EFFECT OF INCLUSION OF PIGEON PEA FLOUR ON THE NUTRITIONAL, FUNCTIONAL AND SENSORY CHARACTERISTICS OF SNACKS FROM BREADFRUIT FLOUR

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ABSTRACT

The effect of pigeon pea flour (PF) on the nutritional, functional and sensory quality of snacks from breadfruit flour (BF) were investigated. Products with PF were more yellow in color, had higher Protein, Ash, Crude fibre, bulk density and water absorption capacity. Snacks with 95% BF: 5% PF had a suitable crisp to hard texture. All the snack products were liked moderately to very much in overall acceptability.

Keywords: Nutritional, Functional, Pigeon pea, Bulk density, Water Absorption capacity.

INTRODUCTION

Snacks can be considered as tasty, savory or sweet foods eaten at non-meal occasions. They are small meals eaten between meals. Snacks provide convenience and manageable portions, and they fulfilled short-term hunger (Eneche, 1999). Snacks tend to be high in calories and fat and low in protein and other nutrients (Rahma and Mustafa, 1998). Healthy snacks help to bridge the gap between meals. Breadfruit-pigeon pea snack is a snack made from breadfruit flour, pigeon pea flour, ground yeast and other ingredient such as pepper, salt/sugar, mono sodium glutamate and water.

Breadfruit (*Artocarpus altilis*) is one of the local staples in the developing countries, although relatively cheap and nutritious but neglected (Akanbi *et. al.,* 2009). It belongs to the Mulberry family Moraceae. It is a tropical fruit and the tree produces fruit twice a year, from March to June and July to September with some fruiting throughout the year (Omobuwajo, 2007). It is one of the principal sources of energy, protein, vitamin and minerals for millions of the poorest people (Tuivavakgi and Samuelu, 2007). Its nutritive value especially carbohydrate, protein, fat and mineral contents is comparable or even superior to some cereal food grains (Adebowale *et. al.,* 2008). Breadfruit is of high protein quality unlike most of cereals especially maize which is generally recognized as being inherently poor in protein quality (Omobuwajo, 2007; Uvere *et. al.*,2002). Pigeon pea (*Cajanus cajan (L) Millsp*.) is a nutritionally important grain legume of the tropical and subtropical regions of the world (Singh *et. al.*,1991). It is ranked 5th in importance among edible legumes of the world (Duhan *et. al.*,1999). Sherry, (2007) found that the protein content of pigeon pea seed samples ranged between 18.5% and 26.3% with a mean of 21.5%. Protein quality is of prime importance in pigeon pea products used for human food (Salunkhe *et. al.*,1996). Pigeon pea protein is a rich sources of lysine but it usually deficient in the sulfur- containing amino acids, methionine and cystine (Salunkhe *et. al.,* 1996). According to Singh *et, al.,(*1991) snacks of blended proteins could increase nutritional value and create better texture or other functional properties. Pigeon pea flour was added to breadfruit flour to increase the protein

content and improve texture of the snack. The objectives of this research work is to investigate the effect of addition of pigeon pea flour to breadfruit flour on the nutritional, functional and sensory characteristics of the flavored snacks produced.

MATERIALS AND METHODS

Materials

Breadfruit (*Artocarpus altilis*) were obtained from Ifewara Osun State ,Nigeria. Pigeon pea (*Cajanus cajan (L.) Millsp*.) were obtained from a central market in Ilesa, Osun State.

Processing of breadfruit into flour

Breadfruit was processed into flour as shown in Figure 1. The breadfruit was thoroughly washed to remove dirt and unwanted materials. It was then peeled and washed with clean water. The breadfruit was sliced, blanched for about 5 min. and then dried in the oven at 105 ^{0}C for 1-3 h, after which it was milled into flour. The flour was screened through a 0.25 mm British Standard Sieve (Model BS 410) (Giami , 1993).

