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Research Paper

Energy, proximate and sensory attributes of soy- fortified "agidi"

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Maize and soybean were bought from Anyigba major market, Kogi State. Agidi was prepared using maize and soybean in the ratios 100: 0, 80:20 and 70:30 respectively. The proximate compositions of the sample were determined using AOAC methods. The crude protein content was determined by micro-Kjeldahl method, using 6.25 as the nitrogen conversion factor. The crude fat content was determined by Soxhlet extraction method using petroleum ether. The ash content was determined by incinerating the samples at 600°C in a muffle furnace. Carbohydrate was obtained by difference, while energy was calculated using the Atwater Conversion factors in KJ and Kcal (17 KJ/4Kcal, 17KJ/4Kcal, and 37KJ/9Kcal, for protein, carbohydrate and lipid respectively. Sensory evaluation was carried out using standard methods and data generated were also analysed using standard methods. The, protein (20.63 and 20.77%), fat (7.71 and 7.99%) and fiber (2.41 and 2.71%) contents of soy-fortified agidi were significantly ($p<0.05$) higher than those 100% agidi (8.92%, 4.85%, and 1.92% respectively). Sensory attributes of colour, consistency and flavor of 100% agidi were preferred to those of soy-fortified agidi. The presence of high protein, fat and fiber in soy-fortified agidi will enhance the nutrient intake of those that consume it.

Key words: Soy-fortified agidi, protein, fat, energy, nutritional status

INTRODUCTION

Malnutrition is both a medical and a social disorder often rooted in poverty (Benson, 2008). Factors that contribute to malnutrition and poor nutrition outcomes are complex and vary across production and consumption setting. In Nigeria the underlying causes of malnutrition are poverty, inadequate food production, inadequate food intake (Igbedioh, 1993) and improper combination of available indigenous foods. One of the fundamental ways of ensuring food security is by improving food preparation, processing and preservation (NPC, 2001); this can be achieved by developing food processing and preservation technologies at village level (Obizoba and Oganah, 2008).

Cereals are grouped among the major staples consumed in Nigeria. Apart from been a good source of digestible starch, cereals are also known to provide non-starch polysaccharides in diets; polysaccharides are known to serve as effective laxative and also lowers plasma cholesterol and reduces the risk of heart diseases (Wolever, 1990). Cereals like most plant foods are considered as second – class protein sources; this is because they are deficient in essential amino acid lysine

and tryptophan (Stadimayr *et al*., 2012). Major cereals produced in Nigeria include rice, wheat, millet, sorghum, hungry rice and maize. Among them, millet, sorghum and maize are the most commonly used in the production of fermented products such as kunu zaki, ogi, apula, agidi etc; these products are however usually rich in carbohydrate but low in protein (Stadimayr *et al*., 2012).

Fortification using available legumes to enrich cereal-based food is one of the simple local technology adopted in Nigeria to enhance protein intake in individuals particularly children. Fortification of some cereals products using legume is however having some gap in knowledge on the optimization and quantification of the actual contribution of these fortificants to the products. This work was therefore designed to determine the energy, proximate and sensory attributes of soy-fortified agidi.

MATERIALS AND METHODS

Source of materials

Maize (white variety) (*Zea mays*) and soybean (crème coloured variety) (*Glycine max*) were obtained from Anyigba Central Market, Dekina Local Government Area, Kogi State, Nigeria.

Preparation of maize sample

About 1 kg of cleaned and sorted maize grains was steeped in 1:100 of potable water for 72 h at room temperature (29±2°C). The steep water was decanted and the grain washed thoroughly with potable water. The grain was milled with 1:100 water using attrition mill. The slurry was sieved with excess water using a muslin cloth. The filtrate was allowed to settle for 12 h and the supernatant decanted. The sediment was placed in a cheese cloth and squeeze to remove excess water.

