998). Adebola *et al.* (2016) reported that the values of proximate composition of solid pap wrapped in nylon were significantly higher than those wrapped with leaf, except for carbohydrate. The authors also reported that the nutritional content of the pap decreased with an increase in the days of storage.

*Madidi*offered to the consumers spoils easily after 2 to 3 days and also with the intense and lengthy stages of its production, perhaps, there is need to extend its shelf stability. Therefore, this will make sure consumers can have access to it as at when needed and ensure its adequate supply. The aim of this study is to investigate the effect of the some selected packaging materials on the chemical composition and shelf life of *Madidi*.

2. MATERIALS AND METHODS

Materials: Grey colored millet grains, plastic container, aluminum foil, Polyethylene nylon bags, banana leaf and *Madidi ganye* (it means leaf that is traditionally used for packaging *Madidi*) were obtained from a popular market in Lafia, Nasarawa State, Nigeria.

Processing of millet grains to *Madidi*:

One thousand kilogram (1 kg) millets were cleaned thoroughly to remove dirt, soaked in water for 5 hrs, milled to fine slurry, sieved through muslin cloth and the sieved portion was cooked until when thick. Twenty five moles of freshly prepared *Madidi* were packed in five packaging materials (Plastic container, aluminum foil, nylon, banana leaf, *Madidi ganye*) and stored for 2 weeks. Freshly prepared *Madidi* served as control at day 0. The chemical composition of the samples were determined at day 0, 7th and 14th of storage. All the samples were studied under room temperature for 14 days.

Chemical analysis

pHwas determined using the method described by (Vasconcelos*et al*., 1990). The Total titratable acidity (TTA) was determined usingKirk and Ronald (1991) method. The moisture, crude protein, crude fibre and ash were determined using AOAC, (2004)method. The carbohydrate content was determined by the difference from the percentage summation of moisture, protein, fat, fibre and ash content composition.

Isolation of Microbiological load

The thick-porridge '*Madidi'* was subjected to total bacterial and fungal counts immediately after the production and storage. One gram of the sample was crumpled and serially diluted by transferring to 9 ml of distilled water. The mixture was thoroughly shaken for even distribution of the available microorganisms. Pour plate method was used, by pouring the diluent on a petri dish for bacterial count, 10 ml of potato dextrose agar with 1 ml of chloramphenicol was poured to prevent bacterial growth for fungal count. The incubation was carried out at 27 °C for 3 days and 37 °C for fungal and bacterial growth, respectively (Amankwah*et al*., 2009).

Identification of isolates

Bacteria and yeast were identified on the basis of the results obtained from biochemical characterization, analyzed using Bergey's manual of systematic bacteriology (Sneath&Jonsyn, 1986) and the yeast identification method of Barneth*et al*. (1990). The results were further confirmed using the API identification kit (API system, France).

Sensory evaluation

Acceptance test was carried out on the stored thick porridge '*Madidi*' packaged in different packaging materials. The samples were presented to 50 panelists that are familiar with the product for sensory evaluation. The panelists rated the taste, texture, appearance of the packaging material, mouth feel, color and overall acceptability of the products using seven point Hedonic scale, where 7 indicates 'like extremely' and 1 indicates 'dislike extremely'.

Data Analysis

The experimental data generated were statistically analyzed using one way analysis of variance (ANOVA) using SPSS version 16.0. Duncan multiple range test was used to separate the means at $p<0.05$ significant differences.

3. RESULTS AND DISCUSSION

Effect of packaging material and storage on the chemical composition of *Madidi*

The results of the chemical composition of stored *Madidi*are presented in Table 1. It shows that the chemical composition of the packaged *Madidi*decreased continuously except for moisture content which increased with storage. The pH of the sample significantly decreased from 4.34 in day 7 to 3.20 in day 14 in sample A and sample B, respectively. However, there were no significant ($p<0.05$) difference among all the samples packaged in different packaging material at Day 7, except sample C. The decrease in the pH of the samples may be due to the acidity content of the samples caused by the production of lactic acid bacteria during the storage period. The TTA value (0.93) obtained for sample A at day 14 was much higher than that of the control sample (0.40). The values for TTA increased with decrease in the pHof the sample. This trend is similar to the reports given byAdedeji&Oluwalana, (2016) on sorghum stem sheath beverage with respect to storage time.

