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Original Article

EFFECT OF SOYBEAN FORTIFICATION ON THE NUTRITIONAL PROPERTIES OF CORN MEALS

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ABSTRACT

The effect of soybeans fortification on sensory and nutritional quality (proximate analysis) of *ogi* was investigate during four groups of *ogi* samples; Sample A contained soybeans, guinea corn, and maize, B contained maize and guinea corn while C contained only maize and D contained only guinea corn. Sensory evaluation of the composite *ogi* was carried out by a ten man panel comprising the students of Federal University of Technology Minna who are familiar with the product. The parameters evaluated were appearance, colour, aroma, taste and texture using a 7- point hedonic scale, ranging from 1 = dislike very much to 7 = like very much. The pH of the fermenting *ogi* decreased steadily during fermentation process from 4.18±0.03 to 3.11±0.01. Lactic acid bacteria (LAB) and yeast count increased in all the samples with increase in fermentation time with yeast predominating at the end of 72hrs. The following nutritional values were observed for samples A, B, C and D respectively; Protein; 15.50±0.02%, 11.2±0.02%, 10.30±0.02%, 11.40±0.02%, Ash; 1.31±0.02%, 0.82±0.01%, 0.02±0.01%, 0.86±0.02% and Fat 8.47±0.01%, 5.80±0.01%, 6.70±0.02%, 5.20±0.01%. The mentioned nutritional values in composite *ogi* fortified with soybeans were significantly higher ($p \leq 0.05$) compared to other samples. However, the sensory scores for maize *ogi* fortified with soybeans and unfortified maize *ogi* were

preferred to other samples. This study revealed that fortification of composite *ogi* with soybean improved the nutritional and sensory quality of ogi.

Keywords: Composite Ogi, Nutritional values, Sensory values, Fortifications

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INTRODUCTION

Ogi is a fermented porridge or gruel from Africa and West-Africans in particular, which is made from cereals of any type. It serves as a major weaning food for the infant in West Africa (Oyewole, 1997). Ogi is consumed as breakfast meal by many and it serves as a choice food for the sick (Oyewole, 1997). During preparation of these fermented cereal foods, nutrients including protein and minerals are lost from the grains thereby affecting nutritional quality adversely (Aminigo and Akingbala, 2004). Such foods are often of poor protein qualities and have high paste properties. Efforts to improve the nutritional status of these staples have been based on fortification with legumes to provide the deficient amino acids (Osundahunsi *et al.*, 2003). Various attempts that have been made towards nutrient restoration and fortification of ogi include blending with fermented and unfermented legumes (Otunola *et al.*, 2006). Soybeans fortification has also been reported to have been used to improve the nutritional quality of ogi (Oluwamukomi *et al.*, 2005; Adeleke and Oyewole, 2010). Lactic acid bacteria and yeast have been identified as the most predominant microorganisms involved in the fermentation of ogi (Odunfa and Adeyele, 1985). The presences of micro organisms during the fermentation process play important roles for aroma, microbial stability and flavour (Omemu *et al.*, 2007).

It is also very possible to improve upon the nutritional content of ogi by combining two or more different cereals (Banigo and Muller, 1972).

The present study was aimed at improving the nutritional and sensory quality of *ogi* using soybeans fortification and a combination of guinea corn and maize in comparison with *ogi* made from either guinea corn or maize alone.

The objectives of the study are to improve the nutritional and sensory quality of ogi using soybeans fortification through fermentation process.

MATERIALS AND METHODS

Source of soybeans and cereals

The soybeans, guinea corn and maize used in this study were obtained from Bosso Market Minna in Niger State, Nigeria, packaged in a clean polythene bag and kept at ambient temperature (27˚C) prior to usage. All chemical reagents used were of analytical grade.

Preparation of composite '*Ogi*'

'Ogi' was prepared using a modified method described by Adesokan *et al.* (2010). The dirts in the samples were picked before being washed with clean water. The maize and guinea corns were steeped in separate plastic containers for 3 days. Soybeans were parboiled for 20 min after which it was dehulled manually. The dehulled soybeans were then added to the softened grains of guinea corn and maize at appropriate ratio, and then milled into slurry. The slurry was sieved using muslin cloth, which separated the pomace from the filtrate. The filtrate was then allowed to settle and ferment for 3 days. The

proportion of guinea corn, maize and soybeans used in the production of fortified composite ogi (Sample A) were in ratio 9:9:2 respectively while sample B contained maize and guinea corn are of equal ratio. The sample C and D were prepared from only maize or guinea corn respectively. During the fermentation process, the pH and microbiological analyses of the products were carried out while the sensory evaluation and proximate analysis were carried out on the cooked products.

Physico-Chemical Analysis

The pH of the various ogi samples was determined at 24 h interval using the digital pH meter. Proximate compositions such as %crude protein, %crude fibre, %ash, %carbohydrate (%CHO) and %moisture content (MC) of the prepared ogi meals were determined using standard procedures as described by AOAC (1990).