Preparation of soybean sample

One kilogram (1kg) of cleaned and sorted soybean was blanched at 90°C for 3 min to inactivate the lipozynase activity and then soaked in 0.5% $NaHSO_3$ solution for 6hours to reduce its beany flavor. The soybean was dehulled manually and sundried for 3 days. The dried bean was milled using attrition machine and filtered through 1mm mesh sieve.

Preparation of agidi

Slurry made from 500 g of sediment maize filtrate mixed with 300ml of potable water was added to 1000 ml of boiling water with continuous stirring (for about 10 min) until a thick paste was formed. The above method was also used to prepare maize: soybean (80:20 and70:30 respectively). The prepared samples were divided into 2 parts. One part was used for sensory evaluation while the other part was used for chemical test. The sample for chemical test was dried at 65°C for 24 h in an oven, after which it was ground and sieved using 0.4 mm screen mesh. The filtrate were collected in an air tight container and taken for chemical analysis.

Chemical analysis

The proximate compositions of the sample were determined using standard AOAC, (2006) methods. Moisture content of the products was determined gravimetrically. The crude protein content was determined by micro-Kjeldahl method, using 6.25 as the nitrogen conversion factor. The crude fat content was determined by Soxhlet extraction method using petroleum ether. The ash content was determined by incinerating the samples at 600°C in a muffle furnace. Carbohydrate was obtained by difference, while energy was calculated using the Atwater Conversion factors in KJ and Kcal (17 KJ/4Kcal, 17 KJ/4Kcal, and 37 KJ/9Kcal, for protein, carbohydrate and lipid respectively.

Sensory evaluation

Sensory evaluation of the jam was carried out with a set of 20 panelists. Pawpaw produced using standard method was used as the control. The panelist consisted of randomly selected staff and students (both males and females) from Kogi State University, Ayigba. The evaluation was carried out in the food laboratory of the Department of Home economics. The judges evaluated the products using a seven point hedonic scale where 5 = like very much and 1 = dislike very much. Panelists scored the sample for four sensory attributes – flavour, colour and consistency. A cup of potable water was given to each panelist to rinse his/her mouth after each tasting.

Statistical analysis

All determinations were done in duplicates. The data generated were entered into the computer and analyzed using Statistical Package for Social Sciences (SPSS version 20) Means and standard deviation obtained from the chemical analysis were calculated. Level of significance was accepted at $p<0.05$. Analysis of variance (ANOVA) was used to compare the values obtained for sensory evaluation.

RESULTS

Energy and proximate composition of 100% sorghum and soy-fortified agidi

Table 1. Proximate composition of agidi made from 100%agidi and soy-fortified agidi.

Nutrient	100% agidi	Maize: soy agidi (80:20)	Maize: soy agidi(80:20)
Moisture (%)	9.26 [a] ± 0.01	8.83[b] ±0.02	8.65 [b]± 0.01
Protein (%)	8.92 [b] ±0.01	20.63 [a] ± 0.01	20.77 [a] ± 0.05
Fat (%)	4.85 [b]±0.01	7.71 [a] ± 0.01	7.99 [a] ±0.01
Ash (%)	0.99 [b] ±0.0	1.21 [a] ± 0.01	1.39 [a] ±0.01
Fiber (%)	1.92 [b]±0.01	2.41 [a] ± 0.01	2.71 [a] ±0.01
Carbohydrate (%)	74.06 [a] ±0.05	59.21 [b]± 0.02	58.49 [a]b±0.03
Energy (kcal)	375.57 [b]	388.75 [a]	388.95 [a]

Values of means ± standard deviation of double determinations.