The moisture content of the samples increased significantly ($p<0.05$) from 9.78% in day 0 (control) to 16.35 % at the day 14 the end of storage. The results on the moisture content revealed there was an increase with the period of storage in all packaging materials; this trend was similar to the report ofAdebola*et al.* (2016). However, the moisture content of *Madidi* packed in plastic container had the highest value, while samples packaged in nylon had the least value at day 7 and 14, respectively. This low value might be due to the less permeability properties of nylon to water vapour and gases than other packaging material used (Adebola*et al.*, 2016) thus inhibit moisture absorption.Although, the high value observed for samples packaged in leaves during the storage days,might be attributed to its permeable surface property that allows interaction between water vapor and environment (Robertson, 2000; Adebola*et al*., 2016). This is an indication that the product will be susceptible to mold growth and deterioration, which invariably reducethe shelf-life of the product (Enyisiri*et al*., 2014).

The ash content of the samples at day 0 (control) were significantly ($p>0.05$) higher than other samples. The values ranged from 1.00 % to 2.02 %, these values were similar to the values reported by Adebola*et al*. (2016). The ash content of the stored *Madidi* samples decreased from 2.02 % before storage to 1.00 % in samples packed in leaves at 14 days of storage. Similar trend was observed byFagbohun, (2012) as well as the decrease in the ash content of packed ogi powder stored in different packaging materials reported byAwoyale*et al*., (2013). The depletion of the ash content in the samples could be as a result of leaching of mineral salts due to the different surface properties of the packaging material or the actions of the microorganisms which uses ash contents the as the storage days increases.

The mean values of fibre content of the samples were significantly ($p<0.05$) different. The values obtained ranged between 4.00 % and 1.70 %. Samples packed in plastic container at 7^{th} day of storage had the highest value, while samples in leaves had the lowest value. The values obtained are comparable with the report of Adebola*et al*. (2016) on effect of wrapping materials on the proximate composition of solid pap, and the findings ofOcheme and Chinma, (2008). The fibre content decreased as the storage day's increases among the samples packed in different packaging materials.

The protein content significantly (p>0.05) decreased from 3.89 % before the samples were stored to 1.10 % in samples wrapped with leaves at the 14th day of storage, except for samples wrapped in nylon that increased to 4.25 % at the 7th day of storage. The result obtained for *Madidi* packed in leaves is similar to 3.02 % and 2.35 % reported by Adebola*et al*. (2016). This increase and decrease trend has been observed during the storage studies carried out on finger millet flour by Chandru*et al*. (2010). *Madidi*packed in nylon had the highest value and the samples packed in leaves had the least value. The decrease with increase in storage days might be related to the hydrolysis of proteins due to high relative humidity of the package material environment (Butt *et al*., 2010), that increased the proliferation of microorganism. Braide*et al*. (2012)reported that the decrease in the protein content with storage days might be as a result of protein hydrolyses by enzymes secreted by microorganisms in the product.

The fat content of *Madidi*at 0 day increased from 0.83 % to 2.40 % in the 7th day of storage, and decreased to 1.13 % at the 14th day of storage. The decrease in fat content might be said to have been the actions of microorganisms that produced lipase and lipoxidase which hydrolyzed the available fat for their consumption (Adams & Moss, 2005). This agrees with the report of Onifade and Jeff-Agboola, (2003) that observed a decrease in the fat content of infected*Cocos nucifera*during storage.

The carbohydrate content of the *Madidi*increased in all the packaging materials from day 0 (70.23 %) to 83.40 %, 86.58 %, 86.84 % and 87.07 %, respectively in 7th day of storage. This increase shows that there's a correlation between the carbohydrate content and the storage period. The result obtained is in line with Daramola*et al*. (2010) who reported that starch content pupuru flour increased during storage. Although, a decrease was also observed as the storage period increased to 14 days. This reduction might be explained by the breakdown of carbohydrate during storage which led to its reduction. The initial carbohydrate value of *Madidi* before storage was similarto that reported byUjabadenyi and Adebolu, (2005) on ogi. Interestingly, all the samples considerably had high quantity of carbohydrate.