Processing of Pigeon pea into flour

Pigeon pea (*Cajanus cajan (L.) Millsp.)* seeds were processed into flour using the procedure by Singh *et.al.,* (1991). An oil pretreatment using 1% corn oil was used to dehull the pigeon pea seeds . The dried pigeon pea seeds were ground in a Victoria grain mill (Low Hooper, Medellin, Colombia), screened through a 0.25 British Standard Sieve (Model BS 410). Figure 2 showed the flow chart for the processing of pigeon pea flour.

Blend Formation

Four blends were prepared by mixing Pigeon pea flour with Breadfruit flour in the percentage proportions of 0:100; 5:95; 10:90 and 15:85 respectively, using machine food processor (Kenwood KM 201, England). Baking powder, pepper, salt/ sugar, were added to each blend to obtain a desired consistency. The dough was thoroughly mixed and cut into shape manually and baked at 220 ^{0}C for 15 min, allowed to cool, packed and stored for other determinations.

Methods of analysis

Proximate analysis was carried out on the snacks using the methods of the Association of Official Analytical Chemists (AOAC, 2000). Water absorption capacity of the sample was determined by the method of AACC (1995). The bulk density was determined as described by Okezie and Bello (1988) and expressed in g/ml.

Swelling capacity was determined by the method described by Takashi and Sieb (1988). Sensory evaluation was conducted in 2 stages. In the 1st stage, trained panelist rated the texture of the unflavored snacks to determine the most suitable textured products. In the 2nd stage, attributes of color, odor, flavor, texture and overall acceptability of the flavored snacks products were evaluated by hedonic testing using consumer panelists. The texture of unflavored snack-containing 5% PF, 10% PF and 15% PF – was rated on a 5- point scale: 5 = very hard, 4 = hard, 3 = crisp, 2 = soft, 1 = very soft. Sensory evaluation was performed using 10 panelists. Panelists were instructed to consider only texture and ignore the other

attributes. Panelists were instructed to place the snacks between molars and bite down slowly and evenly until a fracture or break occurs. The descriptor for texture were very soft = a low perceived force required to compress the snack, soft = a moderate perceived force required to compress the snack,

crisp = as the perceived force in which the snack fractures or crumbles into small pieces, hard = a high perceived force required to compress the snack and very hard = an extreme perceived force required to compress the snack. Twenty- five consumer panelists evaluated the flavored snacks during 2 sessions for color, odor, flavor, texture and overall acceptability. The products were evaluated on a 9 – point hedonic scale. 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. The scores were analyzed by analysis of variance to determine the effects of adding pigeon pea flour to breadfruit flour.

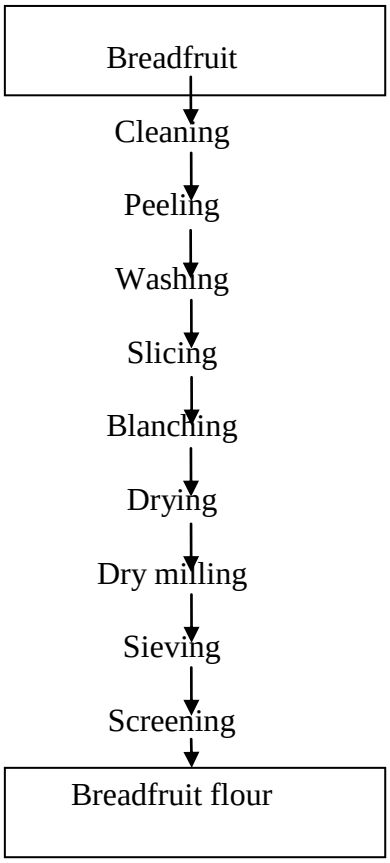

Fig. 1: Flow chart for the production of breadfruit flour.

