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Physico-Chemical, Pasting, and Sensory Properties of "Poundo"-Yam Enriched with Defatted Soy Flour

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ABSTRACT

The effect of defatted soy flour enrichment on the physicochemical, pasting and sensory properties of "poundo" yam flour produced from both cubed/boiled and boiled/mashed yam were evaluated. "Poundo" yam flour was produced by two different methods of peeling, washing followed by dicing/boiling and boiling/mashing then drying differently to produce "poundo" yam flour. The yam flours were enriched with soy flour in a ratios of 100:0; 90:10; 80:20 and 70:30 respectively. Analyses were carried out to determine the proximate, functional, pasting and sensory qualities. Enrichment increased the protein content from 4.21% to 19.56%, fat content from 1.28 to 3.64 %, ash contents from 1.22 to 1.83% and crude fiber from 1.7 to 3.68%) while the carbohydrate decreased from 87.42 to 71.00% depending on the levels of substitution. The bulk density (BD), swelling power (SP) of the flour samples decreased while the water absorption capacity (WAC) increased with soy enrichment. The peak viscosity decreased while the flour from mashed sample had the highest peak viscosity. The sensory evaluation shows that 10% soy enriched reconstituted instant "poundo" yam was still as acceptable as the control sample. Therefore enriching "poundo" yam flour with soybean flour up to 10% level produced an acceptable reconstituted "poundo" yam comparable in quality to the control. The mashed sample was more preferred among the reconstituted yam flour; therefore mashing the boiled yam before drying will be a better method for producing defatted soybean enriched yam flour.

Keywords: "poundo" yam, enrichment, proximate, pasting, physicochemical, sensory

INTRODUCTION

Yam, a member of the genus *Dioscorea* is the most important staple food in West Africa after cereals (Ekwu *et al.,* 2005). It is a major staple food for an estimated 60 million people in the region stretching from Ivory Coast to Cameroon, an area commonly referred to as "Yam Zone" of West Africa (Akissoe, et al., 2003; Jimoh et al., 2009). In the West African yam zone, which is the principal producer on a global basis, *D. rotundata*, *D. alata*, and *D. esculenta* are the most common species. There are indications that yam has great prospect of contributing to closing the projected food deficit in Africa in the 21st century, if efforts are made to identify and overcome the constraints to its production (FAO Statistics, 2006). Consumed with sauces after boiling, roasting or frying. It is mashed or pounded into dough after boiling (Omonigho and Ikenebomeh, 2000). Yam belongs to the semi perishable class of food due to its relatively high moisture content and vulnerability to gradual physiological deterioration after harvesting. However, yams can be processed into less perishable products such as yam flour through a drying process (Jimoh and Olatidoye, 2009). The traditional process of preparing pounded yam is a tedious process, which involves pounding cooked slices of yam in a mortar using a pestle to a smooth dough consistency. However, instant pounded yam flour which is a modern invention to simplify the tedious traditional process.

Soybean has been recognised to be an ideal grain for meeting protein and energy requirement of both man and animal. Soybean is probably the world's most valuable crop, used as feed by billions of livestock, as a source of dietary protein and oil by millions of people. It is also used in the industrial manufacture of thousands of products and as good sources of energy, vitamins and minerals (Nwokolo, 1996). Soybeans have great potential in overcoming protein calorie malnutrition in developing countries, although it is not indigenous to Africa (Nwabueze, 2007). Several attempts to improve the chemical, physical and sensory quality of instant yam have been reported by various authors (Ngoddy and Onuoha, 1983; Sanni, et al., 2006). With increasing rate of malnutrition in developing countries like Nigeria this study would give an insight on the best method for the utilization of soyabean in instant yam flour to produce a product not only having increased protein content but also great acceptability and better storability. It will also give an insight about the better method of producing "poundo" yam flour from dried and boiled cube or dried and mashed yam. The objectives of this study therefore are to determine the chemical, functional and pasting properties of soy-enriched "poundo" yam; vary processing methods and determine the acceptability by sensory evaluation of the reconstituted dough formed from soy enriched "poundo" yam produced from cubed and mashed, boiled yam.