Table 1: Effect of packaging materials and storage periods on the chemical properties of *Madidi*

Storage days	Sample	pH	TTA (%)	Moisture content (%)	Ash (%)	Fibre (%)	Protein (%)	Fat (%)	Carbohydrate (%)
Day 0	Control	4.19^{b}	0.40^{ab}	9.78^{b}	2.02^{b}	3.50^{c}	3.89^{c}	0.83^{a}	70.23^{b}
Day 7	A	4.34^{d}	0.45^{b}	11.80^{c}	1.10^{a}	2.70^{b}	3.13^{c}	2.15^{b}	87.07^{d}
	B	4.19^{d}	0.90^{e}	14.20^{e}	2.00^{b}	4.00^{d}	2.00^{b}	2.30^{b}	86.58^{d}
	C	4.57^{e}	0.45^{b}	9.00^{a}	1.30^{a}	3.30^{c}	4.25^{d}	2.40^{b}	83.40^{d}
	D	4.28^{d}	0.37^{a}	12.94^{d}	1.92^{ab}	3.90^{c}	2.31^{b}	2.25^{b}	86.84^{d}
	E	4.21^{d}	0.57^{c}	9.80^{b}	1.10^{a}	2.70^{b}	3.13^{c}	2.15^{b}	86.84^{d}
Day 14	A	3.98^{c}	0.93^{f}	15.00^{ef}	1.00^{a}	1.70^{a}	1.10^{a}	1.13^{b}	61.00^{a}
	B	3.20^{a}	0.60^{d}	16.35^{f}	1.82^{ab}	2.30^{b}	3.02^{c}	1.30^{b}	85.58^{d}
	C	3.95^{c}	0.65^{d}	11.00^{c}	1.15^{a}	2.30^{b}	1.25^{a}	1.90^{ab}	78.48^{c}
	D	3.76^{b}	0.63^{d}	15.94^{ef}	1.20^{a}	2.40^{b}	1.31^{a}	1.25^{b}	76.62^{c}
	E	3.66^{ab}	0.85^{e}	16.20^{f}	1.00^{a}	1.70^{a}	2.10^{b}	1.13^{b}	61.00^{a}

Means with different superscript along the same column are signify different at p<0.05.Sample A = *Ganyemadidi;* Sample B = Plastic container, Sample C = Nylon, Sample D = Aluminum foil, Sample E= Banana leaf.

Effect of packaging material and storage on the microbiological count of *Madidi*

The total viable and fungal counts of the *Madidi*packaed in different packaging materials increased with an increase in the storage days. At day 0, samples packed in Nylon had the highest value of Total viable counts (TVC) and samples packed in plastic container had the highest value of fungal counts (FC), Samples packed in aluminum foils had the highest value for TVC, while samples packed in banana leaves had the highest value for FC at the end of the 14 days storage period, as shown in Table 2 and 3. The increased proliferation of microbial counts of the samples could be due to the increase in moisture content of the samples, since they absorbed moisture from the environment during storage (Awoyale*et al*., 2013), thereby creating surviving condition for the micobes. Also, the available nutrients in the samples created a favorable environment which resulted in change in pH.The bacteria isolated from the samples at day 0 include *Staphylococcus* spp, *Bacillus* spp., *Lactobacillus* spp. and *Streptococcus* spp, respectively. The presence of *Staphylococcus* spp suggested poor handling and contamination during the processing and packaging of the samples, before storage. However, the values obtained from this result after storage was higher than 10^6cfu/g recommended by the International Microbiological Standards for bacteria pollution for food (Shobh*et al*., 2011).

A number of researchers has emphasized that the existence of fungi and mold in foods poses frequent health hazards and causes numerous deterioration of food products (Fadahunsi*et al*., 2011; Nwokoro&Chukwu, 2012; Adams& Moss, 2005).

It was observed from this study that the samples packed in plastic container had the highest value of FC, this could be due to its high moisture content, thus, facilitating fungi growth. On the other hand samples packed in nylon had the lowest FC, this might be due to its less permeability to water vapor and gases. The initial FC of samples in nylon might be as a result of air sometimes blown into the bags with mouth to open them; this practice introduces vapors and in turn sets the platform for microrganisms. The value 10^6cfu/ g obtained for this result was in agreement of the findings reported for stored cereal products byAran and Eke, (1987) and Awoyale*et al.* (2013). On the other hand, the fungal counts were comparatively higher than 10^3cfu/ g approved by the International Microbiological Standards for food (Shobh*et al*, 2011). The isolated fungi from *Madidi* packed in different packaging materials over the storage period include *Aspergillus* spp., *Fusarium* spp., *Penicillum* spp., *Rhizopus* spp. and *Saccharomyces* spp. were similar to those isolated in the studies carried out byOmosuli*et al*. (2008) in their analysis of hawked 'agidi'.Adegunloye*et al*. (2013) also reported high levels of contamination on pap, pounded yam and bean pudding wrapped in banana leaves.

