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Research Paper

PROXIMATE COMPOSITION, FUNCTIONAL AND SENSORY EVALUATION OF BLENDS OF YAM-SOY-PLANTAIN FLOURS FOR CULINARY PURPOSES

Makanjuola, O. Moses and Ajayi, Adebola

Department of Food Technology,
The Federal Polytechnic,
P.M.B, 50, Ilaro,
Ogun State, Nigeria.

Abstract

The proximate composition, functional and sensory properties of composite flours produced from the blends of yam, soy and plantain flours were investigated using standard methods. The flour samples coded as Z9F, 4AP, DF5, YR1, L3N and GRZ represented 100:0:0, 85:5:10, 80:10:10, 75:15:10, 70:20:10 and 65:25:10 for yam flour, soy flour and plantain flour respectively. The protein contents for all the samples ranged from 4.82% to 15.32% suggesting that protein content increased as the level of soy bean increased. Similar trends were shown for other nutrients except the carbohydrate and moisture content that decreased greatly as the soy bean addition increased. The functional properties showed significant difference ($p \leq 0.05$) among all the samples under consideration revealing different formulations that were made. The sensory qualities of the flour showed significant difference at 5% confidence level of acceptance. For example the level of acceptance decreased steadily from 85:5:10 to 65:25:10 (yam: soy bean: plantain) due probably to the odour posed by the soy bean.

Key words: Yam, Soybeans, Plantain, proximate composition, functional properties, sensory qualities.

INTRODUCTION

Yam (*discorea spp*) is an annual or perennial tuber bearing plant belonging to the family of *dioscoreaceae*. Some species of yam originated from Africa before spreading to other parts of the world, while some originated from Asia and have spread to Africa [1]. It is characterized by the moisture content which render the tuber more susceptible to microbial attacks and bring about high perishability of the tuber with an annual production of above 28 million tons.

Soya beans (*Glycine max*) in the seed of leguminous plant of the *Glycine species*, nature of East China but now cultivated virtually around the world. Soybeans are an important legumes reported to have contained a large amount of protein along with other nutrients. The protein is high in lysine but low in methionine [2].

Plantains (*Musa paradisiaca*) are used as an expensive source of calories. It is an important starch staple and commercial crop in west and central Africa where Fifty percent of the world's plantain crop is produced [3]. Plantain is treated in the same way as potato and yam with similar texture and neutral flavor when unripe fruit is cooked by steaming, boiling or frying [4]. Plantain is increasingly funding a gradual application in weaning food formation and composite flavor preparation [2,5]. Generally, yam is low in protein and fiber, but high in carbohydrate.

Results from previous studies in fortification of yam with plantain flour and soybeans have shown that fortification improve the nutritional quality of the resulting meals. [6] studied the compositional characteristics and functional properties of instant plantain-breadfruit flour while [7] investigated the comparative studies of physicochemical properties of yam (*Discorea rotundata*), cocoyam (*collocasia taro*) breadfruit (*Artocapus artilis*) and plantain (*Musa parasidiaca*) instant flours. Therefore, the aim of this present work is to produce composite flours at different proportions from the blends of yam-soy-plantain with a view of increasing the nutritional status of flours production for culinary purposes.

MATERIAL AND METHODS

Materials

Source of materials :yam tubers (*Discorea rotundata*) locally called white yam, soya beans and unripe but matured plantains were purchased from a local market in Ilaro, Ogun state, south-west, Nigeria; and transported to the laboratories of the department of food technology, Federal Polytechnic Ilaro, Ogun state for processing and analyses. All reagents and chemicals used were of analytical grade.

Sample preparations.

