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EFFECT OF SOAKING PERIOD ON OGI FLOUR PRODUCED FORM SORGHUM FORTIFIED WITH GINGER

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ABSTRACT

Effect of soaking periods on ogi flour produced from sorghum fortified with ginger was investigated using standard analytical procedure. The sorghum grain and ginger were cleaned, washed with clean portable water, soaked for 24, 35, 48, 60 and 72 hours, processed into ogi slurry using traditional methods and then dried in cabinet dryer at 55^0C for 36hours. The resulting ogi flour samples obtained were analyzed for proximate composition, functional properties, colour parameters and sensory evaluation. There are significant differences in terms of the proximate composition of ogi flour sample. Moisture content ranged from 10.17 – 11.07%, protein varied from 1.92 – 2.71%, fat ranged from 0.36 – 1.45%, ash ranged from 0.91 – 1.53, fibre varied from 0.16 – 0.63% with carbohydrate varying from 83.53 – 85.49% respectively. The result showed that sample soaked for 36 and 48hours have low ash, fat, fibre and protein contents with higher value in the moisture content and carbohydrate content. Also the functional properties revealed significant differences ($p<0.05$) in almost all the attributes evaluated. A significant difference ($p<0.05$) occurred in terms of lightness (L*) and redness (a*) while there was none in terms of the yellowness (b*) of the samples. However, samples soaked for 24hours had the highest mean score in terms of the overall acceptability hence rated the best most preferred

Keywords: Soaking Periods, Ogi Flour, Sorghum Fortification, Ginger

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INTRODUCTION

Sorghum belong to the *Poaceae* family (Ranya et al., 2013). It is believed to have the greatest potential among food crops for attaining technological breakthrough that will improve food production in any region. In fact, sorghum can consistently survive under the climatic conditions where other cereals fail to grow (Ajanaku et al; 2013). In many parts of Africa, Sorghum play an essential role in the attainment of food security for a lot of households while its commercial processing into value-added food and beverage products serve as income generating activities and an important driver for economic development (Taylor, 2004).

Ogi is essentially a traditionally-extracted starch from cereals such as maize, sorghum or millet through wet-milling of any of these grains (Modu et al., 2005). It is this extracted starch called "Ogi" that is converted to various other product such as "eko", "agidi", "akamu" and "koko" depending on the locality and form in which it is consumed. According to Oluwamukomi et al., (2005). When ogi is gelatinized into a stiff gel, it is called eko or agidi which is usually consumed by adults with any of the local vegetable soups, moin-moin or akara.

Ginger (*Zingiber officinale*) has great culinary importance all round the world, as it is the most commonly consumed dietary condiment. Powdered or ground ginger is widely used as a food additive and flavouring agent and eating fresh raw ginger is arguably the most popular way of consuming this herb. The use of ginger has been seen as a better option for preserving food compounds to the use of many chemicals.

A lot of researches have been carried out on sorghum and other cereal crops. Adebowale et al., (2005) studied the effect of heat-moist treatment and annealing on the physico chemical properties of red sorghum while Modu et al (2005) reported the production, chemical and sensory properties of ogi produced different pearl millet varieties. The effects of cultivar and germination time on amylolytic potential, extract yield and wort fermenting properties of malting sorghum was reported by Okoli et al., (2010) while Zanariah et al (2015) studied ginger species and their traditional use in modern applications. Also Kulkarni et al., (1991) reported sorghum malted and soybean weaning food formulation preparation, functional properties and nutritive value. However, the objectives of this present study are to know the effect of soaking period on ogi flour produce from sorghum fortified with ginger vis-à-vis its functional properties, proximate composition, colour characteristics as well as sensory properties

Materials and Methods

Source of Materials

Sorghum bicolor (white varieties) and ginger were obtained from the polytechnic, farm of the Federal Polytechnic, Ilaro Ogun State. The sorghum grains and ginger were packed in jute sac and transported to the Food Processing Laboratories of the Federal Polytechnic, Ilaro, Ogun State for further processing and analyses.