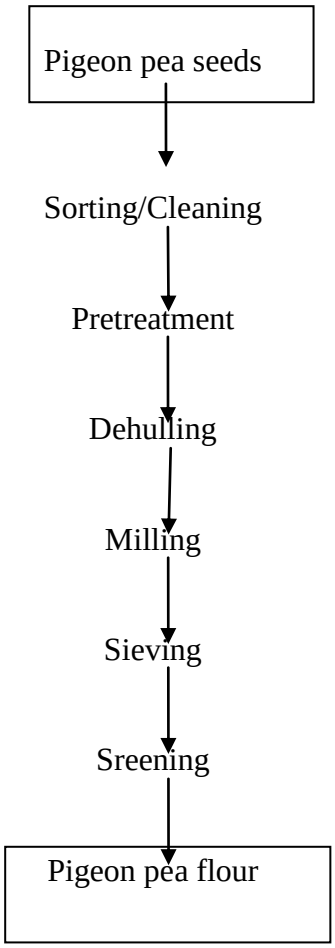

Fig.2. Flow chart for the production of pigeon pea flour.

RESULTS AND DISCUSSION

Proximate composition

Table 1 show the effects of inclusion of pigeon pea flour (%) to Breadfruit flour on the proximate composition of the snacks produced. As expected the addition of pigeon pea flour increased the non carbohydrate components, particularly the crude protein contents of the snacks and reduced the total carbohydrates. The protein content of both BF and PF is high, although that of PF is higher.

The crude fibre (%) ranged between 2.05 and 2.66 and this showed a corresponding increase with increase in the proportion of pigeon pea flour . Pigeon pea has relatively higher crude fibre than breadfruit and this justifies the values of crude fibre obtained for the different snack samples. This observation compares well with the findings of Esuoso and Bamiro, (1995) as well as Amusa *et. al.*, (2002). Crude fibre is known to aid the digestive system of human (Ihekononye and Ngoddy, 1985), indicating that the snacks could attract good acceptability by many people as well as health organizations.

The value obtained for the ash contents indicated that the value increased with increase in pigeon pea substitution. The ash content of pigeon pea was higher than that of breadfruit and could be responsible for the increase in ash obtained. It then follows that incorporation of pigeon pea in the process of snack making could enhance the minerals intake of many people, as ash is indicative of the amount of minerals contained in any food sample.

The fat content (%) of the snack followed the same trends with crude protein, ash and crude fibre, though the increase in values were minimal. The highest value of 1.68 was recorded for the 15% pigeon pea substitution while the lowest value of 1.53 at 5% substitution.

Table 1. Proximate composition of Breadfruit flour (BF), Pigeon pea flour (PF) and the Snacks.

Components g/100g	BF	PF	Snacks % Addition PF to BF		
			5	10	15
Moisture	6.78	7.20	6.20	6.44	6.70
Crude protein	5.49	18.04	6.95	7.40	8.85
Ash	3.06	7.62	3.93	4.25	4.58
Crude fibre	2.93	4.10	2.05	2.35	2.66
Crude Fat	1.49	1.50	1.53	1.60	1.68
Total carbohydrate	80.25	61.18	79.34	77.95	75.53

Crude protein:N×6.25
Carbohydrate by difference

Fat plays a significant role in the shelf life of food products and as such relatively high fat content could be undesirable in baked food products. This is because fat can promote rancidity in foods, leading to development of unpleasant and odorous compounds (Ihekoronye and Ngoddy,1985). The moisture content of the snacks ranged between 6.20 and 6.70, with the 15% substitution having the highest value. These values were minimal and may not have adverse effect on the quality attributes of the products (Esuoso and Bamiro, 1995). The carbohydrate content reduces as expected with increase in pigeon pea addition

Expansion and product bulk density

As the addition of pigeon pea flour to breadfruit flour increases, expansion of snacks decreased, while products bulk density increased (Table 2). These changes can be related to changes in the proximate composition of the feed material (Table 1).

