Advance Journal of Food Science and Technology 5(3): 249-254, 2013
DOI:10.19026/ajfst.5.3252
ISSN: 2042-4868; e-ISSN: 2042-4876

Submitted: September 04, 2012 Accepted: October 24, 2012 Published: March 15, 2013

**Research Article**

# Quality of Garabia (A Nigerian Traditional Snack) From Four Varieties of Rice As Affected By the Addition of Cowpea

[1]M.H. Badau, [1]C. Ngozi and [2]N. Danbaba
[1]Department of Food Science and Technology, University of Maiduguri, PMB 1069, Maiduguri, Borno State, Nigeria
[2]Food Technology and Value Addition Program, National Cereals Research Department, Badeggi, PMB 8, Bida, Niger State, Nigeria

**Abstract:** An experiment was conducted to evaluate the nutritional and sensory attributes of garabia a traditional cereal-based snack of Nigeria manufactured from flour obtained from broken fractions of milled four popular rice varieties in Nigeria as a strategy for the improvement of rice postharvest system for improved income and livelihood. The mean moisture, protein, fat, ash and carbohydrate contents of rice-cowpea blend garabia were 2.25, 11.87, 34.83, 2.04, and 49.00%, respectively and ranged between 1.88 to 2.47% for moisture, 10.72 to 12.86% for protein with FARO 52 blend having the highest and NERICA-L34 recording the lowest value. Calcium was found to be the most abundant mineral in rice garabia. The calculated metabolizable energy values of the blended rice garabia showed that the products are concentrated energy sources and compares favorably snacks from other sources. Consumer overall acceptability (liking) rating was higher than 6 (like slightly) based on hedonic ratings based on 9-point hedonic scales indicating that the product are well-liked by the consumers. It can then be concluded that addition of cowpea to rice flour for the production of garabia significantly improves nutritive value of the products with little or no pronounced effect on consumer acceptability.

**Keywords:** Cowpea, garabia, livelihood, rice, snack, value-addition

## INTRODUCTION

Snack is a portion food often smaller than the regular meals and generally eaten between meals. It contributes an important part of many consumers' daily nutrient and calorie intake (Bhattacharyya *et al*., 1997). Snacks accompany social or simply nice moments. Traditionally, snacks are produced from commonly available ingredients in a locality and typically designed to be portable and quick satisfying. They often contain substantial amount of sweeteners, preservatives and appealing ingredient such as spices and flavors, and consumers, therefore can enjoy snack with good taste, flavor, pleasing texture and mouth feel and get 'fun eating' with nutrient supplements also (Martinez *et al*., 1998). Nowadays, snacks are popular food item which still enjoy steady increase in market size. In fact, it have many varieties which are different in shape, size, taste, aroma and food compositions and normally, they base are dehulled cereals, either in the form of flour or grit (Trongpanich *et al*., 2001). Most snacks are fun to eat but are low in nutritive value. If taken in large quantity, they can suppress the appetite for the main meal. For this reason, snack with high protein and fibre should be developed and promoted as a supplementary diet and must be produced from common food ingredients and meet consumer preference and sell at reasonable price (Prabhavat *et al*., 2000).

Garabia is a sweetened snack that is produced from rice, sugar, groundnut oil and spices (ginger, cloves, and pepper). It is a "Royal snack" that is mainly prepared by the Kauris and Shuwa Arabs of Yobe and Borno State (Kyari, 2002). In the olden days, only the Affluent class and royal families were served "garabia" hence the name "Royal Snack". Nowadays, it is prepared during occasions such as weddings, turbanings, naming ceremonies and other social occasions. The major ingredients used in garabia production are rice flour, sugar, groundnut oil, ginger, cloves and pepper. The ingredients are mixed in appropriate proportion and the resulting dough is then shaped using finjal cups and dry-fried in a local pan known as "ngaya" for 10-15 min (Kyari, 2002). Garabia has become a household snack among the Kanuris and Shuwas and can hardly miss in any celebration. Smallholder women food processors are making considerable income from garabia production and have support them financially.