Sample Preparation

About 3.5kg of sorghum grain and 500g of ginger were cleaned, sorted and divided into five (5) equal parts, then soaked separately in different containers (Stainless bowls) with cover. The sorghum grain and ginger were soaked form 24, 36, 48 60 and 72 hours respectively before rinsed and wet milled using plate attrition mill, slurry obtained were sieved using muslin cloth with fine aperture and then allowed to sediment. The sediment were further drained, before dying in cabinet driers at temperature of 55^0C for 3 hours. The dried ogi granules were then dry-milled and sieved using 300µm sieves to obtain fine ogi flour. They are then packaged in cellophane bag for further analyses. All reagents and chemical used are of analytical grades

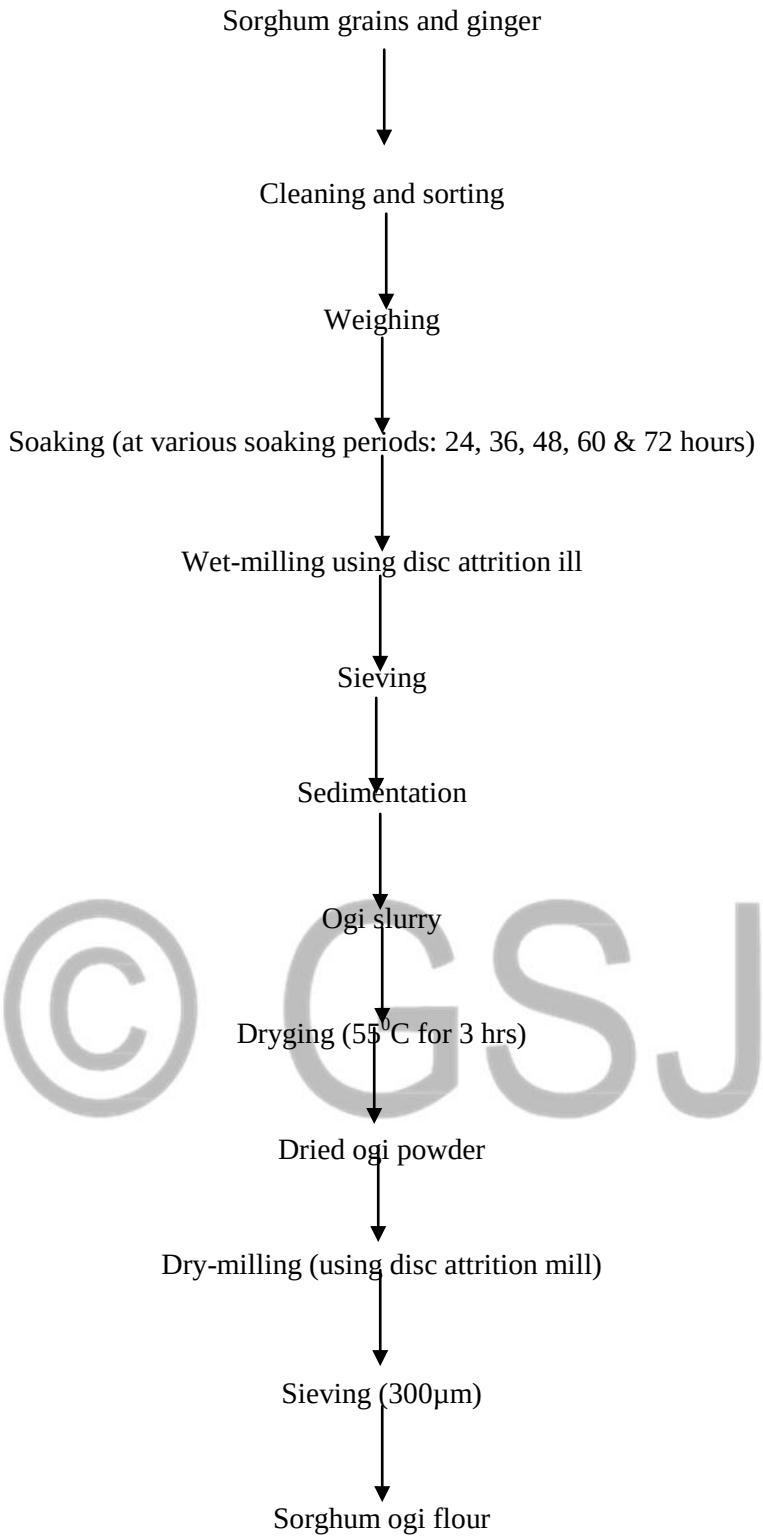

Fig 1: Flow Chart for the Production of Sorghum flour (Akingbala et al., 1992)

Analytical procedures

Proximate composition

Proximate composition was determined using standard methods of AOAC, (2010)

Functional Properties

Bulk density was determined by the methods of Udensi and Okaka (2000). A known amount of samples was weighed into 50ml graduated measuring cylinder. The sample was packed by gently tapping the cylinder on the bench top from a height of 5cm. The volume of the sample was recorded.

$$\text{Bulk density} = \frac{\text{weight of sample (g/m or g/cm}^3\text{)}}{\text{Volume of sample after tapping}}$$

Water and oil absorption capacity

Water and oil absorption capacities of the flour samples were determined using a methods of Abbey and Ibey (1988) with slight modification 1gm of flour sample mixed with 10ml distilled water or oil was placed in a centrifuge tube. The suspension was agitated for one hour on a griffin flask shaker after which it was centrifuged for 15minutes at 2200rpm. The volume of water or oil on the sediment water was measured. Water and oil absorption capacities were calculated as ml of water or oil absorbed per gram of flour respectively