The increase in additions of pigeon pea flour to breadfruit resulted in higher WAI and lower WSI of snacks. These changes can be related to changes in the proximate composition which increase the total carbohydrate components and decrease non carbohydrate components (Table 1). Studies on snacks from starch have shown that the major operations occurring during the process (namely heating in the presence of water and shearing) can impact structure to the product through the transformation of starch granules by the mechanism of gelatinization (Stanley and Sefa-Dedeh, 1987). Tester and Morris (1990) reported in the work on wheat- starch gluten mixtures reported that the lack of protein in raw in raw materials could make starch gelatinization easier, since there is no material that can compete with

starch in water absorption. Singh *et. al*., (1991) reported that water holding capacity (WHC) of snacks decreased while water solubility increased with decreasing concentrate of nonfat dry milk in the blends with corn flour. Thus, on addition of pigeon pea flour to breadfruit flour, it is expected that the interaction between protein and starch would be more extensive, thereby reducing water solubility and increasing water absorption. Increasing WAI is advantageous in determination of the applicability of the snack products for use in situations that involve water binding (Aguilera *et. al*., 1990)

Sensory texture of Breadfruit/ pigeon pea snacks

The effect of pigeon pea to breadfruit flour had significant ($P<0.05$) influence on sensory texture of the snacks. There was no panelist variation ($P<0.05$) in their responses to sensory texture. Snacks produced from blend of 5% PF/95% BF were different ($P<0.05$) in texture from other blends (10% PF/90% BF; 15% PF/85% BF). A mean score of 3.4 (crisp to hard) was given to snacks from 5% PF /95% BF, 4.4 for 10% PF/90% BF snacks (hard to very hard). Snacks containing 10% PF and 15% PF required higher perceived force to fracture the product on 1st bite between molars, unlike snacks with 5%PF, which fractured with ease. Texture of snacks products is one of the most important characteristics affecting consumer acceptance (Suknark *et al*., 1998). Texture, unlike color and flavor is used by consumer not as an indicator of food safety but as an indicator of food quality. Mizubuti *et. al.*, (2000) reported that no products based on valued textural characteristics especially crispness are being created with advertisement stressing the enjoyment they provide.

According to Singh *et al.*, (1991), addition of small amounts of proteins (<5%) enhances textural properties of snack products. An increase of hardness of the snacks products was exhibited as an increase in shear strength. Table 2 indicated that snacks from blend 5%PF / 95%BF had the highest expansion with lowest product bulk density, which might have contributed to the desired crisp texture.

There was no difference ($p>0.05$) in sensory attributes of odor, texture and overall acceptance for the flavored snacks. Figure 3 shows the mean hedonic scores given to sensory attributes (color, odor, flavor, texture and overall acceptability) for the flavored snacks (chocolate, breadrika, breadpea and onion) breadfruit/ pigeon pea flour snacks.

Table 2- Effect of inclusion of Pigeon pea flour on bulk density, water absorption index and water solubility index of snacks

Pigeon pea Flour (%)	Expansion	Bulk density g/ml	WAI g gel/g Sample	WSI %
0	1.48^{a}	0.25^{d}	4.2^{d}	36.9^{a}
5	1.35^{b}	0.28^{c}	4.7^{c}	33.6^{b}
10	1.28^{c}	0.31^{b}	5.0^{b}	31.6^{c}
15	1.16^{d}	0.34^{a}	6.2^{a}	30.2^{d}

Mean followed by different superscripts in the same columns are different ($P<0.05$)