Microbial Analysis

Selected microbial identification and microbial counts were done using spread plate method as described below:

Total Lactic Acid Bacteria Count

Total lactic acid bacteria counts of freshly fermented corn meals were performed on Nutrient Agar Plates, then, incubated at 37^0C. The colonies which appeared after incubation period were counted as logarithm of colony-forming units (Log Cfu/ml) sample. The colony characteristics and cell morphology were observed microscopically after gram staining. All cultures were identified according to Holt (1986).

Yeast Count

The yeast counts of fresh, fermented corn meals were done using Potato Dextrose Agar. Plates were incubated at room temperature (27-30^0C) for 3 to 5 days and isolates identified according to Barnett *et al.* (2000).

Preparation of cooked *Ogi*

Ogi was prepared by separately heating the slurry of the fermented ogi samples in boiling water under constant stirring using a clean stirrer to form a thick paste. The prepared ogi was allowed to cool and was transferred into a sterile, thick; transparent polyethylene bags, tied and stored at ambient temperature (28±2°C).

Sensory Evaluation

Sensory evaluation of the composite ogi was carried out by a ten-man panel made up of the students of Federal University of Technology Minna who were familiar with the product. The parameters evaluated were appearance, colour, aroma, taste and texture using a 7- point's hedonic scale, ranging from 1 = dislike very much to 7 = like very much.

Statistical Analysis

The data obtained were expressed as mean ± standard error (X±SEM); the significant differences between the means were analyzed using SPSS ver. 21.0 statistical package. The level of significance ($P>0.05$) was determined with Duncan Multiple Range Test.

RESULTS

There was a decrease in pH during the fermentation process, ranging from 5.60 to 3.11 as shown in Table 1. The group A and B samples showed significant high pH ($p>0.05$) throughout the fermentation process. The percentage protein and fat contents of sample A are significantly high ($p>0.05$) when compared to other samples as shown in table 2. However, sample D contain high moisture content when compared to others with high protein next to sample A. Nevertheless, group C recorded significant high ($p>0.05$) percentage crude fibre content. Sample C showed high significant sensory values in appearance, colour and texture, followed by sample A. However, there was no significant different ($p> 0.05$) between the tastes and textures of samples A and C as shown in table 3. Generally, the yeast and LAB count (cfu/ml) increased steadily from 0hour to 72hrs with highest count in sample D after 24hours of fermentation. However, sample A showed the lowest yeast and LAB count throughout the fermentation process as shown in figure 1.

Table 1: Change in pH of the *Ogi* Samples with Fermentation Time

	0 HOUR	24HOURS	48 HOURS	72HOURS
A	5.60 ± 0.02^{a}	4.10 ± 0.02^{d}	3.71 ± 0.01^{a}	3.30 ± 0.01^{a}
B	5.59 ± 0.01^{a}	4.11 ± 0.02^{c}	3.68 ± 0.01^{b}	3.15 ± 0.02^{c}
C	5.30 ± 0.02^{b}	4.13 ± 0.02^{b}	3.44 ± 0.02^{d}	3.21 ± 0.03^{b}
D	5.05 ± 0.02^{c}	4.18 ± 0.03^{a}	3.56 ± 0.01^{c}	3.11 ± 0.02^{d}

A = Maize + Guinea corn +Soybean (9:9:2), B=Maize + Guinea corn (equal ratio), C=Maize, D = Guinea corn.
*Values are Mean of triplicates ±Standard Error Mean (SEM).
Values with the same superscript in the same column are not significantly different ($p>0.05$)

Table 2: Proximate Composition of the Prepared *Ogi* Meal Samples

	A	B	C	D
Moisture %	9.93 ± 0.01^{a}	9.46 ± 0.01^{c}	9.20 ± 0.03^{d}	9.60 ± 0.02^{b}
Ash %	1.31 ± 0.02^{a}	0.82 ± 0.01^{c}	0.20 ± 0.01^{d}	0.86 ± 0.02^{b}
Crude Fibre %	2.61 ± 0.01^{b}	2.16 ± 0.01^{c}	3.04 ± 0.02^{a}	2.02 ± 0.01^{a}
Crude Protein%	15.50 ± 0.02^{a}	11.20 ± 0.02^{c}	10.30 ± 0.02^{d}	11.40 ± 0.01^{b}
Fat %	8.47 ± 0.01^{a}	5.80 ± 0.01^{c}	6.70 ± 0.02^{b}	5.20 ± 0.01^{d}
Carbohydrate%	61.20 ± 0.05^{b}	70.45 ± 0.04^{a}	70.42 ± 0.03^{a}	70.50 ± 0.05^{a}

A = Maize+Guinea corn+Soybean (9:9:2), B = Maize + Guinea corn (equal ratio), C = Maize, D = Guinea corn.
Values are Mean of triplicates ±Standard Error Mean (SEM).Values with the same superscript in the same column are not significantly different ($p>0.05$)