Swelling power and solubility

The swelling power and solubility of the flour sample was determined using the methods described by Crosbic (1991). This was done by heating a flour-water slurry (1g) in 10ml of distilled water in a water bath at 60^0C for 30minutes with constant stirring. The slurry was centrifuged at 3000rpm for 15minutes. The supernatant was decanted into a weighed evaporating dish and dried at 100^0C for 20minutes. The difference in weight of the evaporating dish was used to calculate flour solubility. Swelling power were obtained by weighing the residue after centrifugation and dividing by original weight of flour on Dry Weight Basis (DWB)

Wettability

Wettability was carried out by placing 10g of the flour sample around a pestle inside a funnel. The pestle was thereafter lifted to allow the powdered to flow through the stem into a beaker of water. Readings were taken as soon as all the powder flowed in to the beaker of water to determine the time taken by the powder to be completely wetted by the water as described by Udensi et al (2008).

Dispersibility

The methods described by Kulkani et al (1991) was used to determine the dispersbiility of the flour sample. 10g of the flour was poured into 100ml measuring cylinder and distilled water was added to read the volume of 100ml. the set up was stirred vigorously and allowed to settle for 3hours. The volume of settled particles was recorded and subtracted from 100. The difference was recorded as percentage dispersibility

Colour attributes of flour blends

Konica Minolta Colour Measuring System (Chroma Meter CR-410, Minolta LTD Japan) was used to measure the colour of the blend and was based on (CIE) L* a* b* scale. After calibrating the instrument by covering a zero calibration mask followed by white calibration plate. The flour blends were analyzed by placing them on the petridish and then the image was captured on the samples. The colour attributes such as lightness (L*), redness (a*) and yellowness (b*) were recorded.