**Corresponding Author:** N. Danbaba, Food Technology and Value Addition Program, National Cereals Research Department, Badeggi, PMB 8, Bida, Niger State, Nigeria

Cereal grains are the major sources of energy and protein in the diet of many Nigerians whose intake of protein from animal sources is low. The nutritional quality of most cereal protein is poor because they contain less of the essential amino acids, particular lysine, needed for growth and maintenance. Legumes are considered to be a cheap source of protein. The protein quality of legumes is deficient in some essential amino acids (methionine and cysteine) but is rich in an essential amino acid (lysine) (Annon, 1990; Bressani and Elias, 1974; Prabhavat *et al*., 2000). While cereals are poor in lysine and rich in methionine and cysteine, hence supplementation of cereals and legumes has been practiced as a simple and practical method for nutrient improvement of cereal-based foods (Nwasike *et al*., 1979; Okoh, 1985; Annon, 1990; Cheman *et al*., 1992; Surendranath *et al*., 1984; Prabhavat *et al*., 2000). In an attempt to reduce cost and improve the nutritive quality of garabia, rice has been substituted with peal Millet (Bimba, 2008) and rice flour partially substituted with Millet flour and cowpea (Aisha, 2009) but the sensory attributes of these products were not comparable with that of rice.

The current study therefore was designed to evaluate broken rice fraction from four rice varieties for garabia production and the effect of cowpea supplementation on the proximate, mineral, vitamin and consumer acceptability of garabia as a strategy for the improvement of broken rice fractions from local mills which limit smallholder rice farmers accessing advantages of improved rice varieties and agricultural technologies.

## MATERIALS AND METHODS

**Materials:** The experiment was conducted at the Food Processing Laboratory, Food Science and Technology Department, University of Maiduguri and Rice Grain Quality Laboratory, National Cereals Research Institute, Badeggi, Nigeria between January and April, 2012. Four rice varieties, FARO 44, FARO 52, NERICA-L19 and NERICA-L34 were obtained from the Breeding Laboratory of the National Cereals Research Institute, Badeggi Niger State, Nigeria and cowpea and spices bought from Maiduguri main market. Three kg each of the samples were cleaned manually and milled in a laboratory rice mill (locally fabricated in Nigeria) and the milled rice graded to obtain the broken fractions to be used in this study. Broken rice was washed and soaked overnight, after 12 h the soaked grainswere washed and spread on trays to dry off surface water after which the rice was milled and sieved. Cowpeas were sorted, soaked for 2 min, dehulled and then pre-cooked for 30 min (s), dried again and roasted for until golden brown (to reduce beany flavor and anti-nutritional factors associated with cowpea). The roasted cowpeas were milled into flour, sieved and then packaged in plastic bags. The spices used (ginger, pepper and cloves) were cleaned and ground separately into powder; the powdered spices were then sieved and packaged.

**Methods:**

**Production of garabia snack:** Eight formulations consisting of the four varieties with and without cowpea were used to produce Garabia. The flour from each formulation was mixed with the spices, oil and sugar and shaped using "finjal" cups, after which they were removed from the cups and dry-fried using a local pan commonly called "doka" (Fig. 1, Table 1) for 10-15 min; the bottoms were first placed on the hot pan then using a flat spoon to avoid scattering the shape, each of

Table 1: Laboratory formulations (g) of raw materials used in garabia production

| Rice variety | Cowpea | G/nut oil | Sugar | Ginger | Pepper | Cloves |
|---|---|---|---|---|---|---|
| FARO52-100 | 0 | 40 | 30 | 0.2 | 0.2 | 0.1 |
| FARO52-70 | 30 | 40 | 30 | 0.2 | 0.2 | 0.1 |
| FARO44-100 | 0 | 40 | 30 | 0.2 | 0.2 | 0.1 |
| FARO44-70 | 30 | 40 | 30 | 0.2 | 0.2 | 0.1 |
| NERICA-L34-100 | 0 | 40 | 30 | 0.2 | 0.2 | 0.1 |
| NERICA-L34-70 | 30 | 40 | 30 | 0.2 | 0.2 | 0.1 |
| NERICA-L19-100 | 0 | 40 | 30 | 0.2 | 0.2 | 0.1 |
| NERICA-L19-70 | 30 | 40 | 30 | 0.2 | 0.2 | 0.1 |

