Food and Nutrition Sciences, 2015, 6, 234-241
Published Online February 2015 in SciRes. http://www.scirp.org/journal/fns
http://dx.doi.org/10.4236/fns.2015.62024

Nutritional and Sensory Evaluation of Rice-Based *Masa* Enriched with Soybean and Crayfish

Folake O. Samuel[1], Oluwaseun R. Ishola[2], Bolanle O. Otegbayo[3]

[1]Department of Human Nutrition, Faculty of Public Health, University of Ibadan, Ibadan, Nigeria
[2]Department of Chemical, Fibre and Environmental Technology, Federal Institute of Industrial Research, Oshodi, Lagos, Nigeria
[3]Department of Food Science and Technology, Faculty of Agriculture, Bowen University, Iwo, Nigeria
Email: samuelfolake@yahoo.co.uk

Received 19 January 2015; accepted 6 February 2015; published 11 February 2015

Abstract

***Masa* is a cereal based snack made from rice, maize or millet. It is popularly consumed in the northern regions of Nigeria. The objective of this work was to assess the nutritional and sensory properties of the rice-*masa*, enriched with soybean and crayfish. The enriched rice-*masa* produced were labelled sample A (100% rice), sample B (rice: soybean blend (80:20), sample C (rice: crayfish blend (80:20) and sample D (rice: soybean: crayfish (80:10:10). The proximate and mineral composition was evaluated according to standard methods. Anti-nutrient content was also determined. Sensory evaluation was carried out to assess the acceptability of the enriched rice-*masa*. The chemical analysis showed that protein, fibre, iron, zinc and vitamin A and beta carotene contents were highest in sample D with values 8.35 (±0.08) g/100g, 1.08 (±0.02) g/100g, 2.82 (±0.03) mg/100g, 4.20 (±0.03) mg/100g, 602.3 (±1.28) μg/100g and 420.2 (±0.98) μg/100g respectively, while calcium was highest in sample C with a value of 27.34 (±0.06) mg/100g. Moisture and ash contents increased from 47.4 (±0.50) g/100g to 50.9 (±0.80) g/100g and 0.40 (±0.01) g/100g to 1.15 (±0.01) g/100g respectively, while carbohydrate and energy contents decreased from 28.1 (±0.03) g/100g to 21.9 (±0.04) g/100g and 308.42 kcal/100g to 285.64 kcal/100g respectively. The sensory evaluation showed that with regards to taste, aroma, texture and overall acceptability, the sample enriched with soybean was more preferred to that enriched with crayfish, or a combination of both. Enrichment of *masa* could contribute to improvement of nutritional status if promoted as a nutritious, healthy indigenous snack not only where *masa* is already widely consumed, but also in other parts of Nigeria where it has not found wide acceptance.**

How to cite this paper: Samuel, F.O., Ishola, O.R. and Otegbayo, B.O. (2015) Nutritional and Sensory Evaluation of Rice-Based *Masa* Enriched with Soybean and Crayfish. *Food and Nutrition Sciences*, **6**, 234-241.
http://dx.doi.org/10.4236/fns.2015.62024

Keywords

Indigenous Snacks, Rice, *Masa*, Soybean, Crayfish, Enrichment

1. Introduction

Globally a nutrition transition is occurring, as shown by swift and widespread shifts in food consumption patterns towards the western diet and lifestyle. Accompanying this is an increased prevalence of diet-related diseases. Developing countries are gradually experiencing a shift from the utilization of indigenous snacks in favour of pastries and western type of snacks especially amongst urban and peri-urban dwellers. In Nigeria, there exist a variety of indigenous snacks such as "*Aadun*", a maize-based snack, "*Ojojo*" made from water yam, "*Kulikuli*" from groundnuts, and "*Masa*", a muffin-like snack made from cereals, among several others. The consumption of these and other snacks dates back several decades in the country's history, especially among the low income populace, thus contributing to the overall dietary nutrient intake [1]. However, some indigenous snacks are deficient in one or more essential nutrient. There is therefore a need to improve their nutritional quality thus providing a nutritious and healthier alternative to western snacks which can be acceptable by the consumers.

