Chemical and Organoleptic Evaluation of Soyabean-Yam Recipes as possible Snacks and Food for Children

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Abstract

This study examines the use of yam (Discorea rotundata)/soybean (Glycine max) to formulate enriched children's foods. The formulated composite flours were standardized and prepared and were organoleptically assessed. The organoleptic qualities of the samples were evaluated on a 9-point hedonic scale. Random samples of 30 persons were involved in the test. The statistical analysis were done using Duncan's multiple range tests to determine the samples that were significantly different ($p<0.05$). Analysis of the data revealed that there were significant differences ($p<0.05$) between some of the soybean enriched samples and the conventional diets. The proximate analysis of the samples showed that the test samples had higher protein content that the controlled samples and were highly acceptable. The fortification ratio 1:1.75 in (YSC) and (TVP) won the overall acceptability for soy-yam cake and soy-yam flour (amala) respectively.

Keywords: Evaluated, organoleptic, chemical, soybean-yam, children's foods

Introduction

Protein-energy malnutrition (PEM) has remained a bane in the nutritional health in many developing countries such as Nigeria. The traditional children's foods and snacks consist of porridge and food products made from unenriched cereals (maize, sorghum, millet); and starchy foods like yam tubers; hence do not meet the energy and other nutrients need of children. The gruels or pastes are either too watery or have low energy density and or bulky. The quantity the young children therefore consumed cannot meet their nutrient requirements (Los Angeles Chinese learning centre web site; and International Development Research Center (IDRC), 1987).

To overcome the inadequacies of protein and energy in foods for vast majority of vulnerable groups of the population is the enrichment of the staple foods such as yam (*Discorea rotundata*) with soybean (*Glycine max*). This arises as a solution of a great shortage of animal protein in many developing countries such as Nigeria. Animal protein is more efficient in alleviating nutritional problem than plant proteins. Therefore, it requires great effort to find out alternative source of rich plant protein that is cheap enough and nutritionally good as animal protein meet the need of those who cannot afford animal protein. Less expensive sources such as plant proteins should be used to alleviate the problems of protein malnutrition either by formulating new recipes or fortifying traditional foods.

Soybean can form the preferred protein supplement because of its high protein and low cost. The protein content of soybeans is quite high ranging from 40% in full-fat soya flour to 90% in soy isolate (Los Angeles Chinese learning centre web site). Soybean is highly digestible, contains about 20% fat or oil and is quite desirable because it also has a large proportion of unsaturated fatty acids (about 85%) (Los Angeles Chinese learning centre web site; FTF volunteer Rodney Fink for farmers in Uzbekistan web site; Ferrier, 1974 and Wolf *et al.*, 1971). The protein content of yam (*D. rotundata)* is low ranging from 1-2% of the fresh weight (Eka, 1998). The yam tubers in general are low in ether extract, which ranges from 0.04 to 2.0% in terms of dry matter and from 0.04 to 0.3% in terms of wet weight (Eka, 1998). Therefore this study tried to overcome the inadequacies of protein and energy in yam by fortifying it with soybean flour. It assessed the fortified foods organoleptically and chemically.

Materials and Methods

Source: The soybean seeds used for this study were bought at the International Institute of Tropical Agriculture (IITA), Ibadan. The yam tubers and wheat flour were purchased at Nsukka Market.

Treatment of Samples; The samples underwent different treatments. Generally, the soybean seeds were sorted and washed in the water to remove dust and dirt, blanched for twenty-five minutes, manually dehulled and washed. The dehulled soybean was spread on clean trays with good air circulation and dried in a hot air oven at 60ºc until dry. The dried soybean was milled into fine flour and stored in clean transparent airtight polythene bags to prevent deterioration of the flour by insect infestation and moisture absorption.

The yam tubers (*D. rotundata*) were peeled, washed, sliced into thin sizes, dried in a hot air oven at 60ºc until dry and milled into flour. The flour was packaged in airtight polythene bags, labeled and stored.

Method of preparation for soy-yam cake:
1. Creaming margarine with sugar until fluffy and light
2. Sieve soybean and yam; and wheat flours respectively into two different measuring bowls with baking powder
3. Beat eggs into the creamed margarine with sugar and mix in the dry ingredients
4. Grease baking tins and bake till golden brown.