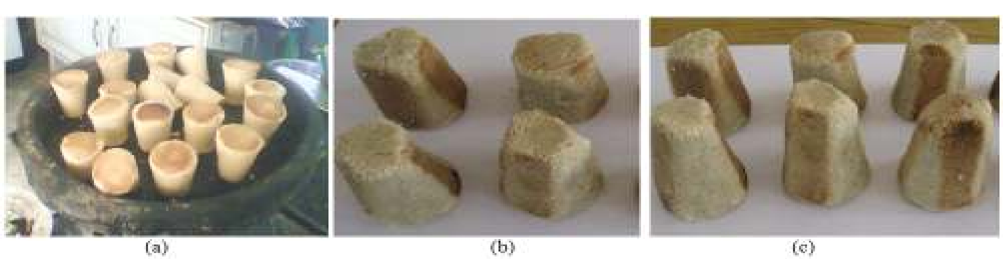


Fig. 1: (Plates a-c): (a) garabia being toasted on 'doka' (b) garabia made from sole rice flour (c) garabia produced from blend of rice and legume flour (70:30)

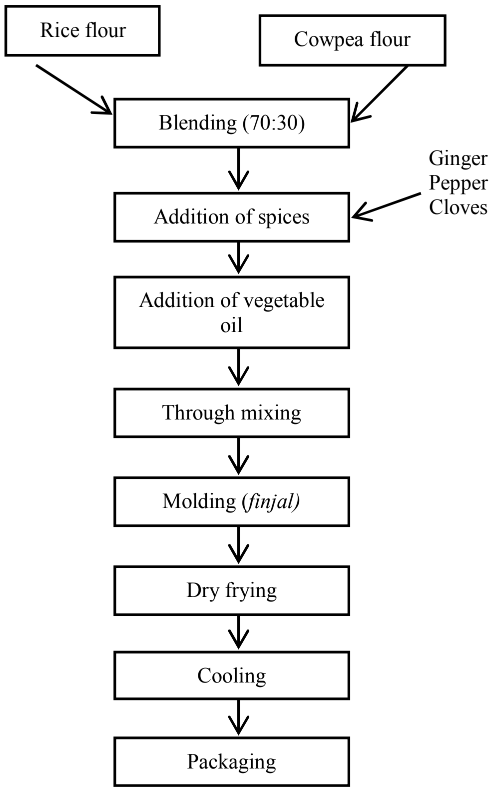


Fig. 2: Flow chart for the production of rice-cowpea garabia

the sides were placed simultaneously on the hot pan until they develop brown color and then the tops were also placed on the hot pan by turning them upside down. Garabia snacks were then removed carefully and then allowed to cool before serving (Fig. 2).

**Chemical analysis:** The proximate analyses of rice garabia for moisture, total ash was by the method described by Kadan *et al*. (1997) and AACC (2000). Nitrogen was determined by the micro Kjeldahl method (AACC, 2000) and the nitrogen content was converted to protein by multiplying by a factor of 6.25. Crude lipid content was determined using Soxhlet apparatus (AOAC, 1990) and carbohydrate content was determined by difference. All the proximate composition values were reported in percentage. Energy (calories) was calculated by the method described by FAO (2002).

Vitamins and mineral composition of the finished products were determined using the methods described by Crawford (2007). Thiamine ($B_1$), Pyridoxine ($B_6$) and Riboflavin ($B_2$) was measured. Two grams of samples were weighed into a 10 mL centrifuge tube with 0.1% Triflouroacetic acids using an ultrasonic bath for 10 min before centrifuging for another 10 min at 4500 rpm. The supernatant from the centrifuge samples were filtered using 0.2 μm nylon macro disc filter into 1.5 mL glass sample vials with the mixture of standard containing 0.024, 0.016 and 0.04 mg/mL of vitamins $B_1$, $B_2$ and $B_6$, respectively. The test samples were then placed into HPLC auto sampler for analysis at detection wavelength (260 nm) where flow rate was set at 1.4 mL/min at 30ºC.

**Sensory evaluation:** The acceptability test was done for each set of eight snack samples to find the best accepted rice-based garabia snacks, by 20 untrained panelists. Different characteristics in terms of color, flavor, texture and acceptability using Hedonic scale: score 9-the extreme like, and score 1-extreme dislikes were used. The difference in statistics was determined using Analysis of Variance (ANOVA) (Steele and Torrie, 1980). The mean were compared using Least Significant Difference (LSD) test.