Masa is a yeast-fermented product which is round in shape, and is prepared in Nigeria and some other West African countries from the flour from millet, maize or rice flour [2]. The product is cooked in a pan with individual cuplike depressions, and is consumed in various forms by all age groups in the Northern states of Nigeria [3], but less so in the Southern and eastern states, except for few rural communities in south western Nigeria where northern immigrants are found. *Masa* is served either as breakfast, a snack item or sometimes with local soup as a muffin [2]. Like most single cereal based products which are generally low in protein and micronutrients [4], rice-*masa* is no exception as it is deficient in amino acid lysine [5]. Studies have been done on the enrichment of *masa* using cereal legume combinations [2] [3] [5] with the results indicating a significant improvement in nutritional quality.

Nigerian cereal products have been successfully enriched using legumes, in particular, soybean. Soy-enriched maize pap ("soy-ogi") was developed by the Federal Institute of Industrial Research, Oshodi Nigeria (FIIRO), and has established processed technologies for soy-ogi production for both infants and adults [6]. Samuel and Otegbayo also evaluated the chemical and sensory properties of "*ogi*" enriched with soybean and crayfish, showing that supplementation with legume and animal-based protein-rich foods increased the nutritive value of *ogi* [7]. Nkama and Malleshi had earlier pointed out that though *masa* is as popular as ogi (fermented cereal gruel), it receives very little attention [3]. The work of Ayo *et al.* [2] [8] extended the knowledge frontier on *masa*, however, review of recent literature showed that there is room for more research on enrichment of *masa*.

The aim of this study was to evaluate the nutrient, anti-nutrient and sensory properties of rice-based *masa* enriched with soy flour and crayfish flour.

2. Materials and Methods

2.1. Materials

Local white rice (*Oryza sativa* L.), soybean (*Glycine max*), crayfish (*Nematopalae monhastatus*), baker's yeast (*Sacharomyces cerevisiae*), Sodium bicarbonate were purchased at Bodija Market, Ibadan, Oyo State.

2.2. Methods

The *masa* samples were prepared in the Dietetics kitchen, Department of Human Nutrition, University of Ibadan. The rice, soybean and crayfish flour was prepared according to the methods described in the literature [2] [9] [10]. The recipe and procedure for the preparation of rice-*masa* samples was developed by modifying methods as described in earlier studies [2] [3] and from local producers of *masa* in Ibadan. **Figure 1** shows the flow chart for the production of rice-*masa*, while the recipe for the production of rice based *masa* is highlighted in **Table 1**.

Soybean-enriched *masa*: Soybean-enriched *masa* was prepared by substituting portions of rice flour with soybeans flour at 20% substitution levels. The soybeans was pre-treated in water for 2 hours and boiled for 20

