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Full Length Research Paper

Effect of partially defatted soybean flour substitution on the proximate, pasting and sensory properties of banana flour

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This study evaluates the proximate, pasting and sensory properties of banana flour fortified with partially defatted soybeans flour. Banana flours were substituted with soybeans flour at 10, 20, 30 and 40% proportions. The fat content ranged from 1.0 - 1.18% while protein contents ranged from 6.99 - 11.59%. Peak viscosity values ranged from 81.58 to 293.13 RVU. Banana flour had higher peak viscosity while sample E had the least peak viscosity. The values decreased with increase in soybeans substitution. Holding strength followed the same trend with higher value (229.33 RVU) in banana flour and the least value in sample substituted with 40% soybean flour. Breakdown values ranged from 15.99 - 63.80 RVU. Final viscosity and setback values ranged from 91.42 - 341.29 and 18.34 - 111.96 RVU respectively. Pasting time and pasting temperature ranged from 5.01 - 5.71 min and 90.03 - 91.74°C respectively. Sensory evaluation showed no significant difference ($p \geq 0.05$) in colour, texture and in overall acceptability of sample A and B. Inclusion of soybeans increased the nutritional value of banana flour and substitution up to 20% of soybeans compared well with the dough from the unsubstituted banana flour.

Key words: Banana flour, pasting properties, soybeans substitution, viscosity.

INTRODUCTION

Banana is the fruit of plant *Musa* spp which grows under tropic and sub-tropical condition. Bananas are high yielding and form an integral component of the farming systems in Africa. They are important staple food crop for rural and urban consumers. They provide 25% of carbohydrate and 10% of the daily calorie intake for more than 70 million people in Africa (IITA, 1992). They are commonly eaten raw until recently when they are used for chips due to high cost of plantain. Banana flour is an important raw material in the baking, confectionery industry and complementary food formulation (Adeniji et al., 2007). This flour is also made into stiff dough (amala) in the south-western part of Nigeria and eaten with vegetable, okro soup and stew. Bananas are predominantly made up of carbohydrate therefore it is necessary to improve the nutrient composition of the flour with legumes to improve the protein content. The food legumes provide the greatest level of protein and are particularly important in plant based diet to compliment amino acids thereby enhancing protein quality. Improving the nutrient composition of banana flour among the low income earners who cannot afford high protein food is very essential to avoid malnutrition especially in children. Legume such as soybean had been known to have high protein content and could be used to enrich the banana flour. Studies had been carried out on fortification of yam flour used for amala with full fat and defatted soybeans flour to improve the protein content (Akingbala et al., 1995 and Achi, 1999). Also, soybeans had been used to enrich other food stuffs such as cassava products, cereal products etc (Osho, 1991; Alabi and Anuonye, 2007; Ayo et al., 2007). The objective of this research work was to evaluate the effect of partially defatted soybeans flour substitution on the proximate, pasting and sensory properties of banana flour.

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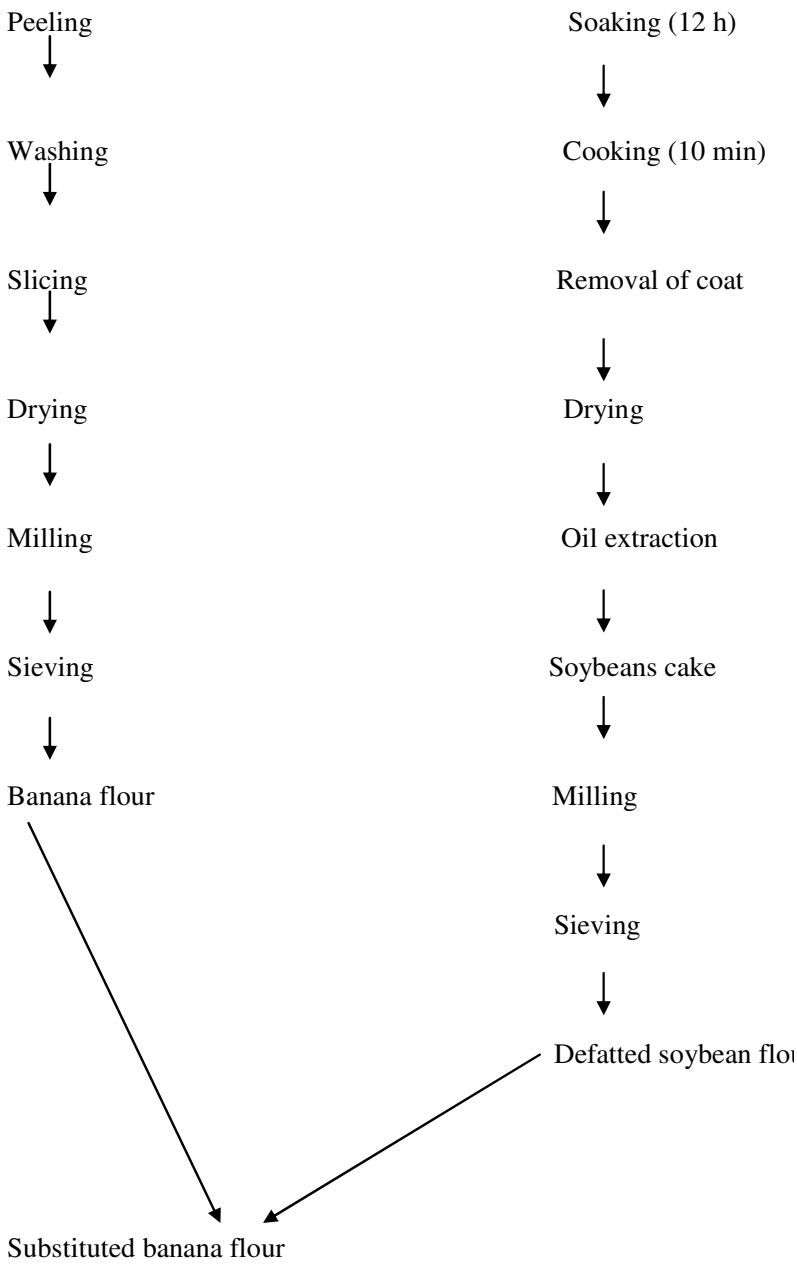