## RESULTS AND DISCUSSION

The proximate composition of garabia snack produced from whole rice varieties and blends of different rice varieties and cowpea (70:30 rice-cowpeas) is presented in Table 2. The mean moisture, protein, fat, ash and carbohydrate contents of rice-cowpea blend garabia were 2.25, 11.87, 34.83, 2.04, and 49.00%, respectively and ranged between 1.88 to 2.47% for moisture, 10.72 to 12.86% for protein with FARO 52 blend having the highest and NERICA-L34 recording the lowest value. The lipid content varied from 28.00% in NERICA-L34 to 42.3% in FARO 52 and the ash content ranged between 1.61% in FARO 52 to 2.54% in NERICA-L34 blend by weight (Table 2). While the original rice flour garabia snacks recorded significant ($p>0.05$) moisture, protein, fat, ash and carbohydrate contents ranging from 1.85 to 2.41, 7.68 to 8.51, 31.33 to 37.73, 0.87 to 1.06 and 51.03 to 59.70%, respectively. Crude protein content of cowpea fortified garabia snack were significantly ($p>0.05$) greater than the whole flour products. Protein content increased from 8.35 to 12.86, 4.60 to 11.48, 8.51 to 10.72 and 7.68 to 12.42%, respectively by weight in FARO 52, FARO 44, NERICA-L34 and NERICA-L19, respectively. This represent 64.93, 40.07, 79.38 and 61.84% increase in protein content, respectively. It has been advocated that to meet the protein requirement of people living in developing countries where animal protein is grossly inadequate, considerable attention is should be paid to plant protein sources, especially legumes. This result indicates significant ($p>0.05$) contribution of cowpea to the protein content of garabia (Table 2).

The values obtained for carbohydrate (by difference) indicate significant decrease ($p<0.05$) in this attributes from 51.05 to 40.72 in FARO 52, 59.70 to 47.72% in FARO 44, 58.08 to 50.82% in NERICA-L19, respectively but increased from 53.14 to 56.74% in NERICA-L34 (Table 2). These values are

Table 2: Proximate composition of garabia produced from different formulations

| Garabia formulations | Moisture (%) | Protein (%) | Fat (%) | Ash (%) | Carbohydrate (%) | Energy (kcal/g) |
|---|---|---|---|---|---|---|
| Rice varieties | | | | | | |
| FARO 52 | 2.41ab | 8.35e | 37.33b | 0.87g | 51.03cd | 573.52b |
| FARO 44 | 2.07c | 4.60g | 32.67cd | 0.96f | 59.70a | 551.20c |
| NERICA-L34 | 1.96d | 8.51e | 35.33cd | 1.05e | 53.14bc | 564.63bc |
| NERICA-L19 | 1.85e | 7.68f | 31.33de | 1.06e | 58.08a | 545.05c |
| Formulation | | | | | | |
| FARO 52 + cowpea | 2.47a | 12.86a | 42.30a | 1.61d | 40.72e | 595.33a |
| FARO 44 + cowpea | 2.36b | 11.48c | 36.33bc | 2.10c | 47.72d | 563.81bc |
| NERICA-L34 + cowpea | 2.00cd | 10.72d | 28.00e | 2.54a | 56.74ab | 521.85d |
| NERICA-L19 + cowpea | 1.88e | 12.42b | 32.67cd | 2.21b | 50.82cd | 546.93c |

Values are mean of triple determinations; Mean within each column not having the same superscript differ significantly ($p<0.05$); Formulations are made from blend of 70 to 30 rice flour to cowpea

Table 3: Vitamins and mineral composition of different formulations of rice-based garabia

| | Vitamins | | | Minerals | | |
|---|---|---|---|---|---|---|
| Formulations | $B_1$ | $B_2$ | $B_3$ | Fe | K | Zn |
| Rice varieties | | | | | | |
| FARO 52 | 0.019c | 0.010c | 0.033c | 0.100e | 0.501e | 0.610f |
| FARO 44 | 0.019c | 0.010c | 0.036c | 0.102e | 6.327b | 0.481g |
| NERICA-L34 | 0.196b | 0.010c | 0.043c | 0.340d | 7.600a | 0.910d |
| NERICA-L19 | 0.021c | 0.015c | 0.039c | 0.472c | 2.113d | 0.322h |
| Formulation | | | | | | |
| FARO 52 + cowpea | 0.022b | 0.017c | 0.207a | 0.853b | 6.293c | 1.226b |
| FARO 44 + cowpea | 0.020c | 0.015c | 0.235a | 0.235d | 6.660b | 1.180c |
| NERICA-L34 + cowpea | 0.237a | 0.123a | 0.190ab | 1.031a | 7.800a | 1.432a |
| NERICA-L19 + cowpea | 0.024c | 0.048b | 0.053c | 0.562c | 7.700a | 0.891e |