MATERIALS AND METHODS

Sources of materials

The yam tuber (*Dioscorea alata*) specie used for this study was obtained from Owena market in Osun State, Nigeria and the soybean was obtained from Jof Ideal Family Limited in Owo, Ondo State, Nigeria.

Preparation of defatted soybean

Soybean flour was prepared by the method described by Ihekoronye and Ngoddy (1985). Soybeans were sorted to remove particles, defective seeds and stones before cleaning thoroughly washed in clean tap water. The seeds were boiled for 30 mins and drained to inactivate the Trypsin inhibitors followed by dehulling by hand rubbing within two palms, after which the soybean cotyledons were dried in a hot air oven at 70°C for 10 hours. After drying the soybean hulls were removed by winnowing the dried samples and defatted using Soxhlet extractor. It was then milled to fine powder and sieved through a standard sieve of 400μm particle size. The flour was stored for further use.

Preparation of Instant yam flour

Yam flour was produced following the method described by Ihekoronye and Ngoddy (1985). The yam tubers were washed to remove sand, dirt and other adhering materials. The yam tubers were peeled sliced to 0.02 mm thickness, and also some were cubed, after which they were dipped in water containing 2.5 g sodium meta-bisulphite in 500 ml of water for 20 mins so as to arrest the browning reaction and placed in a sieve to remove excess water after which they were cooked for 10 mins at 100 ℃. The cooked yam were dried in an oven at 70 ℃ for 7hrs which was followed by milling using a hammer mill and the yam flour was sieved, packaged and stored prior to analysis.

Reconstitution of instant yam flour preparation

The instant yam flour and defatted soybean flour were milled to fine powder separately, the fine powders were sieved, and the various blends were made. The water was boiled in a pot on a gas cooker. A quantity of the flour blend i.e. 90-10%, 80-20% and 70-30% was poured in the boiling water and stirred continuously till it gelatinizes into thick dough. A little quantity of water was added to allow the flour cook properly; the paste was stirred till thick dough was obtained.

Analysis

Chemical Composition

This was determined in terms of moisture content, crude protein, fat, ash content, and crude fibre according to standard methods (AOAC, 2005). The protein content obtained by multiplying the nitrogen content by 6.25 and the carbohydrate was determined by difference. Calorific values was obtained by multiplying the values of the crude protein .fat and carbohydrate by their physiological fuel value of 4, 9 and 4 kcal /100g respectively taking the sum of the products.

Functional Properties

Swelling Index /Capacity was determined according to the method of Ukpabi and Ndimele (1990). Reconstitution index was determined according to Banigo and Akpapunam, (1987). Wettability was determined according to the method of Armstrong *et al* (1979). Water binding capacity of yam flour was determined according to the method of Medcalf and Gilles (1965). The texture (gel strength) of the instant yam flour was determined using precision penetrometers. The Least gelatin index is the least gelation condition determined as the concentration when the sample is inverted and does not fall off or slips.

Sensory qualities: The organoleptic evaluation of soy enriched instant yam flour samples was carried out for consumer acceptance and preference using 23 panelists from across the university community. A random selection using a nine point Hedonic Scale where 1 represents "extremely disliked" and 9 represents "extremely liked" (Larmond, 1977).

Statistical Analysis:Means and standard errors of the mean (SEM) of replicate scores were determined and subjected to analysis of variance (ANOVA) using the Statistical Package for Social Statistics (SPSS version 16). Means were separated using The Duncan's New Multiple Range (DNMR) Test (Steel *et al.,* 1997).

RESULTS AND DISCUSSION

Proximate composition of the enriched "poundo" yam flour.