Production of yam flour:

Yam flour was produced using the method described by [8] 1.5kg of yam tubers were selectively sorted washed with clean portable water to remove dirts, sand and adhering particles. The yam tubers were peeled with clean stainless knife and sliced to 2mm thickness. The yam slices were dipped in water containing 150ppm sodium metabisulphite to prevent browning reaction from taking place. The yam slices were then blanched for 10 minute at 60^0C. The blanched yams sliced were then oven dried at 70^0C for 10 hours. The dried yam slices were milled with the aid of the milling machine to fine powder, sieved and packaged in polythene bags and stored in dry cold place

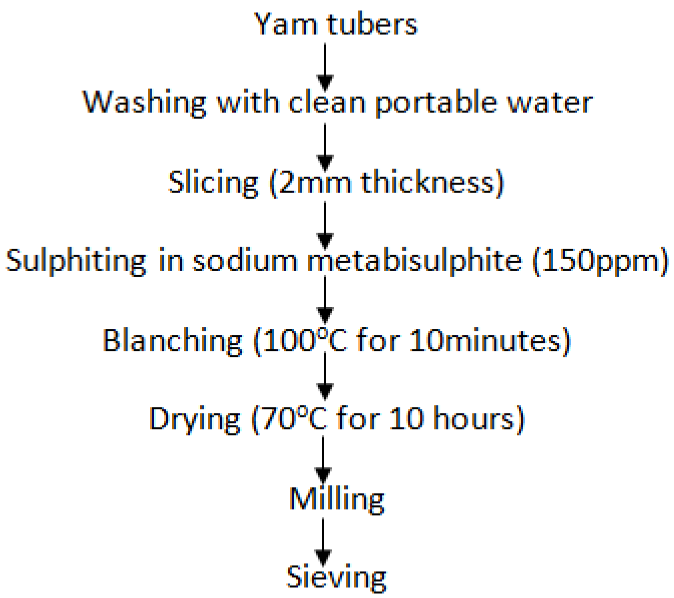

Figure 1: Flow diagram for the production of yam flour

Production of soy bean flour:

For the production of Soy bean flour, 1.5kg of soy bean seeds were sorted to remove soil particles, detective seeds and stones, and then thoroughly washed with clean portable water. The seeds were boiled at 100^{0}C for 30 minute to inactivate the Trypsin inhibitors, and then dehulled manually by rubbing with two palms. After dehulling, the seeds were dried in a hot air oven at 70^{0}C for 10 hours. The dried samples were then milled using a milling machine to fine powder and sieved trough a standard sieve of 400µm particles size. Flour produced was packaged in a cellophane bags and stored in cool dry place

Soy bean grains
↓
Sorting
↓
Cleaning
↓
Soaking and boiling for 30minutes at 100°C
↓
Dehulling
↓
Drying at 70°C for 10 hours
↓
Milling to fine particle size
↓
Sieving using 400µm particle size
↓
Packaging in cellophane bag

Figure 2: Flow diagram showing the production of soybean flour

Production of plantain flour:

Production of plantain flour was carried out using the method described by [9] 1.5kg of matured green plantain fruits were washed with clean portable water to remove adhering soil particles, peeled with the aid of clean stainless knives and then sliced into thin thickness of about 2mm, soaked in 150ppm of sodium metabisulphite for twenty minutes and then dried in the cabinet dryer at 60°C for 24 hours. The dried plantain slices were then milled into flour using a milling machine, sieved in a 400µm to obtained plantain flour. The flour obtain was packaged in a cellophane bags, Stored in cool dry place for analysis.