Method of preparation for soy-yam *Amala*:
1. Sieve flour
2. Boil water
3. Pour yam flour or the mixed flour in boiling water
4. Stir on low heat till a soft cooked consistency.

Serve with *egusi* soup at room temperature.

Preparation of Samples for Organoleptic Evaluation: These fortified samples and their controls were served at room temperature in pre-coded dishes to thirty randomly selected consumers. Each consumer was required to taste a piece of each of the samples and access the characteristics of interest (color, texture, flavor, overall acceptability). Clean drinking water at room temperature was used to rinse the mouth in between testing. They were presented with evaluation sheets. Scores were assigned to each of the characteristics. A 9-point Hedonic scale was used to assess these characteristics, with 9 showing the highest degree of acceptability of the characteristics and 1 indicating lowest degree of acceptability.

Proximate analysis of the products (cakes and *amala*): The nutrient composition of the products from soybean and yam was determined by AOAC (1995) procedures. Crude protein determination was by MicroKjeldahl method using 6.25 as the conversion factor. Ash by dried ashing method in a muffle furnace, fat was by Soxhlet extraction and crude fibre by modified Weende method. Direct air oven method was used for moisture determination. Carbohydrate was determined by difference and energy was estimated using the Atwater conversion factor (Passmore and Eastwood ,1986)

Statistical analysis: Means and standard deviations were calculated for the scores on each characteristic. Analysis of variance table was used to compare the means. Duncan's multiple range tests was used to determine the samples that were significantly different in the characteristics of interest and which were not.

Results

The. proximate composition and energy of the products were presented in the Tables 3 and 4. The protein levels of the cake ranged from 7.52% for YSR to 14.50% for YST. The carbohydrate and fat levels of the snacks varied with supplementation. As the proportion of soybean decreased in the composite, the fat level of the snack consequently decreased 13.20% for YST to 8.50% for YSR, while the carbohydrate levels increased from 18.50% to 25.58% for YSR. The moisture level subsequently increased in level 51.30% for YST to 57.40% for YSR. The product without soybean supplement ROS had the lowest moisture level than the supplemented products. The energy values of the products were influenced by supplementation. The products with more soybeans (YST) had higher energy density than the products with less supplementation (YSR). The ash levels of the products had little variations, although it followed the same trend as the other nutrients, decreasing with decreasing proportion of soybean in the composite.

Table 4 presented the proximate composition and energy density of soy-yam *amala* products. The protein levels of the supplemented products ranged from 5.32% for RSV to 14.32% for SFP. The control (NMS) had the least protein (1.2%). As the proportion of soybean increased in the composites, protein levels also increased. The fat levels of the product increased also as the proportion of soybean increased, from 1.28% for RSV to 6.20% for SFP. Also the moisture levels of the products decreased as the proportion of soybean increased in the composite. The energy density increased with increasing levels of soybean. The variation in ash levels were not much. Amala made with equal proportion of soybean and yam flour still had the highest ash content (1.3%).

Table 5 presented the sensory scores associated with the snacks made from soybean and yam flours. This product was comparable to the product made with the wheat flour (ROS) as control in all the attributes evaluated except for the texture. The texture score for YSC was statistically ($p<0.05$) higher than that of the control (ROS).

Table 6 showed that the sensory scores associated the amala based on 75g soybean and 125g yam flour had higher organoleptic scores than those based on higher or lower ratios. TVP was significantly ($p<0.05$) different from other products in all the attributes.

Discussion

The high protein levels in the supplemented products could be attributed to the high protein content of the soybean (Weigarter web site); while the protein content of yam tuber is very low (Eka, 1998). The higher ratios of soybean to yam flour in the products caused the differences in the proximate composition.

The higher carbohydrate percentage was observed in the products supplemented with a higher proportion of yam flour; yam itself contains much more carbohydrate than soybean hence the result (Eka, 1998).