The results of the effect of increasing level of substitution on enriched 'poundo' yam using different processing methods are as presented in the Table 1. It was observed that there was increase in moisture content with each level of substitution and the mashed yam has a lower moisture content which suggests, it will be more shelf-stable. For the protein, there was no significant difference between the cubed yam and that of the mashed yam as the highest substitution being CS70 and MS70 of soybean has the highest crude protein, there was an increase from C100 (4.21%) and M(4.23%) to CS70 (17.52%) and MS90 (17.25%) respectively indicating nutrients enhancement with soy flour. This could obviously be due to the significant quantity of protein in soy bean seeds (Olaoye et al., 2006). This high protein content in Soy enriched yam flour will be of nutritional importance in most developing countries, Nigeria inclusive where many people can hardly afford high proteinous foods because of the costs. The increase in protein content is similar to some other research study in which soy flour was used in supplementation, such as in "soy-ogi" (Oluwamukomi *et al.*, 2005); wheat-soy plantain in bread (Olaoye et al., 2006). There were significant differences among the samples for the fat content except at MS80, CS70 where both had (3.11%). Though the fat increased with substitution, it was not appreciable since a defatted sample was used therefore will make the sample to store for a long time without going rancid. For crude fibre and ash there were no appreciable significant differences in the enriched '"poundo"' yam blends. The control had the highest carbohydrate when compared with other levels of substitution. Similar decrease was observed by (Oluwamukomi *et al.*, 2005) when "gari" was supplemented with soybean before and after fermentation.

Table 1: Proximate Composition of the Soy-enriched "poundo" yam Blends (%).

Sample	Moisture content	Crude protein	Crude fibre	Ash	Fats	Carbohydrate
C100	4.17±0.13[b]	4.21±0.17[f]	1.71±0.31[f]	1.22±0.20[f]	1.28±0.29[g]	87.42±0.05[b]
CS90	4.38±0.60[a]	19.50±0.02[a]	3.68±0.03[a]	1.83±0.01[a]	3.64±0.00[a]	66.97±0.04[g]
CS80	4.26±0.46[ab]	18.09±0.06[b]	3.58±0.06[b]	1.62±0.02[b]	3.22±0.02[c]	69.23±0.14[e]
CS70	4.28±0.03[ab]	17.50±0.03[d]	2.63±0.04[d]	1.46±0.02[d]	3.11±0.03[d]	71.00±0.06[d]
M100	3.30±0.21[de]	4.23±0.06[f]	1.70±0.00[e]	1.32±0.03[e]	1.37±0.05[f]	87.91±0.11[a]
MS90	3.55±0.06[c]	19.56±0.01[a]	3.37±0.14[b]	1.60±0.02[b]	3.42±0.03[b]	68.52±0.07[f]
MS80	3.47±0.81[cd]	17.86±0.16[c]	3.03±0.42[c]	1.51±0.02[c]	3.11±0.01[d]	71.02±0.20[d]
MS70	3.27±0.09[c]	17.25±0.05[e]	2.45±0.04[c]	1.50±0.01[c]	3.00.05[e]	72.92±0.47[c]

Mean ± S.D of 3 replicates; C 100 = 100% Cubed "poundo" yam; M 100 = 100% Mashed "poundo" yam; CS 90 = 90% Cubed "poundo" yam + 10% Defatted soy bean; MS 90 = 90% Mashed "poundo" yam + 10% Defatted soy bean; CS 80 = 80% Cubed "poundo" yam + 20% Defatted soy bean; MS 80 = 80% Mashed "poundo" yam + 20% Defatted soy bean; CS 70 = 70% Cubed "poundo" yam + 30% Defatted soy bean; MS 70 = 70% Mashed "poundo" yam + 30% Defatted soy bean

Functional properties of the Soy-enriched '"poundo"' yam blends

Functional properties determine the application and use of food material for various purposes. Table 2 shows some functional properties of the enriched "poundo" yam blends. There were no significant differences between C100 and M100, between CS70 and MS70 and also between CS90 and MS90 but there was a significant difference between MS80 and CS70. The differences in the bulk density is generally affected by the particle size and the density of the flour and it is very important in determining the packaging requirement, material handling and application in wet processing in the food industry, indicating a lesser package requirement with increase in soy flour substitution (Adebowale et al. 2008). Water holding capacity of "poundo" soy flours increased with soy flour substitution due to increase in protein content. Addition of soy flour to instant yam flour improved the reconstitution ability and textural ability obtainable from the flour (Adebowale et al., 2008). The swelling capacity increased with increased levels of substitution. There was a significant difference between cubed yam (CS70) and mashed yam, (MS70) with 2.95% and 2.98% respectively.