Figure 1. Flow diagram for production of substituted banana flour.

MATERIALS AND METHODS

Raw materials

Matured green cooking banana (*Musa cardaba*) and soybean (*Glycine max*) were purchased at Ada market, Osun State, Nigeria.

Production of banana flour

Matured green banana were separated from the bunch, peeled and sliced into two under water with 0.05% sodium metabisulphite to prevent browning reactions. The sliced bananas were dried in the oven at 50°C for 72 h, milled and packaged (Daramola and Osanyinlusi, 2006).

Production of partially defatted soybeans flour

The soybeans used were soaked for 12 h and cooked for 10 min. The coats were removed and were dried in the oven at 50°C for 24 h. The fats were removed using Hydraulic screw press (Osho, 1991). Soybeans cakes were milled, sieved and packaged.

Substitution of banana flour with partially defatted soybeans flour

The substitution of banana flour with partially defatted soybeans flour was shown in Figure 1. Partially defatted soybean flour was used to substitute banana flour in different proportion as shown in Table 1.

Table 1. Proportion of samples used.

Sample	Proportion (%)
A	Banana flour
B Banana : soybean flour	90:10
C Banana : soybean flour	80:20
D Banana : soybean flour	70:30
E Banana : soybean flour	60:40

Table 2. Proximate composition of banana flour fortified with partially defatted soybeans.

Paramater (%)	A	B	C	D	E
Moisture content	10.05c	9.78d	9.26e	10.23a	10.16b
Fat	1.03d	1.08c	1.13b	1.15b	1.18a
Protein	6.99e	10.67d	10.85c	11.17b	11.59a
Fiber	1.99a	1.85b	1.68c	1.59d	1.48e
Ash	1.09d	2.12b	2.20a	2.05bc	1.99c
Cardohydrate	78.40a	74.50b	74.88b	73.81c	73.60c

Mean values followed by the same letter in the column were not significantly different ($p \leq 0.05$).

Analyses

Proximate analyses were carried out on the samples using A.O.A.C. (1995) while the pasting properties were determined using Newport Scientific procedure (1998). The stiff dough for each sample was prepared using the method of Nwaegbute et al. (1995). Sensory evaluation was carried out with ten panelists who were conversant with the stiff dough from banana flour. The dough were examined and scored according to their degree of likeness with a 9-point hedonic scale ranging from 1 (extremely liked) to 9 (extremely disliked). The parameters evaluated were the color, odour, texture and overall acceptability. Analyses were carried out in triplicates and the data collected were evaluated for significant differences in their means with analysis of variance (ANOVA) ($p \leq 0.05$). Mean separation was carried out using student's t-test as packaged by SPSS 10.0 software.