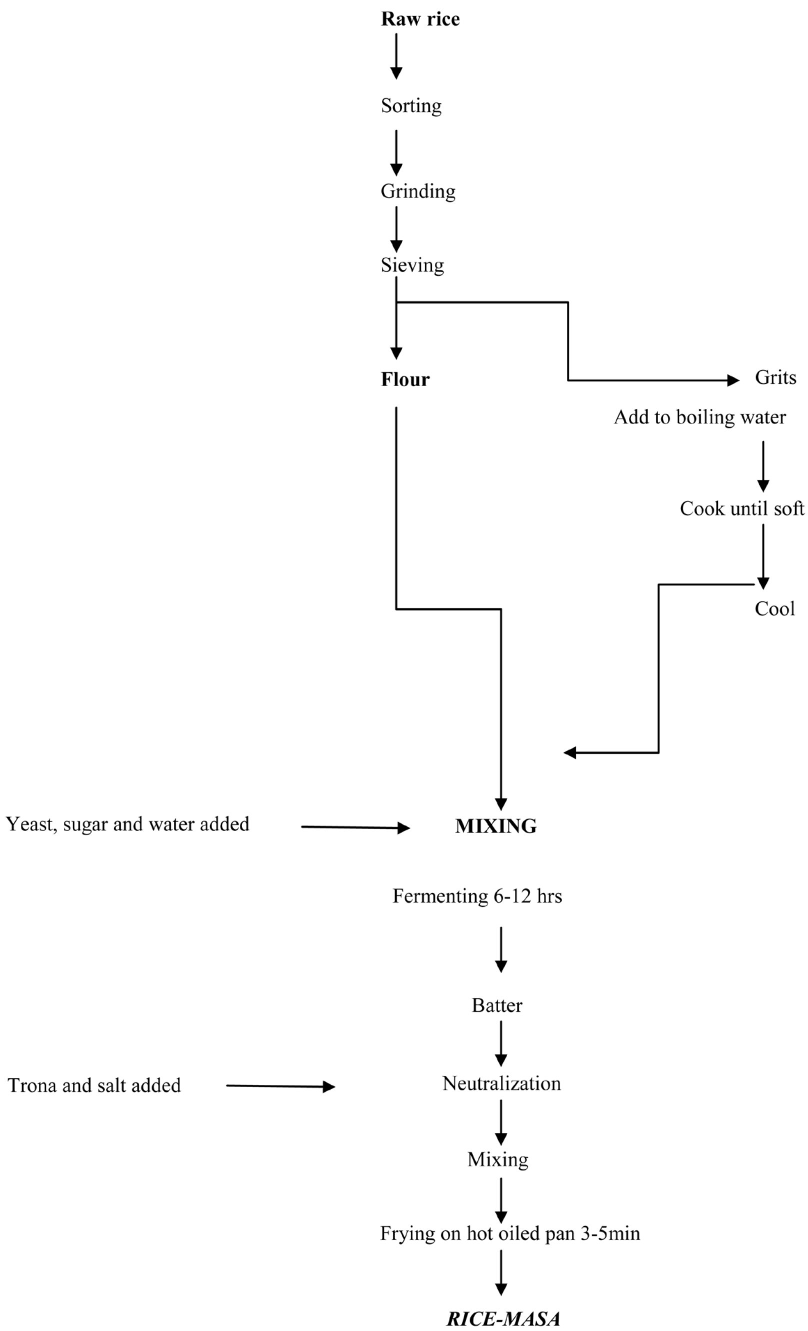

Figure 1. Flow chart for the production of rice-*masa*.

minutes to inactivate its trypsin inhibitor activity and reduce the beany flavour [11]. The boiled beans were dehulled by abrasion. The dehulled soybean was dried, roasted and then milled into flour to obtain soybean flour. For enrichment, the soybean flour was mixed with the rice flour (ratio 80:20) to obtain composite flour.

Crayfish enriched *masa*: Crayfish enriched *masa* was prepared by substituting portions of rice flour with crayfish flour in the ratio 80:20. The crayfish was sorted, cleaned and sundried. The dried crayfish was milled and sieved with 30mm particle size sieve to obtain crayfish flour.

Soybean and crayfish enriched *masa*: The soybean and crayfish enriched *masa* was prepared by substituting portions 20% of rice flour with 10% soybean flour and 10% crayfish flour (*i.e*. ratio 80:10:10 respectively). **Figure 1** shows the flowchart for the production of rice-*masa*.

Table 1. Recipe for the production of rice-*masa*.

Raw material (g)	Sample A	Sample B	Sample C	Sample D
Rice (g)	500	400	400	400
Soybean (g)	-	100	-	50
Crayfish (g)	-	-	100	50
Water (cm^3)	600	600	600	600
Sugar (g)	30	30	30	30
*Trona (cm^3)	10	10	10	10
Yeast (g)	5	5	5	5
Frying oil (cm^3)	12	12	12	12
Salt	Pinch	Pinch	Pinch	Pinch

*20% solution of Trona.

2.3. Chemical Analysis of Samples

The proximate and mineral composition as well as anti-nutritional properties of the samples were determined according to methods described by AOAC [12]. The energy content was calculated by multiplying the nutrient content by factors 4, 4 and 9 for carbohydrate protein and fat respectively. All the analyses were done in triplicate. The mean scores were compared using one way analysis of variance (ANOVA), bonferroni multiple comparison test.

2.4. Sensory Evaluation

The sensory evaluation of the samples were carried out for consumer acceptance and preference using 20 panellists who were randomly selected from among students and staff of the Department of Human Nutrition, University of Ibadan, Nigeria. University of Ibadan is located in the South-Western part of the country, where *masa* is not widely consumed. A 9-point hedonic scale, where "1" representing "extremely dislike" and "9" representing "extremely like" was used. The mean scores were differentiated using analysis of variance methods. The qualities assessed include colour, taste, odour, texture, appearance and general acceptance. Coded samples of the same size and temperature (29˚C) were served on a (white) coloured plate to judges in each panel.