Values are mean of triple determinations; Mean within each column not having the same superscript differ significantly ($p<0.05$); Formulations are made from blend of 70 to 30 rice flour to cowpea

comparable with an acceptable range mean value for legumes, 20-60% on dry weight bases (Arkroyed and Doughty, 1964). This result also indicate that rice-cowpea garabia is a rich source of energy and capable of supplying the daily energy requirement of the body. Balogun and Olatidoye (2012) reported that rice based protein are easily digested and provides the necessary calories in diet of many segment of the world population and therefore promote the utilization of dietary fat and reduce wastage of protein. From Table 2, the mean net energy value (indicating the net metabolizable energy in kcal/g available to the body from ingested garabia) ranged from 545.05 to 573.52% in whole flours of NERICA-L19 and FARO 52, respectively and increase to a mean values ranging from 521.85 to 595.33% in cowpea blended rice flours with FARO 52 recorded the highest energy value and the least value recorded in NERICA-L34 (521.85%). The calculated metabolizable energy values of the blended rice garabia (Table 2) shows that the products are concentrated energy sources. This result compares favorably with report of Al-Kanhal *et al*. (1999) who reported that the energy density of rice-based foods of Saudi Arabia ranged between 124 to 165 kcal/100 g. Though snacking is often considered bad habit because it contain high energy and may facilitate hyperphagia while providing insignificant qualities of valuable nutrients due to choice low quality snacks (Drummond *et al*., 1996) nutritionists still agrees that since human bodies need re-fueling every 3-4 h, healthy snack like garabia may provide energy burst and help keep hunger under control so you aren't tempted to over eat later.

**Minerals and vitamin compositions:** Bioavailability of minerals (especially trace elements) and vitamins in foods have increasingly attracted research attention in the field of Food Science and Technology and Nutritional studies. Elements required in trace quantities such as Ca, Fe, Zn, Cu, K, Mn, Na etc., are essentially harmful at high concentration, but essential for normal growth and development. They play important role in nerve functioning, sugar metabolism, activities of numerous enzymes and in cardiac function (Milena *et al*., 1993). Table 3 shows the minerals and vitamins in terms of Fe, K and Zn and $B_1$, $B_2$, and $B_6$, respectively present in whole rice flour garabia and cowpea fortified rice based garabia.

Vitamin content ranged from 0.019-0.237, 0.010-0.123 and 0.033-0.235% for thiamine, riboflavin and pyridoxine, respectively (Table 3). The highest value for $B_1$ and $B_2$ were obtained from a blend of NERICA-L19 and Cowpea, while the other samples showed no significant difference ($p>0.05$) in terms of these two vitamins. For pyridoxine, higher values were obtained from rice-cowpea blends of FARO 55 and FARO 44. The mineral content ranged from 0.235-1.031, 0.501-7.8 and 0.322-1.432% for Fe, K and Zn, respectively. There was a significant difference ($p>0.05$) between FARO 44 and NERICA-L34 blends which showed the highest value for Fe while whole FARO 55 and FARO 44 flour yielded the lowest values. NERICA-L34 flour and its blend and NERICA-L19 whole flour had the highest values while the rest showed significant difference. There was a significant difference ($p>0.05$)

Table 4: Consumer preference analysis of garabia produced from different rice varieties blended with cowpea at 30%

| Sample code | Color | Taste | Aroma | Texture | Overall acceptability |
|---|---|---|---|---|---|
| Rice varieties | | | | | |
| FARO 52 | 6.70ab | 7.20a | 6.40ab | 6.10a | 7.00a |
| FARO 44 | 6.20ab | 7.40a | 5.95ab | 6.50a | 6.65ab |
| NERICA-L34 | 6.85a | 5.85bc | 6.00a | 5.70b | 6.50b |
| NERICA-L19 | 6.20ab | 5.70bc | 6.10a | 5.60c | 6.65ab |
| Rice + cowpea | | | | | |
| FARO 52 + cowpea | 6.70a | 6.25b | 5.95ab | 5.95a | 6.35b |
| FARO 44 + cowpea | 5.45b | 5.55c | 4.60c | 5.30c | 5.85c |
| NERICA-L34 + cowpea | 6.25b | 6.30b | 5.85ab | 5.65c | 6.65b |
| NERICA-L19 + cowpea | 6.80a | 6.25b | 6.00a | 5.80b | 6.40b |

Means within each column not having the same superscript differ significantly ($p<0.05$); Hedonic ratings based on 9-point hedonic scales with the descriptors: 9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like nor dislike, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much, 1 = dislike extremely

in all the samples for Zn, FARO 52-Cowpea blend showed the highest value (Table 3).