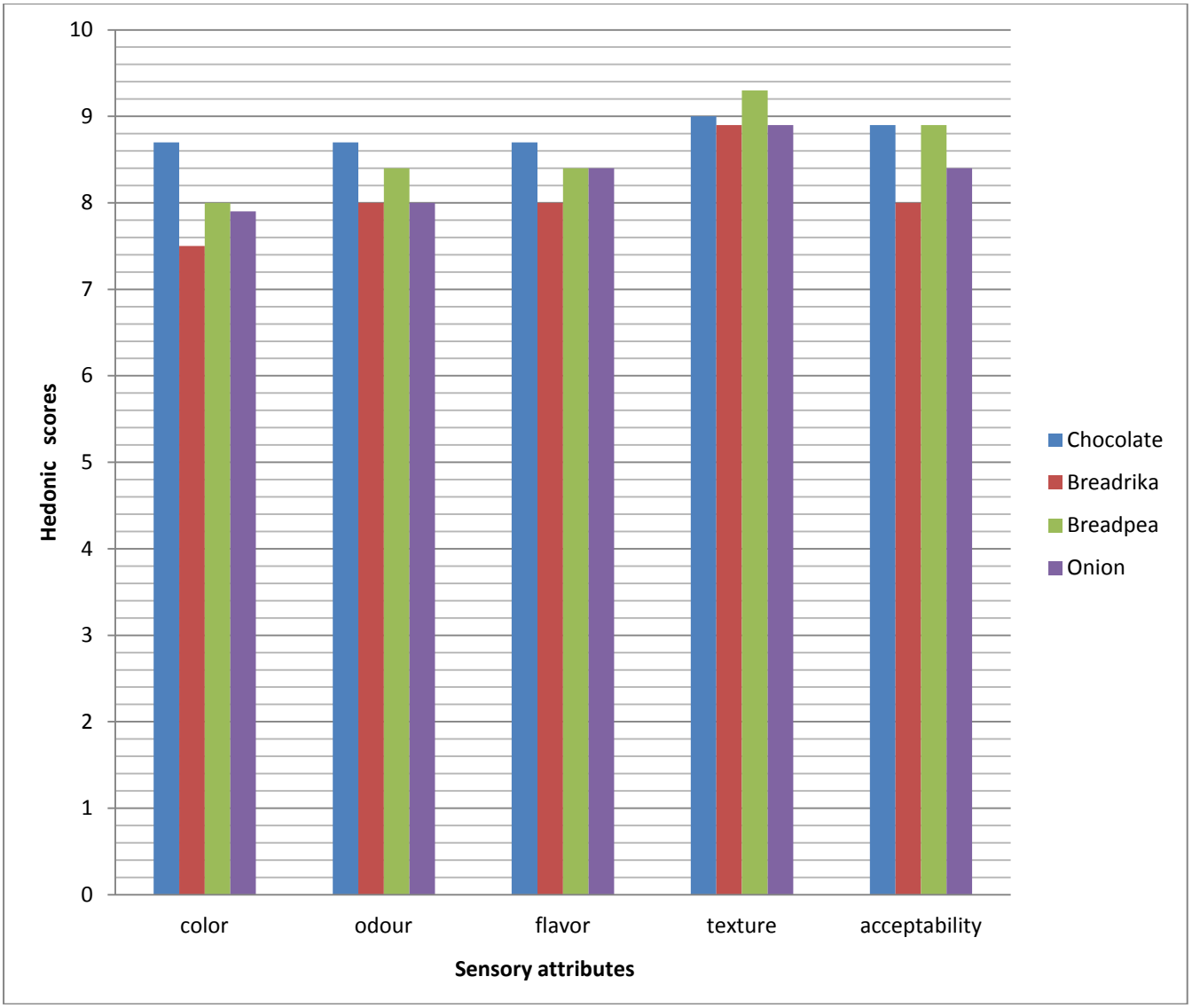

Fig 3- Mean (n=25) Hedonic sensory scores for sensory attributes of flavored breadfruit/ pigeon pea flour snacks

CONCLUSION

The study has shown that inclusion of pigeon pea flour to breadfruit flour in the preparation of snack is a welcome idea, The snacks produced from addition of 5% pigeon pea flour to breadfruit flour was more preferable. This sample apart from increasing the protein content, it produced suitable crisp to hard-textured snacks. All snacks with chocolate, vanilla (breadrika), pineapple (breadpea) and onion were liked moderately to very much in overall acceptability. The study has also shown that utilization of both breadfruit and pigeon pea can be increased and encouraged.

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