The table showed that there were significant differences with the levels of substitution on the wettability. There was an initial increase in wettability with introduction of soy flour from 20.04 and 19.73 seconds for C100 and M100 respectively to 28.30 and 26.15 seconds for both the C90 and M90 (10% soy flour) but as the levels of substitution increased the wettability values decreased to 22.76 and 21.45 seconds for C70 and M70 (30% soy flour) being the lowest values for both cubed and mashed yam samples. The higher the wettability the higher the sinkablity. The table also showed that there was no significant difference in the C100 and M100 with 0% soy flour for the reconstitution index but varied significantly with increase in the substitution level, with MS90 (5.97 v/v) being slightly significant different from others. The reconstitution index indicates the time it takes for the enriched flour to reconstitute at varying temperature. The least gelation was observed for CS70 (6.0). The gelatinization index decreased with increase in the level of substitution. There were no significant differences in the texture (gel strength) of the enriched '"poundo"' yam blend at each level of substitution ranging from 20.23 to 23.00 mm. This means that enrichment did not adversely affected the gel strength of the "poundo" yam flour when reconstituted with hot water to form a dough. The texture evaluation of the enriched "poundo" yam blends could be correlated with the force required to compress the food between the tongue and the palate which is normally a preliminary action carried out in the mouth during consumption, which can lead to whether food will eventually be swallowed rather than masticated or chewed (Szczesniak, 2002). Hence, lower softness could predispose that the food product would be masticated or chewed while relative higher gel strength encourages swallow ability.

Table 2: Functional properties of the Soy-enriched '"poundo"' yam blends

Samples	Bulk density (g/dm^3)	Swelling capacity (%)	Water binding capacity (%)	Wettability (secs)	Gel Strength (mm)	Gelatinization index	Reconstitution index (v/v)
C100	0.85[a] ±0.01	2.68[e]±0.01	267.44[a]±0.88	20.04[f]±0.02	20.23[a]±1.42	0.73[ab]±0.12	6.76[a]±0.01
CS90	0.70[e]±0.01	3.33[a]±0.01	258.37[e]±0.65	28.30[a]±0.29	21.73[a]±3.77	0.8[a]±0.00	6.09[cd]±0.08
CS80	0.76[c]±0.01	3.08[b]±0.01	261.30[d]±0.96	26.53[b]±0.13	21.00[a]±1.35	0.73[ab]±0.12	6.33[b]±0.03
CS70	0.80[b]± 0.01	2.95[d]±0.01	263.36[c]±1.16	22.76[d]± 0.28	21.23[a]±1.70	0.6[b]± 0.00	6.72[a]±0.03
M100	0.85[a]±0.01	2.69[e]± 0.02	265.52[b]±1.19	19.73[f]±0.34	21.27[a]±1.61	0.8[a]±0.00	6.73[a] ±0.06
MS90	0.69[e] ±0.02	3.34[a]±0.01	255.35[f]±1.07	26.15[b]±0.16	20.93[a]±0.51	0.8[a]±0.00	5.97[d]±0.09
MS80	0.73[d]± 0.01	3.10[b]±0.02	259.38[e]±1.05	23.23[c]±0.22	23.00[a]±0.10	0.67[ab]±0.12	6.14[c]±0.15
MS70	0.78[c]±0.01	2.98[c]±0.02	262.61[cd]±0.91	21.45[e]±0.22	20.83[a]±0.21	0.73[ab]±0.12	6.09[cd]±0.08

Mean ± S.D of the three replicates; C 100 = 100% Cubed "poundo" yam; M 100 = 100% Mashed "poundo" yam; CS 90 = 90% Cubed "poundo" yam + 10% Defatted soy bean; MS 90 = 90% Mashed "poundo" yam + 10% Defatted soy bean; CS 80 = 80% Cubed "poundo" yam + 20% Defatted soy bean; MS 80 = 80% Mashed "poundo" yam + 20% Defatted soy bean; CS 70 = 70% Cubed "poundo" yam + 30% Defatted soy bean; MS 70 = 70% Mashed "poundo" yam + 30% Defatted soy bean