Table 2: Total viable counts TVC (cfu/g) and isolates of stored *Madidi*in different packaging materials

Storage Samples	0 day TVC (cfu/g)	Isolates	7th day TVC (cfu/g)	Isolates	14th day TVC (cfu/g)	Isolates
A	0.86×10^7	*Staphylococcus* spp.	1.12×10^7	*Bacillus* spp.	2.20×10^7	*Lactobacillus* spp.
B	0.26×10^7	*Bacillus* spp.	1.34×10^7	*Staphylococcus* spp.	2.80×10^7	*Lactobacillus* spp.
C	1.3×10^7	*Bacillus* spp.	1.24×10^7	*Staphylococcus* spp.	2.40×10^7	*Streptococcus* spp.
D	0.65×10^7	*Lactobacillus* spp.	3.50×10^7	*Staphylococcus* spp.	7.30×10^7	*Lactobacillus* spp.
E	0.90×10^7	*Streptococcus* spp.	1.12×10^7	*Bacillus* spp.	2.2×10^7	*Lactobacillus* spp.

Sample A = *Ganyemadidi;* Sample B = Plastic container, Sample C = Nylon, Sample D = Aluminum foil, Sample E= Banana leaf

Table 3: Fungal counts (FC) (cfu/g) and isolates of *Madidi*of stored in packaging materials

Storage Samples	0 day FC (cfu/g)	Isolates	7th day FC (cfu/g)	Isolates	14th day FC (cfu/g)	Isolates
A	3.50×10^{6}	*Aspergillus* spp.	6.00×10^{6}	*Aspergillus* spp.	21.80×10^{6}	*Aspergillus* spp.
B	5.10×10^{6}	*Aspergillus* spp.	9.80×10^{6}	*Saccharomyces* spp.	28.18×10^{6}	*Saccharomyces* spp.
C	3.80×10^{6}	*Fusarium* spp.	6.30×10^{6}	*Rhizopus* spp.	15.85×10^{6}	*Rhizopus* spp.
D	4.20×10^{6}	*Penicillum* spp.	9.20×10^{6}	*Fusarium* spp.	20.13×10^{6}	*Fusarium* spp.
E	3.50×10^{7}	*Penicillum* spp.	6.0×10^{6}	*Aspergillus* spp.	25.0×10^{6}	*Aspergillus* spp.

Sample A = *Ganyemadidi;* Sample B = Plastic container, Sample C = Nylon, Sample D = Aluminum foil, Sample E= Banana leaf

Table 4: Effect of packaging materials and storage period on the some sensory qualities of *Madidi*

Storage days	Samples	Taste	Texture	Colour	Appearance of packaging	Mouth feel	Overall acceptability
0	A	5.08^{b}	5.70^{bc}	5.28^{c}	5.35^{c}	5.65^{c}	5.86^{b}
	B	3.85^{a}	3.95^{a}	4.20^{b}	4.80^{b}	4.00^{b}	5.00^{b}
	C	3.60^{a}	3.85^{a}	3.25^{a}	2.30^{a}	2.60^{a}	2.90^{a}
	D	5.05^{b}	5.55^{b}	3.66^{a}	5.90^{cd}	5.65^{c}	6.15^{bc}
	E	6.35^{c}	6.10^{c}	6.21^{d}	6.10^{d}	6.25^{d}	6.25^{c}
7	A	4.40^{c}	3.95^{c}	2.21^{a}	1.90^{a}	4.45^{b}	2.80^{b}
	B	6.60^{e}	6.75e	3.52^{b}	6.90^{c}	6.60^{d}	6.80^{e}
	C	5.15^{d}	5.50^{d}	3.20^{b}	5.00^{b}	5.20^{c}	4.85^{d}
	D	2.00^{b}	2.15^{b}	2.85^{ab}	5.40^{b}	1.90^{a}	3.15^{c}
	E	1.65^{a}	1.65^{a}	2.06^{a}	1.35^{a}	1.45^{a}	1.40^{a}
14	A	1.35^{a}	1.90^{b}	1.65^{a}	1.35^{a}	1.45^{a}	1.60^{a}
	B	3.95^{c}	4.85^{c}	3.06^{c}	6.30^{d}	3.95^{c}	5.75^{d}
	C	2.60^{b}	4.05^{c}	2.95^{bc}	3.95^{b}	2.50^{b}	4.30^{c}
	D	1.20^{a}	1.50^{a}	2.22^{b}	5.45^{c}	1.20^{a}	2.60^{b}
	E	1.50^{a}	1.35^{a}	1.45^{a}	1.05^{a}	1.50^{a}	1.15^{a}