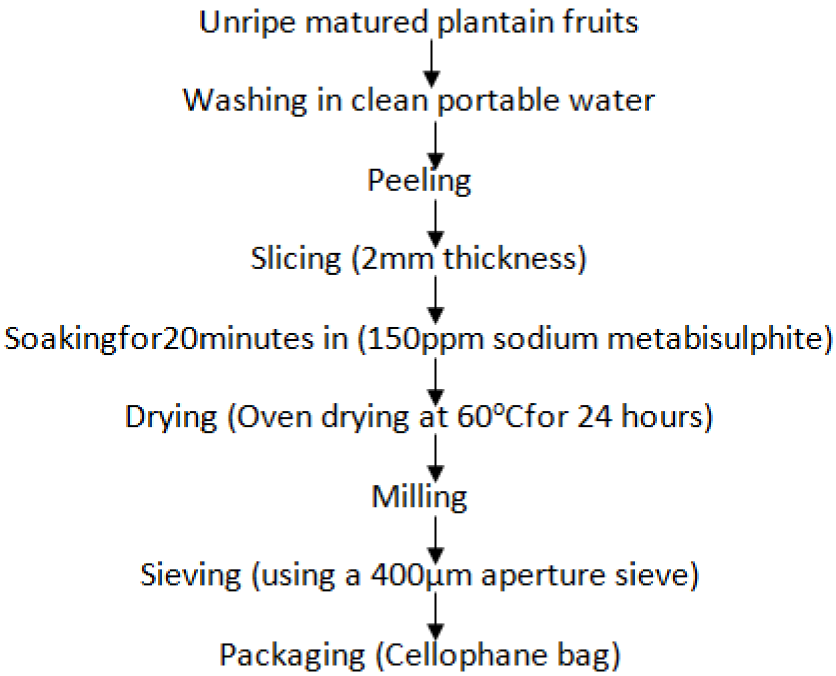

Figure 3: Flow diagram for the production of plantain flour.

Sample formulation:

The yam-soy-plantain flour samples were formulated in the following ratio, using codes for easy identification.

Table 1: Yam-Soy-Plantain formulations.

SAMPLES	FORMULATIONS		
	Yam flour	Soy flour	Plantain flour
Z9F	100	0	0
4AP	85	5	10
DF5	80	10	10
YRI	75	15	10
LBN	70	20	10
GRZ	65	25	10

Proximate analysis

The proximate analysis of the flour samples were carried out according to the standard methods [10].

Functional properties:

Determination of bulk density

The bulk density of each flour sample was determined using the method described by [11]. 20g of each flour samples was weighed into 100ml graduated measuring cylinder. The samples were packed by gently tapping the cylinder on the bench top 10 times from height of 5cm. the volume of the sample was recorded.

$$\text{Bulk density (g/ml)} = \frac{\text{weight of the sample}}{\text{Volume of sample after tapping}}$$

Determination of swelling power.

Swelling power was determined by the method described by [10]. 1g of flour sample was weighed into a 50 ml centrifuge tube after which 10ml of distilled water was added and mixed gently. The slurry was heated in a water bath at a temperature of 100^{0}C for 15 minutes. During heating, the slurry was stirred gently to prevent clumping of the dough. On completion of 15 minutes, the tube containing the paste was centrifuged at 3000rpm for 10 minutes. The supernatant was decanted immediately after centrifuging. The weight of the sediment was taken and recorded. The moisture content of the sediment gel was used to determine the dry matter content of the gel.

$$\text{Swelling power} = \frac{\text{weight of wet mass sediment}}{\text{Weight of matter in gel}}$$

Determination of water absorption capacity

Water absorption capacity was determined by the method of [12]. 1g of each flour sample was weighed into a centrifuge tube and 10ml of distilled water was added. Samples were vortexed for 5 minutes and allowed to stand for 15 minutes at room temperature (28±2^{0}C) before centrifuging at 3500rmp for 30 minutes. Excess water was then decanted, and the sample was allowed to drain by inverting the tube over absorbent paper. The weight of the water-bond sample was determined by difference

Determination of water solubility index

Water solubility index was determined by the method of [13]. 2g of each flour sample was weighed into a porcelain dish and hydrated with 10ml of distilled water. The hydrated flour was heated in a water bath of 100^{0}C for 30 minutes and allowed to cool to room temperature. The supernatant was decanted, evaporated to dryness and then weighed. Water solubility index was calculated as the weight percent of the dry supernatant.

Water binding capacity

Water binding capacity was determined according to the procedure described by [14]. The sample (2g) was transferred into a weight centrifuge tube to which 30ml of distilled water was added. The bottle was tarred and agitated in a shaker for 1 hour. It was then centrifuged at 3500rpm for 10 minutes. The supernatant was decanted immediately and the bottle was tipped up and allowed to drain for 10 minutes further. The bottle was weighed and the amount of water held by the flour was calculated.

$$\text{Water binding capacity} = \frac{\text{g bond water}}{\text{Weight of the sample}} \times 100$$

Sensory evaluation

Sensory evaluation was carried out using a 30 member semi-trained taste panel, where evaluation was done based of ratings on the basis mouth feel, color, flavor, texture and overall acceptability. The rating of the samples was done using a 9-piont hedonic (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).