Sensory Evaluation

The sensory evaluation of the sample (ogi) was carried out for consumer acceptance and preference using sixty (60) Semi-trained panelists. The panelists evaluated the ogi sample (gruel) on the basis of colour, flavor. taste (Sourness), mouthfeel and overall acceptability. The parameters were rated on a nine-point hedonic scale (1-9) where 9 was liked extremely, 5 was neither like or dislike, 1 was dislike extremely. Data generated was subjected to Analyses of Variance (ANOVA) and the means were separated using Duncan Multiple Range Test (DMRT)

Statistical ANALYSIS

All determination were done in triplicates. The mean and the standard deviation were calculated in each test. ANOVA was performed and mean value done using DMRT at $p<0.05$ using Statistical Package for Social Science (SPSS) version 16.0

Result and discussion

Results

Table 1: Proximate analysis of Ogi Produced from sorghum fortified with ginger

Sample code	Parameters (%)					
	Moisture	**Protein**	**Fat**	**Ash**	**Fibre**	**Cho**
DAR	$10.17^{a}\pm0.02$	$2.17^{cd}\pm0.01$	$1.45^{b}\pm0.03$	$1.53^{ab}\pm0.03$	$0.63^{ab}\pm0.02$	$83.53^{ab}\pm0.06$
PAO	$11.07^{ab}\pm0.03$	$1.92^{cd}\pm0.02$	$0.36^{cd}\pm0.02$	$1.03^{ab}\pm0.03$	$0.16^{ab}\pm0.02$	$85.49^{bc}\pm0.03$
TNE	$10.86^{bc}\pm0.02$	$2.43^{cd}\pm0.01$	$0.91^{ab}\pm0.01$	$0.91^{c}\pm0.01$	$0.25^{c}\pm0.01$	$84.73^{cd}\pm0.04$
SRN	$1057^{cd}\pm0.02$	$2.22^{cd}\pm0.02$	$1.26^{cd}\pm0.02$	$1.32^{cd}\pm0.02$	$0.36^{ab}\pm0.02$	$84.27^{ab}\pm0.53$
BIA	$10.33^{ab}\pm0.03$	$2.63^{bc}\pm0.02$	$1.37^{cd}\pm0.01$	$1.45^{b}\pm0.03$	$0.55^{cd}\pm0.01$	$83.67^{cd}\pm0.02$

Value are mean ± standard deviation of triplicate determination. Values on the same column having the same superscript letters are not significantly different ($p>0.05$)

Key Sample DAR 24hours of soaking
Sample PAO 36hours of soaking
Sample TNE 48 hours of soaking
Sample SRN 60 hours of soaking
Sample BIA 72 hours of soaking

Table 2: Selected functional properties of ogi produced from sorghum fortified with ginger

Sample code	Bulk density (g/cm^3)	Wettability (min)	Dispersibility (%)	Oil Absorption Capacity (%)	Water Absorption Capacity (%)	Swelling power (g/ml)	Solubility
DAR	$0.74^{cd}\pm0.08$	$2.50^{ab}\pm0.03$	$75.3^{bc}\pm0.57$	$173.3^{ab}\pm11.6$	$1.33^{cd}\pm20.18$	$5.63^{ab}\pm0.00$	$14.94^{ab}\pm0.02$
PAO	$0.75^{b}\pm0.07$	$2.45^{ab}\pm0.01$	$80.0^{bc}\pm0.00$	$146.7^{a}\pm5.77$	$0.90^{a}\pm17.32$	$4.943^{ab}\pm0.04$	$14.23^{ab}\pm0.00$
TNE	$0.75^{cd}\pm0.03$	$2.31^{ab}\pm0.01$	$80.0^{b}\pm0.00$	$150.0^{a}\pm10.0$	$0.97^{bc}\pm11.54$	$3.88^{bc}\pm0.02$	$14.36^{ab}\pm0.03$
SRN	$0.77^{cd}\pm0.05$	$2.45^{ab}\pm0.05$	$74.0^{bc}\pm1.00$	$166.7^{ab}\pm15.3$	$1.37^{c}\pm5.80$	$4.25^{bc}\pm0.02$	$14.52^{ab}\pm0.03$
BIA	$0.73^{b}\pm0.06$	$3.03^{bc}\pm0.02$	$73.7^{ab}\pm0.06$	$166.7^{bc}\pm45.1$	$1.40^{cd}\pm0.00$	$4.73^{bc}\pm0.03$	$14.73^{ab.}\pm0.03$

Value are mean ± standard deviation of triplicate determination. Values on the same column having the same superscript letters are not significantly different ($p>0.05$)