Means with different superscript along the same column are signify different at $p<0.05$.
Sample A = *Ganyemadidi;* Sample B = Plastic container, Sample C = Nylon, Sample D = Aluminum foil, Sample E= Banana leaf.

The FC increased as the storage period increases, possibly because of the available moisture and the breakdown of nutrients which stirred their existence.
The high values of microbiological counts from this study suggested that the samples are carriers of food borne infections, irrespective of the packaging material used.

Effects of packaging material and storage period on the sensory attributes of *Madidi*
The results of the sensory evaluation of *Madidi* wrapped in different packaging materials and stored for a period of 14 days is presented in Table 4. At day 0 before storage, the panelists rated the samples wrapped in banana leaves higher than other samples in terms of taste, texture, colour, appearance of packaging material, mouth feel and overall acceptability. The high scores might be due to the fact that *Madidi* are traditionally packed in leaves, which the panelists are quite familiar with, thus, the high acceptance by the panelists. However, samples wrapped in nylon were rated lowest in respect of the sensory attributes evaluated. It was observed that the sensory scores decreased as the storage days increased,although samples packed in plastic container was still rated high by the panelists. Ocheme, Ocheme, (2007) reported similar trends with the decrease in the sensory scores of porridge as the storage period increased. The drastic decrease in scores of *Madidi* wrapped in leaves was not surprising because of the high microbiological counts in the samples, as well as absorption of moisture (Akhtar *et al*., 2005) which might have caused modifications in the composition of the product. Also, the panelists disliked the mushy texture of the samples; this might be due to the moisture and gases permeability of the packaging material. Generally, the samples in plastic container had

the highest acceptability, followed by those in nylon in respect of the sensory attributes at the end of the storage period.

4. CONCLUSIONS

The pH, TTA, protein, fat, fibre, ash and carbohydrate contents of *Madidi*wrapped in different packaging materials decreased significantly (p<0.05), while moisture content and microbiological counts increased with storage period. It was observed that samples packaged in nylon were the best packaging material that retained the chemical composition and reduced the microbial presence of the stored *Madidi*. However, the use of leaves as a packaging material should be discouraged, because it didn't preserve the nutrients of the products and the observed high microbial load likely pose risk of food infections to consumers.

5. REFERENCES

[1]. Adams, M.R., & Moss, M.O. (2005). Microbiology of primary food commodities: In, Food Microbiology, 3nd Edn. (The Royal Society of Chemistry, Cambridge, U.K), Pp, 122.

[2]. Adebola, M.O., Muhammed, H.M., Bello, I.M., &Abdulyekeen, M. (2016). Effect of wrapping materials on myco flora growth, proximate composition and shelf life of solid pap sold in Lapai, Niger State, Nigeria. *International Journal of Applied Sciences*, 1 (1), 14-22.

[3]. Adedeji, T.O., &Oluwalana, I.B. (2016). Effects of Preservative Techniques on the storage stability of sorghum stem sheath beverage. *Nigerian Food Journal*. 34, 40-46.

[4]. Adegunloye, D.V., Agarry, O.O., Adebolu, T.T., &Adetuyi, F.C. (2013). Effect of leaf-packaging on the microbiological assessment of some food items. Department of Microbiology, Federal University of Technology, Akure, Ondo State, Nigeria. *African journal of Biotechnology*, 5, 445-447.

[5]. Adejumo, B.A., & Ola, F.A. (2008).The Appraisal of Local Food Packaging Materials in Nigeria. *Continental Journal of Engineering Sciences*, 3, 13-20.