2.5. Data Analysis

The mean and standard deviation of the triplicate determinations of the nutrient, anti-nutrient, functional and sensory values were calculated. One-way analysis of variance was used to test for significant differences in the nutrient, anti-nutrient and sensory properties of the snack samples.

3. Results and Discussion

3.1. Proximate Composition

The proximate composition of traditional rice-*masa* and enriched rice-*masa* samples as well as the cooked rice sample are shown in **Table 2**.

The energy content of the *masa* samples (A, B, C, D) were higher than the energy content of the cooked rice. The same was observed for protein, fat and ash. The fibre and carbohydrate contents of samples A, B and D was higher than that of the cooked rice. Sample C on the other hand, had the same values as cooked rice in both carbohydrate and fibre. It can be observed that local rice produced in form of *masa*, provides higher nutrients than its traditional cooked form. The moisture content of sample A, B, C, D, as shown in **Table 2**, ranged between 47.4% and 50.9%. These values are slightly lower than the moisture content of traditionally baked *masa*, which was about 56% as reported by Nkama and Malleshi [3]. The moisture content of 100% rice *masa* reported in this study was higher than reported by Ayo *et al.* [2] for rice-*masa*. Moisture content was highest in sample C and lowest in sample A. Significant difference ($P < 0.05$) was observed between the means. The moisture content of the cooked rice was significantly higher than those of the *masa* samples. The carbohydrate content of the four

Table 2. Proximate composition of rice-*masa* and enriched *masa* samples.

	Sample A	Sample B	Sample C	Sample D	Sample E
% Moisture content	47.4 ± 0.50[a]	48.8 ± 0.41[b]	50.9 ± 0.80[c]	48.7 ± 0.10[b]	72.7 ± 0.08[d]
% Crude protein	4.23 ± 0.72[a]	7.12 ± 0.67[b]	7.21 ± 0.07[b]	8.35 ± 0.08[c]	2.90 ± 0.04[d]
% Crude fat	19.9 ± 0.04[a]	20.8 ± 0.01[b]	18.8 ± 0.04[c]	18.4 ± 0.43[c]	2.23 ± 0.03[d]
% Ash	0.40 ± 0.01[a]	0.52 ± 0.01[b]	1.15 ± 0.01[c]	0.92 ± 0.05[d]	0.20 ± 0.01[e]
% Fibre	0.34 ± 0.01[a]	0.89 ± 0.03[b]	0.62 ± 0.01[c]	1.08 ± 0.02[d]	0.62 ± 0.01[e]
% Carbohydrate	28.1 ± 0.03[a]	22.7 ± 0.08[b]	21.9 ± 0.04[c]	23.8 ± 0.07[d]	21.9 ± 0.02[ec]
Energy (kcal/g)	308.42	306.48	285.64	294.2	119.51

Mean scores having the same alphabet along the same row are not significantly different P = 0.05; Values are means ± standard deviation of triplicate determination; KEY: Sample A = 100% rice *masa*; Sample B = 80% rice:20% soybean *masa*; Sample C = 80% rice:20% crayfish *masa*; Sample D = 80% rice:10% soybean: 10% crayfish *masa*; Sample E = cooked polished rice.

samples varied from 21.9% to 28.1%, with sample A having the highest value compared with samples B, C, D, with significant difference (P < 0.05) was observed between the means. Protein content of the *masa* samples increased significantly (P < 0.05) from 4.23% to 8.35%. Sample D had significantly higher protein content than all the samples, this significant increase is due to the addition of both plant (soybean) and animal sources (crayfish) of high quality protein. The protein content of sample A (100% rice *masa*) was lower than 7.59% reported by other studies [2] [3] [13]. The variation in the protein content of the rice *masa* reported by the authors may due to differences in the chemical composition of variety of rice that was used. The protein content of enriched *masa* samples was significantly higher than that of 100% rice *masa* sample. Hence the addition of either soybean or crayfish to rice-*masa* significantly increased the protein content of the snack. The protein, carbohydrate and energy content of the enriched samples were also lower than that of rice *masa* supplemented with cowpea and groundnut [3]. Fat content varied between the samples from 18.4% to 20.8%, and this was significantly higher in rice-*masa* than what was previously reported [2]. The fat content was highest in the soybean enriched *masa* (sample B), this could be attributed to the high fat content of soybean. However, a major contributor of fat in the *masa* samples is the vegetable oil that was used in frying. The ash and fibre content of the *masa* samples varied between 0.4% to 1.15% and 0.34% to 1.08% respectively, these varied significantly among the four samples. The enriched *masa* samples still had higher ash content than the rice *masa* with the highest in sample D, though the ash content of the *masa* samples were lower than what was reported in literature [2] [13].