The higher fat content for all the supplemented products was because they had a higher ratio of soybean. Soybean seed store their food energy as oil. The snacks and *amala* food are potentially good sources of polyunsaturated fatty acids (Weigarter web site). The traditional children's food and snacks consisted of porridge and food products made from non supplemented cereals and or starchy foods like corn meals and or yam tubers;

Table 1: Formulated Soy-Yam composite and recipe for cake

Sample Codes	Soy flour (g)	Yam flour (g)	Wheat flour (g)	Margarine (g)	Sugar (g)	Egg (Medium)	Baking Powder (tsp)	Water (mls)
ROS	-	-	45	22.5	22.5	3	1	100
YST	22.5	22.5	-	22.5	22.5	3	1	120
SOC	19	25	-	22.5	22.5	3	1	120
YSC	16	28	-	22.5	22.5	3	1	120
YSR	11	33	-	22.5	22.5	3	1	120

	Ratio
45 g Wheat flour	*0:1*
22.5 g Soy flour and 22.5g yam flour	*1:1.0*
19g Soy flour and 25g yam flour	*1:1.32*
16g Soy flour and 28g yam flour	*1:1.75*
11g Soy flour and 33g yam flour	*1:3.0*

Table 2: Formulated Soy-Yam composite and recipe for Amala

Sample Codes	Soy flour (g)	Yam flour (g)	Water (ml)
NMS	-	200	16
SFP	100	100	163
TVP	75	125	163
RSV	50	150	163

Note:	*Ratio*
200 g Yam flour	*0:1*
100 g Soy flour and 100 g Yam flour	*1:1.0*
75 g Soy flour and 125 g Yam flour	*1:1.67*
50 g Soy flour and 150 g Yam flour	*1:3.0*

Table 3: Proximate Composition of Soy-Yam Cake (%/100 g) Edible Portion

Sample	Moisture %	Protein %	Fat %	Ash %	CHO %	Energy (KJ)
ROS	46.80	12.05	10.90	1.01	29.24	1105.23
YST	51.30	14.50	13.20	2.50	18.50	1049.40
SOC	53.80	12.00	11.50	1.40	21.30	991.60
YSC	56.20	9.20	10.00	1.04	23.56	926.92
YSR	57.40	7.52	8.50	1.00	25.58	877.20

Note:	*Ratio*
45g Wheat flour	*0:1*
22.5g Soy flour and 22.5g yam flour	*1:1.0*
19g Soy flour and 25g yam flour	*1:1.32*
16g Soy flour and 28g yam flour	*1:1.75*
11g Soy flour and 33g yam flour	*1:3.0*

Table 4: Proximate Composition of Soy-Yam Flour (Amala) (%/100 G) Edible Portion

Samples	Moisture %	Protein %	Fat %	Ash %	CHO %	Energy (KJ)
NMS	66.50	1.20	0.10	0.40	31.80	554.70
SFP	60.20	14.32	6.20	1.30	17.98	778.50
TVP	62.70	10.00	3.63	0.70	20.97	660.80
RSV	69.20	5.32	1.28	0.40	23.80	542.40

Note:	*Ratio*
200 g Yam flour	*0:1*
100 g Soy flour and 100 g Yam flour	*1:1.0*
75 g Soy flour and 125 g Yam flour	*1:1.67*
50 g Soy flour and 150 g Yam flour	*1:3.0*

Table 5: Test Panel Rating of Soy-Yam Cake

Characteristic	ROS	YST	SOC	YSC	YSR
Colour	7.85±0.05^{ab}	7.87 ±0.52^{ab}	5.03 ±0.02^{c}	8.50 ±0.07^{a}	7.67 ±0.08^{b}
Texture	7.40±0.25^{b}	7.16 ±0.42^{b}	3.52 ±0.04^{c}	8.30 ±0.09^{a}	7.40 ±0.09^{b}
Flavour	8.13±0.15^{a}	6.77 ±0.13^{b}	3.79 ±0.06^{c}	8.13 ±0.04^{a}	7.40 ±0.06^{b}
Overall Acceptability	8.76 ±0.35^{a}	6.19 ±0.21^{b}	3.83 ±0.02^{c}	8.77 ±0.11^{a}	6.77 ±0.03^{b}

Note:	*Ratio*
45g Wheat flour	*0:1*
22.5g Soy flour and 22.5g yam flour	*1:1.0*
19g Soy flour and 25g yam flour	*1:1.32*
16g Soy flour and 28g yam flour	*1:1.75*
11g Soy flour and 33g yam flour	*1:3.0*

a-c values in the same row for each characteristic value with similar superscripts are statistically similar ($p>0.05$) while those with different superscripts are statistically ($p<0.05$) different.