Pasting properties of the enriched '"poundo"' yam blends

Table 3 shows the result of the pasting characteristics of the enriched '"poundo"' yam blends at different levels of substitution. The pasting properties of starch are rheological characteristics that used in assessing the suitability of its application as functional ingredient in food and other industrial products. The most important pasting characteristic of granular starch dispersion is its amylographic viscosity (Aviara et al., 2010, Oluwalana and Oluwamukomi, 2011). When starch or starch-based foods are heated in water beyond a critical temperature, the granules absorb a large amount of water and swell to many times their original size. Over a critical temperature, which is characteristic of a particular starch, the starch undergoes an irreversible process known as gelatinization (Adebowale et al., 2008). When the temperature rises above the gelatinization temperature, the starch granules begin to swell and viscosity increases on shearing. The temperature at the onset of this rise in viscosity is referred to as the gelatinization or pasting temperature (Isikli and Karababa, 2005). It increased with increase in supplementation levels from 86.4°C to 95.8°C for C100 and C70 respectively and 84.85°C to 94.85°C for M100 and M70 respectively. This pasting temperature is a measure of the minimum temperature required to cook a given food sample (Sandhu *et al.*, 2005) and affects the stability of other components in the food formula and also affects energy costs (Newport Scientific, 1998).

The peak viscosity of the samples with 0% SF was highest for both the cubed and mashed poudo yam flour, C100 (905 RVA) and M100 (1173 RVA) and these decreased with increase in the supplementation levels. It decreased to 416 for CS70 and 321 for MS70 respectively. The decrease in the peak viscosity was most probably because of the distortion of the intermolecular hydrogen bond which allowed less water to be absorbed by the starch granules with increase in the levels of soy flour supplementation; which invariably might have led to a reduced internal forces holding the molecules within the granules (Hodge and Osman, 1978). The relatively low peak viscosity affected by soy flour addition indicates that the flour may be suited for products requiring low gel strength and elasticity. Peak viscosity is the maximum viscosity, developed during or soon after the heating portion of the pasting test (Newport Scientific, 1998). Peak viscosity is often correlated with the final product quality. It also provides an indication of the viscous load likely to be encountered during mixing (Maziya-Dixon *et al.*, 2004). Higher swelling index is indicative of higher peak viscosity while higher solubility as a result of starch degradation or dextrinization results in reduced paste viscosity (Shittu *et al.*, 2001). The final viscosity also decreased with increasing level of substitution. It was highest at C100 (1380 RVA) and M100 (1689 RVA) respectively and lowest at C70 (1386 RVA) and M70 (1697 RVA) respectively. The final viscosity indicates the ability of the material to form a viscous paste or gel after cooking and cooling as well as the resistance of the paste to shear stress during stirring (Oluwalana and Oluwamukomi, 2011).

The trough, sometimes called hold period, shear thinning, holding strength, hot paste viscosity due to the accompanied breakdown in viscosity is a period when the sample was subjected to a period of constant temperature (usually 95°C) and mechanical shear stress (Oluwalana *et al.* 2011). It is the minimum viscosity value in the constant temperature phase of the RVA profile and measures the ability of paste to withstand breakdown during cooling (Newport Scientific, 1998.The trough decreased with increase in supplementation levels. It decreased from 814 RVA for C100 to 321RVA for C70 and 1058 RVA for M100 to 416 RVA for M70 respectively). It is an indication of breakdown or stability of the starch gel during cooking (Ragaee *et al.,* 2006, Zaidhul *et al.*, 2006). The lower the value the more stable is the starch gel.

The setback or viscosity of cooked paste is the viscosity after cooling to 50°C. It is a stage where retrogradation or reordering of starch molecules occur. Starch will have tendency to become firmer with increasing resistance to enzymatic attack (Ihekoronye and Ngoddy, 1985). It also affects the digestibility of the starch. The setback also decreased with the increase in the supplementation levels. It decreased from 572 RVA to 243 RVA for M100 and C70 respectively and 639 RVA to 263 RVA for M100 and M70 respectively. Higher setback values means reduced dough digestibility (Shittu *et al.*, 2001) while lower setback during the cooling of the paste indicates lower tendency for retrogradation (Ragaee et al., 2006, Sandhu *et al.*, 2007). The peak time is a measure of the cooking time (Adebowale *et al.*, 2005). It did not vary in all the samples. It was 7minutes in all the samples.