3.2. Micronutrient Composition

Table 3 shows the micronutrient content of the samples. The iron content of the samples ranged from 0.03 mg/100g to 2.82 mg/100g. *Masa* samples enriched with crayfish showed higher iron contents. However the combination of both soybean and crayfish gave the highest iron hence the addition of crayfish to the soybean enriched *masa* samples would lead to a significant increase in iron content of the snack. The calcium content of the four samples varied from 13.15 mg/100g to 27.34 mg/100g. Significant difference (P < 0.05) was observed between the means. The calcium content of the crayfish enriched *masa* was higher than that of the soybean enriched *masa* and this could be attributed to the higher calcium content of the crayfish compared to soybean which is a legume and has lower calcium.

Zinc content of the samples varied from 1.51 mg/100g to 4.20 mg/100g, with higher values observed in samples C and D. Zinc was highest in sample D, having a mean value of 4.20 mg/100g with a significant difference between the means of the other samples. Sample D had the highest values for both zinc and iron. The zinc and iron content of the soybean and crayfish enriched *masa* was significantly higher than the report for cowpea enriched *masa* [3]. Vitamin A values were not determined for sample A and B, since they do not contain animal source of food, rather beta-carotene was determined. The beta-carotene content increased from 388.5 µg/100g to 420.2 µg/100g and was highest in the sample D. Significant difference (P < 0.05) was observed between the means.

Table 3. Micronutrient composition of rice-*masa* and enriched *masa* samples.

	Sample A	Sample B	Sample C	Sample D
Vitamin A (μg/100g)	ND	ND	595.6 ± 1.12	602.3 ± 1.28
Beta carotene (μg/100g)	388.5 ± 0.81	413.8 ± 0.37	ND	420.2 ± 0.98
Calcium (mg/100g)	13.15 ± 0.04^a	14.08 ± 0.03^b	27.34 ± 0.06^c	15.63 ± 0.02^d
Iron (mg/100g)	1.94 ± 0.03^a	0.03 ± 0.00^b	2.54 ± 0.02^c	2.82 ± 0.03^d
Zinc (mg/100g)	1.51 ± 0.02^a	1.58 ± 0.03^a	1.68 ± 0.04^b	4.20 ± 0.03^c

Mean scores having the same alphabet along the same column are not significantly different P = 0.05; ND: Not determined; Values are means ± standard deviation of triplicate determination.

3.3. Anti-Nutrient Composition

It has been well documented that raw soybeans contain anti-nutritional compounds, which can be removed by various methods of processing. The anti-nutrient content of rice-*masa* and enriched rice-*masa* samples is shown in **Table 4**. The trypsin inhibitor was only determined in samples containing soybean, which has been reported to contain trypsin inhibitor [14] [15]. The mean values for Trypsin Inhibitor Units (TIU) per milligram were quite low, ranging from 0.10 to 0.12 per mg of each sample; and TIU was not determined for two samples which are the samples that lack soybean as part of their constituents. Phytate, on the other hand, ranged from 0.002 to 0.006 percent while oxalate ranged from 0.005 to 0.009 percent. Phytates and oxalates were highest in sample A and lowest in sample C, though at levels safe for consumption. There was a significant difference ($P < 0.05$) in the phytate and oxalate content among all the samples. Oxalates form complexes with calcium, magnesium and iron leading to formation of insoluble salts and resulting in the formation of oxalates stones, and has also been known to inhibit potassium and sodium.

3.4. Sensory Attributes

Mean scores of all sensory attributes for each of the samples as evaluated by the panelists are shown in **Table 5**. The overall acceptability of the four samples showed that sample A was the most accepted while sample C, the rice-*masa* with crayfish was the least accepted of the four samples with mean scores of 7.05 and 3.90 respectively, rated on the basis of the score of "1" being "extremely dislike" and "9" being "extremely like".