[6]. Adetuyi, F.O., Badejo, O.F., Ikujenlola, A.V., &Omosuli, S.V. (2009). Storage influence on the functional properties of malted and unmalted maize (*Zea mays* L. ssp. *mays*) and soybean (*Glycine max* L. *Merrill*) flour blends. *Africa Journal of Food Science*, 3(2), 56-60.

[7]. Akhtar, S., Anjum, F., &Rehman, M.S. (2005). Effect of iron and zinc fortification on chemical composition of whole wheat flour. *J. Res*. 16, 95–103.

[8]. Amankwah, E.A., Barimah, J., Nuamah, A.K.N., Oldham, J.H., &Nnaji, C.O. (2009). Formulation of weaning food from fermented maize, rice, soybean and fishmeal. *Pakistan Journal of Nutrition*, 8, 1747–1752.

[9]. AOAC, 2004. Official Methods of Analysis of the Association of Official Analytical Chemists.15th edn. (Arlington, Virginia, USA) p, 22(113-114), 169(207-208).

[10]. Aran, N., & Eke, D. (1987). Mouldmycoflora of Kas¸ar cheese at the stage of consumption. *Food Microbiol*ogy, 4, 101–104.

[11]. Awoyale, W., Maziya-Dixon, B., Menkir, A. (2013). Effect of packaging materials and storage conditions on the physicochemical and chemical properties of Ogi powder. *Journal of Food, Agriculture and Environment*, 11 (3&4), 242-248.

[12]. Banigo, E.O.I., & Muller, H.G. (1972). Manufacture of ogi (a Nigerian fermented cereal porridge): Comparative evaluation of corn, sorghum and millet. *Can Inst Food Sci Tech Journal*, 5, 217-219.

[13]. Barnett, J.A., Payne, R.W., &Yarrow, D. (1990). Yeast Characterization and identification. 2nd edition, (Cambridge University Press), Pp, 1002.

[14]. Blandino, A., Al-Aseeri, M.E., Pandiella, S.S., Cantero, D., & Webb, C. (2003). Cereal-based fermented foods and beverages. *Food Reserves International*, 36, 527-543.

[15]. Bolaji, O.T., Awonorin, S.O., Olalusi, A.P., Idowu, M.A., Henshaw, F.O., &Adepoju, P.A. (2011). Effect of storage temperature on some Ogi Properties. *Advance Journal of Food Science and Technology*, 3(2), 89-94.

[16]. Braide, W.N., Waoguikpe, R.N., Oranusi, S.U., Udegbunam, L.I., Akobondu, C.I., &Okorondu, S.I. (2012). The effect of biodeterioration on the nutritional composition and microbiology of an edible long- winged reproductive termite, Macrotermsbellicosus. Smeathman. *International Journal of Research in Pure and Applied Microbiology*. 2, 7-12.

[17]. Butt, M.S., Nasir, M., Akhtar, S., & Sharif, K. (2010). Effect of moisture and packaging on the shelf life of wheat flour. *International Journal of Food Safety* 4, 1-6.

[18]. Chandru, R., Ranganna, B., Palanimuthu, V., Munishamanna, K.B., &Subramanyam, S. (2010). Biochemical and microbial changes associated with storage of value added ready to cook finger millet flour. *Mysore Journal of Agricultural Sciences*, 44(2), 255-259.

[19]. Daramola, O.A., Idowu, M.A., Atanda, O.O., &Oguntona, C.R.B. (2010). Effects of packaging material on the quality of "pupuru" flour during

storage. *African Journal of Food Science.* 4(5), 258–263.

[20]. Ekwu, F.C., &Ikegwu, J.O. (1998). Effect of packaging materials and storage period on the functional and microbial load of cocoyam flour. Proceeding of the 22nd Annual NIFST Conference, pp, 266-267.

[21]. Enyisi, S.I., Umoh, V.J., Whong, C.M.Z., Abdullahi, I.O., Alabi, O. (2014). Chemical and nutritional value of maize and maize products obtained from selected markets in Kaduna State, Nigeria. *African Journal of Food Science and Technology.* 5, 100-104.

[22]. Fadahunsi, I.F., &Garuba, E.O., &Elutade, O. (2011). Physico-chemical studies on the growth of an Ochratoxin A-degrading Rhizopus sp. *Nature and Science*, 9, 240-244.