Key Sample DAR 24hours of soaking
Sample PAO 36hours of soaking
Sample TNE 48 hours of soaking
Sample SRN 60 hours of soaking
Sample BIA 72 hours of soaking

Table 3: colour analysis of ogi produced from sorghum fortified with ginger

Sample	L*	a*	b*
DAR	87.84^{ab} ±0.04	3.67^{ab}±0.04	9.72±0.04
PAO	89.05^{bc}±2.17	2.14^{ab}±0.02	7.74^{ab}±0.02
TNE	91.39^{cd}±0.27	2.61^{bc}±0.23	9.46^{ab}±0.04
SRN	91.39^{b}±0.05	3.13^{a}±0.05	10.14^{ab}0.02
BIA	88.30^{c}±1.06	3.37^{ab}±0.26	10.14^{ab}±0.02

Value are mean ± standard deviation of triplicate determination. Values on the same column having the same superscript letters are not significantly different (p>0.05)

Key Sample DAR 24hours of soaking
Sample PAO 36hours of soaking
Sample TNE 48 hours of soaking
Sample SRN 60 hours of soaking
Sample BIA 72 hours of soaking

Table 4: Sensory evaluation result of Ogi flour

Sample	**PARAMETERS (%)**				
	Colour	**Flavor**	**Taste**	**Mouth feel**	**Overall acceptability**
DAR	7.780^{a}±0.16	8.75^{a}±0.03	8.89^{a}±0.03	7.42^{a}±0.06	8.78^{ab}±0.03
PAO	7.35^{a}±2.14	8.52^{ab}±0.00	8.45^{ab}±0.03	6.47^{a}0.06	7.75^{bc}±0.02
TNE	6.89^{ab}±0.28	7.45^{a}±0.00	7.45^{a}±0.03	6.40^{ab}±0.01	5.55^{a}±0.00
SRN	6.50^{bc}±0.03	6.80^{bc}±0.02	7.45^{bc}±0.00	5.14^{ab}±0.05	6.51^{ab}±2.13
BIA	5.26^{cd}±0.28	6.58^{cd}±0.25	7.32^{bc}±0.00	5.62^{bc}±0.00	6.54^{bc}±0.05

Value are mean ± standard deviation of triplicate determination. Values on the same column having the same superscript letters are not significantly different (p>0.05)

Key Sample DAR 24hours of soaking
Sample PAO 36hours of soaking
Sample TNE 48 hours of soaking
Sample SRN 60 hours of soaking
Sample BIA 72 hours of soaking

Discussion

The proximate composition of ogi flour produced form sorghum fortified with ginger at different soaking periods are as shown in table 1. The moisture content ranged from 10.71 to 11.07% for all the flour samples. The higher value in terms of moisture content was recorded in sample soaked for 36 hours (PAO) while lowest value was recorded in sample soaked for 24 hours (DAR). There was decrease in moisture content with increase in the soaking period. Low moisture value is an indication that the flour would have good keeping quality, contributing to longer shelf life and preventing spoilage microflora from thriving in the product. There was significant difference ($p<0.05$) in the protein content of all the ogi flour samples. The protein contents ranged from 1.92 to 2.71%. Protein is an essential nutrient required for growth. Cereals generally are poor nutritional based food, in terms of protein content, lacking in lysine an essential protein. The amount obtained in this work are low and this could be attributed to leaching due to increased soaking period. The fat contents showed significant difference ($P<0.05$) among samples evaluated. It ranged from 0.36 to 1.45%. Fats, generally plays significant role in the shelf life of food products such as flour. Fat promote rancidity in foods leading to the development of unpleasant and odorous compounds (Ihekoronye and Ngoddy 1985). Ash is the residue remaining after destroying from sample. It is a non-organic compound containing mineral content of foods and nutritionally aid in metabolism of other organic compound such as fat and carbohydrates. Ash contents of 1.53%, 1.03%, 0.91%1.32% and 1.45% were obtained at the end of soaking periods of 24, 36, 48, 60 and 72 hours. There were significant difference ($p<0.05$) in the fibre contents of the ogi flour sample. The fibre content varied from 0.16 to 0.63% for the flour samples. The decrease from the initial 0.63% fibre content could be attributed to prolonged soaking periods. According to American Diabetes Association (2011), Crude fibre may promote health by binding to fat deposits in the digestion tracts of humans, preventing several degenerative

disease such as obesity, hypertension and diabetes. The carbohydrate contents revealed significant differences among sample ($p \leq 0.05$). It was generally observed that carbohydrate contents increased as the soaking period decreased.