The addition of cowpea (30%) had increased the mineral by showing high values in Fe, K and Zn; this may be due to the initial ash content of cowpea and rice. Calcium was found to be the most abundant mineral in rice garabia. This result is in agreement with the observation by Olaofe and Sanni (1988), Aremu *et al*. (2005) and Balogun and Olatidoye (2012) that calcium was the most predominant mineral in Nigerian agricultural products.

**Sensory characteristics:** Mean consumer rating of ‘liking’ for color, taste, aroma, texture and overall acceptability are presented in Table 4. All the sensory characteristics evaluated showed significant difference ($p<0.05$) between whole rice flour products and rice-cowpea blend and between different varieties. Overall, consumer liked all the samples (rating greater than 6) except garabia produced from the blend of FARO 44 and cowpea was rated slightly lower (5.85) for overall acceptability. Phang and Chan (2009) reported that rating higher than 6 (like slightly) for hedonic ratings based on 9-point hedonic scales implies that the product tested is well-liked by the consumers. Though consumer ratings indicated a significant ($p<0.05$) average rating of above 5 (neither like nor dislike) in terms of aroma and texture, the result implies non detectable effect of the addition cowpea to rice flour for the production of garabia snack (Table 4). Devereux *et al*. (2003) reported texture is an importantattribute of food quality, where the neither like or dislike (5) rating of the texture does not diminished the overall acceptability.

## CONCLUSION

Addition of cowpea (30%) to different rice flour for the production of garabia snack was found to have significant effect ($p<0.05$) on the protein content and metabolizable (kcal/g) energy. While the addition of cowpea significantly improves the $B_2$ vitamin in NERICA-L34 and NERICA-L19, there was no significant change in products from the other formulas. Consumer overall acceptability (liking) rating higher than 6 (like slightly) for hedonic ratings based on 9-point hedonic scales is an indication that the product are well-liked by the consumers. It can then be concluded that addition of cowpea to rice flour for the production of garabia significantly improves nutritive value of the products with little or no pronounced effect on consumer acceptability. The use of broken rice for the production of value-added product like garabia therefore, is aright step towards the improvement of the utilization of broken rice to improve livelihood and food security of smallholder rice farmers in Africa.

## ACKNOWLEDGMENT

This study is one of the ‘Development of new rice-based products from broken rice fraction’ components funded by Canadian International Development Agency and Africa Rice Center under the project ‘Enhancing food security in Africa through the improvement of rice post-harvest handling, marketing and the development of new rice-based products’. We also acknowledge the National Cereals Research Institute, Badeggi for providing the rice varieties and its processing.

## REFERENCES

AACC, 2000. American Assn. of Cereal Chemists. 2000. Approved Methods of AACC. 10th Edn., Method 0-25, Method 61-02.St.Paul, Minn. AACC.

Aisha, U.M., 2009. Quality of garabia as affected by the addition of pearl millet and cowpea flour. B.Sc. Unpublished Thesis, submitted to Food Science and Technology, University of Maiduguri.

Al-Kanhal, M.A., I.S. Al-Mohezia, A.I. Al-Othaimeen, and M.A. Khan, 1999. Nutritive values of various rice based dishes in Saudi Arabia. Ecol. Food. Nut., 38: 223-235.

Annon, 1990. International Code of Conduct on Distribution and use of Pesticide. Food and Agricultural Organization of United Nation, Rome, pp: iii+ 34.

AOAC, 1990. Official Methods of Analysis of AOAC, Int. 17th Edn., Gaithersburg, Md., AOAC.

Aremu, M.O, A. Olonisakin, J.W Otene and B.O Otolaye, 2005. Mineral contents of some agricultural products grown in middle belt of Nigeria. Orien. J. Chem., 21: 419-426.