[23]. Fadamiro, H.Y., &Odeyemi, O.O. (1998). Effect of temperature and packaging materials on storage of cocoa (*Theobroma cacao* L.). *Applied and Tropical Agriculture*, 3(2), 99-103.

[24]. Fagbohun, E.D. (2012). Antimicrobial activities of Cocoa pod (*Theobroma cacao* l) infected with Phytophthorapalmivora. Ph.D. Thesis, Ekiti State University, Ado- Ekiti, Nigeria.

[25]. Hounhouigan, D.J., Nout, M.J.R., Nago, C.M., Houben, J.H., &Rombouts, F.M. (1993). Characterization and frequency distribution of species of lactic bacteria involved in the processing of mawe, a fermented maize dough from Benin. *International Journal of Food Microbiology*, 18, 279-87.

[26]. Kadam, D.M., Samuel, D.V.K.., Chandra, P., &Sikarwar, H.S. (2008). Impact of processing treatments and packaging material on some properties of stored dehydrated cauliflower. *International Journal of Food Science and Technology*. 43, 1-14.

[27]. Kirk, R.S., & Ronald, S. (1991). Pearson's Composition and Analysis of Food. 9th Edn. (Longman Scientific and Technical London) pp, 645-681.

[28]. Komolafe, E.A. (2005). Food Packaging. A Monograph. (Biotidara Press and Computers Akure), pp, 81.

[29]. Nwokoro, O., &Chukwu, B.C. (2012). Studies on Akamu, a traditional fermented maize food. *Rev ChilNutr*, 39(4), 180-184.

[30]. Ocheme, O.B. 2007. Effect of storage of millet flour on the quality and acceptability of millet flour porridge (Enyiokwolla). *Journal of Food Technology*, 5(3), 215-219.

[31]. Ocheme, O.B., &Chinma, C.E. (2008). Effects of soaking and germination on some physicochemical properties of millet flour for porridge production. *Journal of Food Technology*, 6(5), 185-188.

[32]. Ogiehor, I.S., Ekundayo, A.O., &Okwu, G.I. (2005). Shelf stability of agidi produced from maize (Zea mays) and the effects of sodium benzoate treatment in combination with low temperature storage. *African Journal of Biotechnology*, 4, 738-743.

[33]. Omosuli, S.V., Opawale, B.O., & Ibrahim, T.A. (2008). A survey of bacterial content of 'agidi' and 'eko' produced and hawked in IkareAkoko, Ondo State, Nigeria. *Journal of Science and Technology*, 6, 114-117.

[34]. Onifade, A.K., & Jeff-Agboola, Y.A. (2003). Effect of fungal infection on proximate nutrient composition of coconut (Cocos nucifera Linn) fruit. *J. Food Agric and Environ.* 1, 141-142.

[35]. Robertson, G.L. (2000). Shelf Life of Packaged Foods, Its Measurements and Prediction, in Developing New Food Products for a Changing Marketplace, edited by (Brody, A. L. and J. B. Lord, Technomic Publishing Lancaster.). Pp, 329–353.

[36]. Shobh, D. Prasanna Kumar, M.K., Putaramanaïk, I., &Sreematty, T.A. (2011). Effect of antioxidant on the shelf life of quality protein maize flour. *Indian Journal of Fundamental Applied Life Sciences.* 1, 129-140.

[37]. Sneath, B., &Jonsyn, F.E. (1986). Fungi associated with selected fermented food in science leone. MIRCEN. *Journal of applied microbiology and bacteriology*, 93, 319-323.

[38]. Ujabadeniy, A.O., &Adebolu, J.T. (2005). The effect of processing method on nutritional properties of ogi produced from three maize varieties. *J. Food, Agric and Environment*. 3, 108-109.

[39]. Vasconcelos, A.T., Twiddy, D.R., Westby, A., & Reilly, P.J.A. (1990). Detoxification to food cassava during garri preparation. *International Journal of Food Sci Tech*, 25, 198-203.

[40]. Wasiu, A., Busie, M., &Abebe, M. (2013). Effect of packaging materials and storage conditions on the physicochemical and chemical properties of ogi powder. *Journal of Food, Agriculture and Environment*, 11, 242-248.