Table 2 showed the result of the functional properties of ogi flour produced from sorghum fortified with ginger at different soaking period. The water absorption capacity (WAC) is the ability of a product to associate with water under limiting conditions (Singh, 2001). The results showed significant differences among samples ($p \leq 0.05$)) it ranged from 0.90 to 1.40%. It was observed that the water absorption capacity was 1.33% at the end of soaking period of 24hours slightly declined to 0.90% at 3hours and progressively increased 0.97%, 1.37% and 1.40% at the soaking periods of 48hours, 60hours and 72hours respectively. Oil absorption capacity (OAC) is the ability of flour (food) to absorb oil, which is important as oil acts as flavour retainer and improved mouth feel (Aremu et al; 2007). It is crucial to assessment of flavour retention. It varied from 1.46% to 1.73% with sample soaked for 36 hours having the lowest value (1.46%) and sample with soaking period of 24hours having the highest value (1.73%). Oil absorption capacity revealed significant difference among sample ($p<0.05$). Bulk densities of 0.74, 0.75, 0.75, 0.77 and 0.73g/cm^3 were recorded for the soaked period of 24, 36, 48 60 and 72 hours respectively and this is in agreement with a similar work reported by Njitang et al., (2007) (0.734 – 0.773 g/cm^3 but greater than 0.43 – 0.49g/cm^3 reported by Tagodoe and Nip (1994). Swelling power is a measure of hydration capacity of starch and is usually expressed as the weight of centrifuged swollen granules, divided by the weight of the original dry starch used to make the paste (Shimelis et al., 2006). The swelling power ranged from 3.88 – 5.63g/ml. it was observed that there are significant differences among the sample treated ($p<0.05$). The solubility index varied from 14.23 – 14.94g/ml indicating no significant difference among sample. According to Adebowale et al (2005) the soaking period does not play any significant effect on the solubility of dried ogi and may be unconnected with the temperature of drying. Wettability described how readily a dry flour sample absorbs moisture and ranged from 2.31 – 3.03 seconds, revealing significant difference among treated samples. Dispersibility is an index of the sample. Sample with the highest dispersibility value will have the ability to disperse more easily and faster in aqueous solution or in food

The colour analysis of the effect of soaking in ogi flour produced form sorghum fortified with ginger are as shown in table 3. There are significant differences in terms of the lightness and redness of the sample ($P<0.05$) while there are no significant differences in terms of yellowness of the sample evaluated. For example, there was progressive increase in the lightness of the sample as the soaking period increases

Table 4 showed the results of sensory evaluation of ogi flour produced from sorghum fortified with ginger subjected to different soaking periods. There are significant differences in terms of the quality attributes evaluated i.e the colour, flavour, taste (Sourness), Mouthfeel and overall acceptability. The value of colour ranged from 5.26 -7.78, flavour varied from 6.58 – 8.75, taste (Sourness) ranged from 7.32 – 8.89 mouth feel varied from 5.14 – 74.2 while the overall acceptability ranged from 5.55 – 8.78. The highest means score for overall acceptability revealed that sample soaked for 24 hours was most preferred hence rated the best while sample soaked for 48 hours was rated as the least among all ogi samples

Conclusion

The research work has shown that soaking period significantly affected the quality properties of the ogi flour produced from sorghum fortified with ginger in terms of the proximate composition which decreased with increased in the soaking periods. Also, significantly affected are the functional, colour, and sensory properties.

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