Statistical analysis of data generated was performed by subjecting the data to analysis of variance (ANOVA) to calculate significant difference in treatment means and [15] was used to separate the means

RESULTS AND DISCUSSION

PROXIMATE COMPOSITION

The moisture content for all the flour samples ranged from 8.05% to 11.76% suggesting a good storage potential. The moisture content and water activity in a dry sample greatly determine the keeping quality of a product [16]. It was also observed that there was a gradual increase in moisture content as the rate of substitution decreases. The protein content for all the flour samples were 4.82%, 6.79%, 8.60%, 11.11%, 13.21% and 15.32%. The trend showed an increase in the level of protein as the enrichment of the sample with soy flour increases. This is due to the high protein content present in soil bean seeds. [17] recorded protein contents of 13.16% for yam flour. The high protein content obtained in sample GRZ (60% yam: 25% soy: 10% plantain) could be of nutritional importance in most developing countries where people cannot afford proteinous food because of the cost.

Table 2: proximate composition of yam-soy-plantain flour

Parameters			**Samples**			
%	**Z9F**	**4AP**	**DF5**	**YR1**	**L3N**	**GRZ**
Moisture	11.76^{a} ±3.11	9.88^{b}±0.04	9.86^{b}±1.23	8.86^{c}±1.15	11.06^{a}±1.53	8.05^{c}±1.01
Protein	4.82^{c}±0.56	6.79^{b}±0.28	8.66^{b}±0.93	11.11^{a}±0.28	13.21^{a}±0.77	15.32^{c}±0.13
Fat	0.84^{e}±0.66	0.95^{e}±0.33	1.12^{d}±063	2.84^{c}±0.84	4.48^{b}±0.78	6.70^{a}±0.83
Ash	3.38^{d}±0.73	5.22^{a}±0.74	5.72^{a}±0.09	5.88^{c}±0.98	6.01^{b}±1.09	6.32^{b}±1.58
C. Fiber	0.56^{e}±0.10	0.60^{d}±0.003	0.74^{c}±0.001	0.90^{b}±0.01	0.99^{b}±0.01	1.28^{a}±0.04
CHO	78.64^{a}±3.59	76.56^{a}±1.38	73.90^{b}±2.90	70.41^{b}±2.27	66.78^{c}±4.75	62.33^{c}±0.56

Values are means± standard deviation of yam-soy-plantain flour at ($p \leq 0.05$)

ZF9= 100% yam flour

4AP= 85:5:10% yam-soy-plantain flour

DF5=80:10:10% yam-soy-plantain flour

YR1= 75:15:10% yam-soy-plantain flour

L3N= 70:20:10% yam-soy-plantain flour

GRZ= 65:25:10% yam-soy-plantain flour

As the soy substitution increases, it was observed that the fat content of the flours increases. The soy bean used for the research work was not defatted, although high fat in flour product can promote unpleasant and odorous compound. [18] Fiber content (0.56% to 1.28%) increase with increase in the soy beans substitution. The ash contents for all ranged from 3.38% to 6.32%. All the food samples (yam, fiber and plantain) are all good sources of mineral [19] Carbohydrate contents of the flour sample ranged from 62.43% - 78.64% with the yam flour without substitution having the highest value. The carbohydrate content decreases as the level of substitution increase and this is in agreement with a previous work [20,21,22].

FUNCTIONAL PROPERTIES

The functional properties of blend of yam-soy-plantain flour are shown in Table 3. The bulk density ranged from 0.39g/ml to 53g/ml for all the flour samples. Bulk density is affected by the particle size and the density of the flour, which serves as an important factor in determining packaging material, material handling [23]. High bulk density is desirable in ease of dispensability and reduction of paste thickness. Water absorption capacity represents the ability of a product to associate with water under condition where water is limited [24]. The water absorption capacity for the samples ranged from 316% to 414%.