Table 3: Sensory Evaluation of the Prepared *Ogi* Meal Samples

Sample	Appearance	Colour	Aroma	Taste	Texture
A	$6.00^{b}\pm0.17$	$5.20^{b}\pm0.20$	$6.20^{a}\pm0.23$	$6.20^{a}\pm0.23$	$5.60^{a}\pm0.12$
B	$4.40^{c}\pm0.21$	$3.80^{c}\pm0.21$	$4.80^{c}\pm0.23$	$5.00^{b}\pm0.17$	$4.20^{b}\pm0.23$
C	$6.40^{a}\pm0.23$	$6.40^{a}\pm0.23$	$6.00^{b}\pm0.17$	$6.20^{a}\pm0.21$	$5.80^{a}\pm0.21$
D	$2.40^{d}\pm0.21$	$3.60^{c}\pm0.23$	$6.00^{b}\pm0.21$	$3.00^{c}\pm0.17$	$1.40^{c}\pm0.38$

*Values are Mean of triplicates ±Standard Error Mean (SEM).Values with the same superscript in the same column are not significantly different ($p>0.05$).

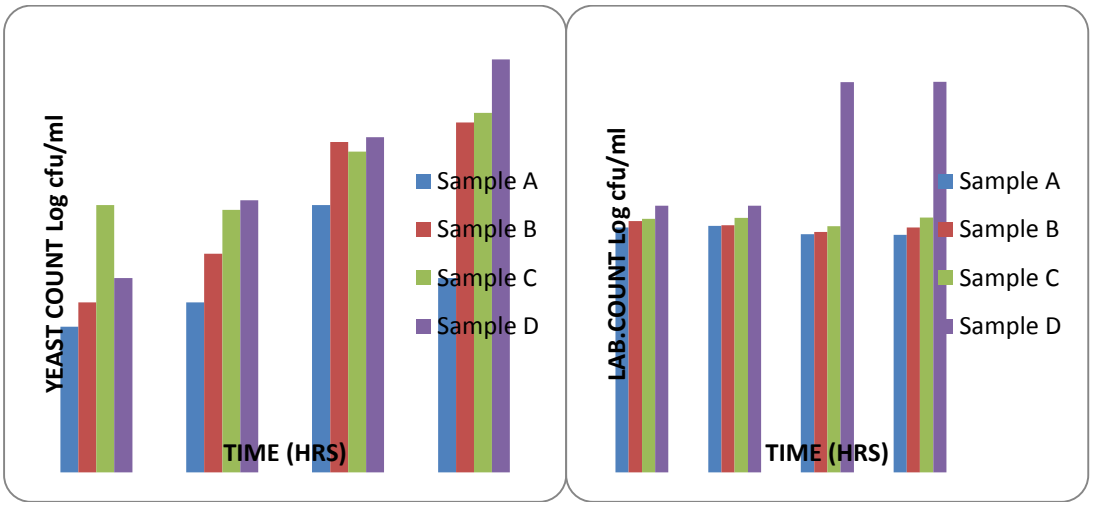

Figure 1; Yeast Count and Lactic Acid Bacterial (Log Cfu /mL)
A = Maize + Guinea corn +Soybean (9:9:2), B=Maize + Guinea corn (equal ratio), C=Maize, D = Guinea corn.

DISCUSSIONS

The results from this study showed that there was a decrease in pH during the fermentation process, ranging from 5.60 to 3.11 as shown in Table 1. This could be as a result of acid production by the fermentative organisms such as lactic acid bacteria as suggested by (Oyewole, 1997). The increase in LAB bacterial during fermentation was also reported in some traditional fermented foods in Nigeria by Odunfa and Adeyele (1985).The highest protein content was recorded in sample produced from a combination of maize, sorghum and soybeans. Previous studies have indicated that loss in nutrient during the various stages of ogi production might be compensated by combining two different cereals(Banigo and Muller, 1972); and incorporation of soybeans (Adeleke and Oyewole., 2010). Kolapo and Sanni (2005) and Sanni and Sobamiwa (1994), also reported improvement in protein content of tapioca and *gari* respectively due to fortification with soybeans. There was a significant difference in sensory property of 'ogi' samples fortified with soybeans and unfortified samples except in the case of maize ogi that was also highly preferred by the taste panel to fortified ogi. The maize samples and fortified samples were rated best in all the tested parameters. This might be as a result of the quantity of combined cereal used in fortified samples that might suppress the beany taste of fortified samples, for this reason there is no agreement with the reports of previous studies carried out by Sanni

and Sobamiwa (1994) and Kolapo and Sanni (2005) on the sensory quality. They reported that the beany taste of the composite *Ogi* meal which was derived from the soybeans made the meals unacceptable to the taste panels. Likewise, the general acceptability of maize samples might be due to the familiarity of the samples to the taste panels. The unfortified sorghum samples were rated lowest among the samples by the taste panels. This study revealed that incorporation of soybeans in the composite ogi produced from maize and sorghum in ratio 9:9:2 significantly improved the nutritional and sensory qualities of the product and was generally acceptable by the taste panel.

CONCLUSIONS

This study shows that the fortification of composite ogi with small ratio of soybeans has the ability to increase its nutritional values with improved sensory qualities.

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