RESULTS AND DISCUSSION

Proximate composition

Table 2 showed the results of proximate and sensory properties of banana flour fortified with soybeans. The fat content ranged from 1.03 - 1.18% while protein contents ranged from 6.99 - 11.59%. Both parameters increased with increase in soybean substitution. The protein content of banana flour was higher than the value (3.20%) reported by Suntharalingam and Ravindran (1993) while the fat content (1.30%) was higher than the value obtained in this study. Differences in the values obtained may be due to the varieties of banana used and cultural practices adopted during planting. Sample A had the highest crude fiber content while sample C had the highest value in ash content. Carbohydrate content ranged from 73.60 - 78.40% with banana flour having the highest value (78.40%). These values decreased as the percentage of soybean flour added increased. Muzanila and Nwakiposa (2003) reported 77.50 - 85.43 g/100g for carbohydrate contents from four varieties of banana. This indicates that banana flour is very high in carbohydrate content.

Pasting properties

The pasting properties of flour substituted with soybeans are shown in Table 3. Peak viscosity values ranged from 81.58 - 293.13 RVU. Sample A had higher peak viscosity (293.13 RVU) while sample E had the least peak viscosity. The values decreased with increase in soybeans substitution. Sample A was significantly different ($p \leq 0.05$) from the samples substituted with soybeans. The peak viscosity obtained was lower than the values (434.75 - 837.17 RVU) reported for six varieties of banana flour by Daramola and Osanyinlusi (2006). The peak viscosity obtained in sample A was higher than the values reported for three varieties of yam flour used for amala (Efuru 206.04 RVU, Ise-Osi 242.75 RVU and Abuja 241.25 RVU) (Babajide et al., 2007). Holding strength followed the same trend with higher value (229.33 RVU) in sample A and the least value in sample E. Soybean substitution was observed to reduce the peak viscosity and holding strength values.

Sample A had higher water binding capacity and can form viscous gel in hot condition than the substituted flour samples. Breakdown values decreased down with increase in soybean addition and it ranged from 15.99 -

Table 3. Pasting properties of banana flour substituted with soybean flour.

Sample	Peak viscosity (RVU)	Holding viscosity (RVU)	Breakdown (RVU)	Final viscosity (RVU)	Setback (RVU)	Pasting time (min)	Pasting temp (°C)
A	293.13a	229.33a	63.80a	341.29a	111.96a	5.01d	91.74a
B	169.38b	135.00b	34.38b	187.61b	52.61b	5.71a	90.03d
C	146.75c	131.50b	15.25c	167.20c	35.70c	5.46b	91.06c
D	108.58d	92.59c	15.99c	121.23d	28.65d	5.23c	91.71a
E	81.58e	73.08d	8.10d	91.42e	18.34e	5.57b	91.30b

Mean values followed by the same letter in the column were not significantly different ($p \leq 0.05$).

Table 4. Sensory properties of banana flour fortified with partially defatted soybeans.

Paramater	A	B	C	D	E
Colour	1.28a	1.33a	4.75b	5.60c	5.65c
Texture	1.80 a	1.85a	2.29b	8.22c	9.00d
Odour	1.40 a	2.20b	3.70c	4.80d	6.24e
Overall acceptability	1.40a	1.59a	2.10b	6.70c	8.50d

Mean values followed by the same letter in the column were not significantly different ($p \leq 0.05$).

63.80 RVU. The substituted flour sample will be more stable than the banana flour (sample A). Sample E had the highest resistant to heating due to its least breakdown value. Breakdown is a measure of susceptibility of cooked starch granules to disintegrate and has been reported by Beta et al. (2000) to affect the stability of the flour products.

Final viscosity and setback values were higher in sample A than other samples. These were significantly different ($p \leq 0.05$) from the substituted flour samples. The values ranged from 91.42 - 341.29 and 18.34 - 111.96 RVU. Pasting time and pasting temperature ranged from 5.01 - 5.71 min and 90.03 - 91.74°C. Pasting temperature provides an indication of the minimum temperature required to cook a given sample, which can have implications on stability of other components in the flour, and also indicate energy costs (Newport Scientific, 1998). Addition of partially defatted soybean flour reduced the viscosity of the banana flour.

Sensory evaluation

Sensory evaluation showed no significant difference ($p \geq 0.05$) in colour, texture and in overall acceptability of sample A and B (Table 4). This was followed by sample C but sample D and E were not acceptable due to the texture and odour of the amala made from the flour. Samples fortified with 30 - 40% soybean flour were not firm but sticky. Akingbala et al. (1995) and Achi (1999) substituted yam flour with defatted and full fat soy flour but 10% defatted and 20% full fat soy flour substitution was recommended for yam flour used for amala.

Conclusion

Substitution of banana flour with soybeans flour improved the protein content of the flour and reduced the viscosity of the flour. Therefore, substitution up to 20% of soybeans compared well with the dough from the unsubstituted banana flour. This will improve the processing and utilization of banana flour.

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