Table 2. Sensory attributes of agidi made from 100%agidi and soy-fortified agidi

Attributes	100% agidi	Maize: soy agidi (80:20)	Maize: soy agidi (70:30)
Colour	3.46[a]	3.35[b]	3.30[c]
Consistency	3.75[a]	3.55[b]	3.50[c]
Flavour	3.43[a]	3.35[b]	3.30[c]
General acceptability	3.56[a]	3.35[b]	3.32[b]

The energy and proximate composition of soy-fortified agidi is shown on (Table 1). The moisture composition of the products ranged between 8.65 and 9.26% with soy-fortified agidi having the lowest (8.65 and 8.83%) moisture content while 100% agidi had the highest moisture value (9.26%).Energy and some other proximate components were observed to be significantly ($p<0.05$) higher in soy-fortified agidi than in 100% agidi. Protein obtained for soy-fortified agidi was 20.63 and 20.77% respectively, fat (7.71 and 7.99%), ash (1.21 and 1.39%), fiber (2.41 and 2.71%), carbohydrate (64.49 and 69.04%) and energy (388.75 and 388.95 kcal). Protein, fat, ash, fiber, carbohydrate and energy values obtained for 100% agidi were 8.92%, 4.84%, 0.99%, 1.92%, 83.32% and 375.57kcal respectively. The fiber and carbohydrate contents of 80:20soy- fortified agidi wee significantly different from those of 70:30 soy-fortified agidi.

Sensory attributes of the products

The sensory attribute of the products is shown on (Table 2). The scores for colour, consistency and flavor (3.46, 3.75 and 3.43 respectively) of 100% agidi were higher than the scores for colour (3. 30 and 3.46), consistency (3.50 and 3.55), and flavor (3.50 and 3.55) obtained for soy- fortified agidi. General acceptability for soy-fortified agidi (80:20) was comparable to that of 100% agidi.

DISCUSSION

Moisture content of any food is an index of its stability and moisture in the products particularly those of soy-fortified agidi were low. This implies that these products will have long shelf-life. Moisture content of less than 10% has been reported to be responsible for the state of non-deterioration in food (Makkar and Becker, 1996). There was no similar work to compare this work with, but when compared with a study done on ogi (Adeola *et al*., 2012), moisture obtained in this study fell within values reported in that study.

Protein obtained in this study particularly for soy-fortified agidi was quiet high. Protein obtained in soy-fortified agidi was several folds higher than that of 100% agidi. Soy bean must have increased the protein value. Soybean is known for its rich protein value (Stadimayr *et al*., 2012): it is commonly incorporated into cereal products to improve their protein quality (Obizoba and Oganah, 2008).

The ash content of soy-fortified agidi was significantly ($p<0.05$) higher than that of 100% agidi. Ash content of any food is an index of its mineral composition (Genah *et al*., 2012). When compared with other studies the ash values of soy- fortified agidi was higher than that of *Treculia africana* seed milk (Onweluzo and Nwakalor, 2009) but was comparable to the ash value reported for soymlk (Ukwuru et al., 2008). Higher fiber values found in soy-fortified could be attributable to soybean added to it. Fiber is known to be essential for effective gastro-intestine functions, and in the treatment and prevention of many diseases including colon cancer, coronary heart diseases, obesity, diabetes and gastrointestinal disorders (Anderson *et al*., 1994; Ogbonna *et al*., 2012).

Protein and fat obtained for soy-fortified agidi was comparable to that of beniseed milk (Okudu and Nwankoro 2015). Soybean fat has some health benefit because it contains both mono and polyunsaturated fatty acid (Stadimayr *et al*., 2012). Carbohydrate content of

100% agidi was significantly higher than those of soy-.fortified agidi, while energy was higher in soy-fortified agidi. Higher energy found in soy fortified agidi was expected because energy is a function of its protein, carbohydrate and fat composition and soy-fortified agidi had higher protein and fat than 100% agidi.

The colour, consistency and texture of 100% agidi were preferred over those of soy-fortified agidi. The preference for colour, consistency and flvour of 100% agidi over those of soy-fortified agidi was expected because the panelist were already used to consuming agidi without fortifying it with soybean. Combining maize with soybean to prepare agidi must have altered or affected its usual colour, consistency and flavor.

Conclusion

The study showed that soy-fortified agidi had higher protein, fat, ash, fiber and energy values, while 100% agidi had higher moisture and carbohydrate. Sensory evaluation showed that 100% agidi was preferred in terms of colour, consistency and flavor.

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