Specifically, for appearance, scores of the four samples ranged from 5.80 to 6.80 with samples C and D rating the lowest and highest respectively, however there was no significant difference among the samples in terms of their appearance. Taste of the four samples differed significantly, and ranged from 3.65 to 6.85 with samples C and A rating the lowest and highest respectively. For aroma, samples C and A rated lowest and highest respectively. The mean score also shows that sample A was rated highest and sample C lowest in terms of taste and aroma. This could be associated to the fermentation of crayfish alongside rice for 12 hours, during the production of *masa*. This result does not agree with the recommendation that fermentation of rice, soybean and crayfish can attain 24 hrs [16] as taste is a very important factor in ensuring consumer acceptance and willingness to adopting enriched foods. Although sample A was the most preferred in texture with a mean score of 5.85, there was no significant difference in the mean scores for texture, showing that enrichment did not significantly alter the texture of *masa*.

4. Conclusions

This study shows that soybeans and crayfish can be employed as enrichment materials in the production of traditional rice-based *masa*. Although the crayfish enriched *masa* gave more desirable results in improving the protein as well as micronutrient content of the snack, its sensory attributes were poorer than that of soy enriched sample. On the other hand, enrichment of *masa* with full fat soy flour considerably improved the nutrient content in terms of protein, fat and micronutrients; the sensory characteristics were rated acceptable by panel lists, and were safe for consumption giving the low level of anti-nutrients.

As an indigenous food sold in a ready-to-eat form, enriched *masa* has potential to be promoted as a nutritious, healthy food choice for breakfast or as a snack not only where *masa* is already widely consumed, but also in other parts of Nigeria where it has not found wide acceptance. Part of the applicability of this research lies in the

Table 4. Anti-nutrient composition of rice-*masa* and enriched *masa* samples.

	Sample A	Sample B	Sample C	Sample D
Trypsin inhibitor (TIU/mg)	ND	0.12 ± 0.11	ND	0.10 ± 0.01
Phytate (%)	0.006 ± 0.00[abc]	0.003 ± 0.00[a]	0.002 ± 0.00[b]	0.004 ± 0.00[c]
Oxalate (%)	0.009 ± 0.05 [a]	0.006 ± 0.00[b]	0.005 ± 0.00[c]	0.007 ± 0.02[d]

ND: Not determined; Values are means± standard deviation of triplicate determination.

Table 5. Sensory properties of rice-*masa* and enriched *masa* samples.

	Sample A	Sample B	Sample C	Sample D
Appearance	6.26 ± 1.41[a]	6.65 ± 1.49[a]	5.80 ± 1.43[a]	6.80 ± 1.32[a]
Taste	6.85 ± 0.98[a]	5.25 ± 1.73[ab]	3.65 ± 2.30[b]	4.15 ± 2.22[b]
Aroma	6.60 ± 1.09[a]	5.60 ± 1.53[a]	4.05 ± 2.21[b]	5.15 ± 1.78[ab]
Texture	5.85 ± 1.38[a]	5.30 ± 1.80[a]	5.30 ± 1.75[a]	5.39 ± 2.07[a]
Overall acceptability	7.05 ± 0.99[a]	5.90 ± 1.71[ac]	3.90 ± 2.33[b]	5.05 ± 1.90[bc]

Mean scores having the same alphabet along the same row are not significantly different P = 0.05; Values are means± standard deviation of triplicate determination.

possibility of promoting enriched *masa* as an underutilized yet nutritious food product among populations where it remains largely unexploited. Consumption of indigenous foods and snacks is gradually being abandoned by urban and peri-urban dwellers in Nigeria, in favour of pastries and western type of snacks. For future research, *masa* can be improved and promoted not only for poor rural dwellers, but also as a street food for urban and peri-urban dwellers of different socio-economic status. Urban dwellers are often regular consumers of processed or fast foods, given the pressures of city life and being away from home for a greater part of the day, leaving little or no time to shop for foodstuffs or to prepare wholesome meals. Hence, the enrichment of *masa* could contribute significantly as a means of tackling undernutrition, as well as improving nutritional status when promoted in Nigeria.