Table 3: Functional properties of yam-soy-plantain flour

Parameters	Samples					
%	Z9F	4AP	DF5	YR1	L3N	GRZ
B.D. g/ml)	0.53^{a}±0.02	0.50^{b}±0.013	0.47^{c}±0.015	0.45^{d}±0.007	0.45^{d}±0.02	0.39^{e}±0.008
WAC (%)	82.5^{ab}±6.36	331.5^{b}±14.85	316.8^{c}±17.32	319.25^{c}±0.35	342^{ab}±19.40	414^{a}±17.88
WSI (%)	85.5^{b}±6.36	72.5^{d}±3.54	78.5^{c}±4.95	80.0^{b}±14.4	97.5^{a}±0.74	75.0^{c}±7.00
SC (g/g)	1.94^{c+}±0.08	2.06^{b}±0.00	2.03^{b}±0.12	2.06^{b}±0.08	2.18^{a}±0.06	2.34^{a}±0.13
WBC (g/g)	25.25^{c}±1.77	14.25^{d}±3.18	26.75^{c}±2.48	12.00^{d}±2.83	47.0^{b}±2.83	64.75^{a}±1.77

Values are means± standard deviation of yam-soy-plantain flour at ($p \leq 0.05$)

ZF9= 100% yam flour

4AP= 85:5:10% yam-soy-plantain flour

DF5=80:10:10% yam-soy-plantain flour

YR1= 75:15:10% yam-soy-plantain flour

L3N= 70:20:10% yam-soy-plantain flour

GRZ= 65:25:10% yam-soy-plantain flour

B.D= Bulk density, WAC= Water absorption capacity, WSI= Water solubility index, WBC= Water binding capacity, SC= Swelling

The water solubility index (WSI) ranged from 75.0% to 97.5%. The increase of the water solubility index was expected since high molecular weight carbohydrate and plantain were hydrolyzed to simpler more soluble components during the processing to flours. [25, 26]. There was significant difference ($p \leq 0.05$) in the swelling power of the sample at 100^{0}C sample GRZ (65% yam: 25% soy: 10% plantain) had the higher value of 2.34g/g while sample Z9F (100% yam flour) had the lowest mean value of 1.94g/g. this suggest that particle size of the starch granules and damage done to the starch during milling operation had great effect in the swelling capacity of the flour [19]. The water binding capacity varied between 12.00g/g and 64.75g/g. water binding capacity improves the reinstitution and textural ability that in obtainable from plantain flour [19].

SENSORY EVALUATION

Table 4: Sensory evaluation of yam-soy-plantain flour

Parameters	Samples					
%	Z9F	4AP	DF5	YR1	L3N	GRZ
Mouth feel	7.33^{a}	6.78^{c}	6.67^{b}	7.00^{b}	7.33^{a}	7.67^{a}
Color	6.67^{b}	7.33^{a}	6.89^{b}	7.33^{a}	6.78^{b}	7.33^{a}
Flavor	6.78^{b}	6.89^{b}	6.44^{c}	6.22^{d}	7.22^{a}	6.67^{b}
Texture	5.78^{c}	6.56^{b}	6.00^{c}	6.89^{a}	7.11^{a}	6.89^{a}
O. A	7.22^{a}	7.11^{b}	6.78^{c}	7.11^{b}	7.44^{a}	7.22^{a}

Values are mean sensory score of yam-soy-plantain flour at ($p \leq 0.05$)

ZF9= 100% yam flour

4AP= 85:5:10% yam-soy-plantain flour

DF5=80:10:10% yam-soy-plantain flour

YR1= 75:15:10% yam-soy-plantain flour
L3N= 70:20:10% yam-soy-plantain flour
GRZ= 65:25:10% yam-soy-plantain flour, O.A= Overall Acceptability

Table 4 showed the results of sensory analysis of flours. The result revealed that the paste produced has significant differences in mouth-feel, color, flavor, texture and overall acceptability. From the test it was observed that panelists' preferred 100% yam flour and this may be due to the familiarity of the product in terms of taste, colour and texture. The level of acceptance increases steadily from 85:5:10 to 65:25:10 for yam-soybean-plantain flour with an increase in the level of substitution of soybean flour to yam flour. This may be due to odour and other intrinsic properties possed by the soybean.

CONCLUSION

Substitution of yam flour with soybean flour and plantain flour resulted in improved nutritional qualities of the composite flour and this would be of nutritional importance to people in developing countries such as Nigeria where people can hardly afford cheap animal proteinous food because of its cost. Therefore, availability of this blend is an attempt to address global food crises in the underdeveloped nations.

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