Table 6: A Summary of the Sensory Evaluation of Soy-Yam Flour (*Amala*)

Characteristic	NMS	SFP	TVP	RSV
Colour	7.63 ± 0.08 [b]	6.87 ±0.03 [c]	8.37 ±0.06 [a]	8.23 ±0.16 [ab]
Texture	6.60 ± 0.13 [b]	1.37 ±0.02 [c]	7.50 ±0.21 [a]	6.83 ±0.15 [b]
Flavour	7.20 ± 0.05 [b]	3.33 ±0.04 [d]	8.13 ±0.05 [a]	6.40 ±0.25 [c]
Overall Acceptability	7.33 ± 0.08 [b]	3.37 ±0.07 [d]	8.63 ±0.09 [a]	6.57 ±0.03 [c]
Note:				***Ratio***
200 g Yam flour				*0:1*
100 g Soy flour and 100 g Yam flour				*1:1.0*
75 g Soy flour and 125 g Yam flour				*1:1.67*
50 g Soy flour and 150 g Yam flour				*1:3.0*

For each nutrient value with similar superscripts in each row statistically similar ($p>0.05$) while those with different superscripts are statistically ($p<0.05$) not different.

which are either too watery or have low energy density and bulky. This therefore does not meet the energy and other nutrients need of children. The quantity the young children consumed cannot meet their nutrient requirements (Weigartner web site).

The school-age is a period of growth and calls for an increase in the intake of nutrients. The school aged child therefore needs nutritious and complete lunch that satisfies approximately one third of the daily requirement. Snacks are a way of life with school children and are popular for their energy needs. It is necessary to provide nutrient dense snacks for them (Ene-Obong, 2001).

The snack and food are potentially good sources of polyunsaturated fatty acids, because of the presence of soybeans (Bender *et al.*, 1999).These supplemented products when consumed, would ensure that energy intake from fat would meet normal requirement. The high levels of protein and fat in the snack and food was translated to high energy levels. The products, particularly the ones supplemented with soybean could contribute effectively in fighting against protein-energy malnutrition in Nigeria.

When summary of all the attributes were examined for cake YSC with (16g soybean and 28g yam flour) won the preference of the panelists. It was also observed that the more soybean content increased the panelists complained of beany flavour.

YSC and ROS are similar ($p>0.05$) statistically in all the parameter except the texture. ROS with (100% wheat flour) is the conventional cake they were used to. The preference by the panelists for the colour and texture of the YSC (supplemented product) over others could be attributed to the synergistic effects of blending the two flours (soybean and yam) at a ratio 1:1.75 to produce a much more desirable product.

The panelists preference for soy-*amala* (TVP), was noticed in all the attributes; and also was more preferred than NMS (control) possibly because of its variance from the usual pounded yam. The milky tinct effect of soybean on the *amala* may have fascinated the panelists, and also the softness as a result of the oily effect of the soybean. The energy (660.80KJ) of TVP was higher than the control NMS (554.70KJ), hence improving the energy content of *amala*.

Conclusion: The snacks and foods contained reasonable quantities of fat, protein, and carbohydrate. Fat increases the energy density of foods if available. The products could be potentially valuable to diversify the source of protein and oil needs of the populace particularly the young children. Nutrition education of the population would lay emphasis on the supplementation of the traditional yam flour with soybean to improve its nutritional quality. This would increase the production and the utilization of the yam flour supplemented with soybean.

There is need to identify other local legume/yam based snacks and foods with promising nutrient potentials. These would be popularized after modification for use in the dietary diversification programmes to reduce food insecurity, poverty and malnutrition in Nigeria. \

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