References

[1] Aletor, O. and Ojelabi, A. (2007) Comparative Evaluation of Nutritive and Functional Attributes of Some Traditional Nigerian Snacks and Oil Seed Cakes. *Pakistan Journal of Nutrition*, **6**, 99-103. http://dx.doi.org/10.3923/pjn.2007.99.103

[2] Ayo, J.A., Agu. H., Ayo, V.A. and Famoriyo, O.F. (2008) Effect of Groundnut Paste on the Quality of Maize Based Masa. *Pakistan Journal of Nutrition*, **7**, 557-560. http://dx.doi.org/10.3923/pjn.2008.557.560

[3] Nkama, I. and Malleshi, N.G. (1998) Production and Nutritional Quality of Traditional Nigerian *Masa* from Mixtures of Rice, Pearl Millet, Cowpea, and Groundnut. *Food and Nutrition Bulletin*, **19**, 366-373.

[4] Akanbi, B.O., Agary, O.O. and Garba, S.A. (2010) Quality Assessment of Selected Cereal—Soybean Mixtures in "Ogi" Production. *New York Science Journal*, **3**.

[5] Nkama, I. (1993) Studies on Improving the Nutritional Quality of *Masa*. Tradition Nigeria Fermented Cereal Based Food. A Report. United Nations University CFTRI, Mysore.

[6] FIIRO (2014) Historical Background of Cereals and Legumes Division of the Federal Institute of Industrial Research, Oshodi. http://mail.fiiro.gov.ng/index.php/historical-background/48-seminar/181-cereals-and-legumes-division

[7] Samuel, F.O. and Otegbayo, B.O. (2006) Chemical Analysis and Sensory Evaluation of Ogi Enriched with Soybeans and Crayfish. *Nutrition and Food Science*, **36**, 214-217. http://dx.doi.org/10.1108/00346650610676785

[8] Ayo, J.A., Agu. H., Ayo, V.A. and Famoriyo, O.F. (2008) Effect of Different Cereals on the Quality of *Masa*. *Pakistan Journal of Nutrition*, **7**, 530-533. http://dx.doi.org/10.3923/pjn.2008.530.533

[9] Owusu-Kwarteng, J., Akabanda, F. and Glover, R.L.K. (2010) Effect of Soybean Fortification on Fermentation Characteristics and Consumer Acceptability of Hausa Koko, a Ghanaian Fermented Porridge. *Journal of Applied Biosciences*, **28**, 1712-1717.

[10] Iombor, T.T., Umoh, E.J. and Olakumi, E. (2009) Proximate Composition and Organoleptic Properties of Complementary Food Formulated from Millet (*Pennisetum psychostachynum*), Soybeans (*Glycine max*) and Crayfish (*Euas-*

tacus spp). *Pakistan Journal of Nutrition*, **8**, 1676-1679. http://dx.doi.org/10.3923/pjn.2009.1676.1679

[11] Plahar, W.A., Nti, C.A. and Annan, N.T. (1997) Effects of Soy Fortification Method on the Fermentation Characteristics and Nutritional Quality of Fermented Maize Meal. *Plant Foods for Human Nutrition*, **51**, 365-380. http://dx.doi.org/10.1023/A:1007996203309

[12] AOAC (2005) Official Methods of Analysis of the Association of Analytical Chemists International. 18th Edition, AOAC International, Gaithsburg.

[13] Igwe, E.C., Oyebode, Y.B. and Dandago, M.A. (2013) Effect of Fermentation Time and Leavening Agent on the Quality of Laboratory Produced and Market Samples of *Masa* (a Local Cereal Based Puff Batter). *African Journal of Food*, *Agriculture*, *Nutrition and Development*, **13**, 8415-8427.

[14] Hwang, D.L., Lin, K.T.D., Yang, W.K. and Foard, D.E. (1977) Purification, Partial Characterization, and Immunological Relationships of Multiple Low Molecular Weight Protease Inhibitors of Soybeans. *Biochimica et Biophysica Acta*, **495**, 369-382. http://dx.doi.org/10.1016/0005-2795(77)90392-0

[15] Kim, W.S., Chronis, D., Juergens, M., Schroeder A.C., Hyun, S.W., Jez, J.M. and Krishnan, H.B. (2012) Transgenic Soybean Plants Overexpressing O-Acetylserine Sulfhydrylase Accumulate Enhanced Levels of Cysteine and Bowman—Birk Protease Inhibitor in Seeds. *Planta*, **235**, 13-23.

[16] Odumodu, C.U. (2008) Effect of Malt Addition and Fermentation on Sensory Characteristics of Formulated Cereal Based Complementary Food. *Pakistan Journal of Nutrition*, **7**, 321-324.