Arkroyed, W.R. and J. Doughty, 1964. Legume in Human Nutrition, Food and Agricultural Organization Nutrition Studies Publication, 19. FAO Rome.

Balogun, I.O. and O.P. Olatidoye, 2012. Chemical composition and nutritional evaluation of valvet bean seed (Mucunautilis) for domestic composition and industrial utilization in Nigeria. Pak. J. Nut. 11(2): 116-122.

Bhattacharyya, S., P. Chakraborty, D.K. Chattory, and S. Makherjee, 1997. Physico-chemical characteristics of extruded snacks prepared from rice and chickpea by single screw extruder. J. Food. Sci. Technol., 34: 320-323.

Bimba, S., 2008. Quality of rice Garabia as affected by the addition of pearl millet flour. B.Sc. unpublished Thesis, Food Science and Technology, University of Maiduguri, Nigeria.

Bressani, R. and L.G. Elias, 1974. Legume Foods. In Altschul, A.M. (Ed.), New Protein Foods: A Technology. Academic Press, New York and London, 1: 230-297.

Cheman, Y.B., N.B. Mohamad Abdul Karim and T.K. Tan, 1992. Evaluation of flour high protein rice-soy snack formulations. J. Fd. Sci. Technol., 27: 715-719.

Devereux, H.M., G.P. Jones, L. McCormack and W.C. Hunter, 2003. Consumer acceptability of low fat foods containing inulin and oligofructose. J. Food. Sci., 68(5): 1850-1854.

Drummond, S., N. Crombie and T.R. Kirk, 1996. A critique of the effects of snacking on body weight status. Eur. J. Clin. Nutr. 50: 779-783.

Food and Agricultural Organization of the United Nation (FAO), 2002. Food Energy-methods of analysis and conversion factors. FAO Food and Nutrition Paper 77, Report of Technical Workshop Rome, 3-6, December.

Kadan, R.S., E.T. Champagne, G.M. Jr Ziegler and O.A. Richard, 1997. Amylose and protein contents of rice cultivars as related to texture of rice based fries. J. Food. Sci., 62(4): 701-3.

Kyari, Y.F., 2002. Standardization of ingredients used in production. B.Sc. unpublished Thesis, of Food Science and Technology, University of Maiduguri.

Martinez, B.F., Y.K. Chang, A.C. Bannwart, M.E. Roadriguez, P.A. Guede and E.R. Gaiotti, 1998. Effect of calcium hydroxide and processing conditions on corn meal extrudate, Cereal. Chem., 75: 796-801.

Milena, L., D. Mardi, A. Kenjeri and A.P. Piri, 1993. Intake of some minerals in healthy adult volunteers. Int. J. Food. Sci. Nut., 60: 77-87.

Nwasike, C.C., 1979. Lysine level in solvent of pearl millet. J. Agric. Food Chem., 27:1329-1331.

Okoh, P.N., 1985. Studies on the seed proteins of millets.1, Amino acid compotion of protein factors of early and late maturing varieties. J. Agric. Food Chem., 33:55-57.

Olaofe, O. and C.O. Sanni, 1988. Mineral contents of agricultural products. Food Chem., 30: 73-79.

Phang, Y.L. and H.K Chan, 2009. Sensory descriptive analysis and consumer acceptability of original ‘kaya’ and ‘kaya’ partially substituted with inulin. Int. Food. Res. J., 16: 483-492.

Prabhavat, S., H. Duangchan and T. Lohana 2000. Production of snacks from composite flour of full fat soy flour and addition of nata de coco. Kasetsart. J. Nat. Sci., 34: 289-299.

Steele, R.G. and J.H. Torrie, 1980. Principle and Procedures of Statistics. A Biometric Approach and Edition, McGram Hill, Sub Routine of Statistics 9.0.

Surendranath, M.R., G. Azumoddin, D.A. Ramayya and S.D. Thirumalarao, 1984. Preparation of low - fat, high - protein sesame seed. J. Fd. Sci. Technol., 21: 425-426.

Trongpanich, K., P. Boonyasirikool, S. Srikumlaitong, C. Taengpook and U. Kanjanapakornchai, 2001. Feasibility of study on snack production by using dietary fibre concentrates from soymilk residue. Kasetsart. J. Nat. Sci., 35: 188-194.