Table 3: The Pasting Properties of the Enriched '"poundo"' Yam flour

sample	Peak viscosity (RVA)	Trough (RVA)	Breakdown (RVA)	Final Viscosity (RVA)	Setback (RVA)	Peak Time (mins)	Pasting Temp (ºC)
C100	905	814	91	1386	572	7	86.4
CS90	626	548	78	958	410	7	92.05
CS80	476	415	61	724	309	7	93.5
CS70	377	321	56	564	243	7	95.8
M100	1173	1058	115	1697	639	7	84.85
MS90	784	702	82	1141	439	7	90.5
MS80	663	604	59	960	356	7	91.3
MS70	468	416	52	679	263	7	94.85

Mean ± S.D of the three replicates; C 100 = 100% Cubed "poundo" yam; M 100 = 100% Mashed "poundo" yam; CS 90 = 90% Cubed "poundo" yam + 10% Defatted soy bean; MS 90 = 90% Mashed "poundo" yam + 10% Defatted soy bean; CS 80 = 80% Cubed "poundo" yam + 20% Defatted soy bean; MS 80 = 80% Mashed "poundo" yam + 20% Defatted soy bean; CS 70 = 70% Cubed "poundo" yam + 30% Defatted soy bean; MS 70 = 70% Mashed "poundo" yam + 30% Defatted soy bean

Sensory qualities of the Composite "poundo" yam

The mean scores of sensory evaluation of the composite "poundo" yam is presented in Table 4 The dough prepared from control samples (0% soy flour) for both M100 and C100 was rated significantly higher than the other level of substitution ($P < 0.05$) in all the attributes evaluated. However, the supplemented samples were accepted up to 10% Soy flour inclusion as there was no marked significant difference ($P > 0.05$) between the sensory attributes of the samples and those of the control samples in both cubed and mashed yam. Their taste, aroma, colour, texture (mouldability) and overall acceptability were indistinguishable. Similar observation was made by Odetokun *et al.* (1998) who reported that dough prepared with 30% defatted soybean was rated with little acceptability for both cubed and mashed yam. The Control sample (C100) and M100 with 0 and 10% soy flour substitution had no significant difference at 5% probability level while there was a sharp difference between those with 0% substitution and 20% substitution levels (Table 4). This observation suggests that instant yam flour could be substituted up to 10% soy flour yielding product with acceptable sensory characteristics as the control sample. The rejection and low acceptability at CS70 were based on lack of cohesiveness and its softness.

Table 4: Sensory Evaluation of Composite "poundo" Yam Blends

Sample	Taste	Aroma	Appearance	Texture	Mouth feel	Overall acceptability
C100	6.09 ± 1.13^{b}	6.52 ± 1.08^{ab}	5.83 ± 1.56^{bc}	6.13 ± 1.71^{ab}	5.96 ± 1.33^{ab}	6.52 ± 1.24^{ab}
CS90	6.00 ± 1.76^{b}	6.26 ± 1.48^{ab}	5.91 ± 1.44^{abc}	5.70 ± 1.52^{abc}	5.30 ± 1.87^{bc}	5.61 ± 1.44^{bc}
CS80	5.61 ± 1.44^{bc}	5.96 ± 1.22^{abc}	4.91 ± 2.95^{cd}	5.83 ± 1.72^{ab}	5.57 ± 1.78^{bc}	5.83 ± 1.61^{bc}
CS70	4.61 ± 2.06^{cd}	5.17 ± 1.75^{c}	4.70 ± 1.94^{d}	4.61 ± 1.99^{c}	4.57 ± 1.73^{c}	4.43 ± 2.09^{d}
M100	7.09 ± 1.38^{a}	6.91 ± 1.41^{a}	7.45 ± 1.24^{a}	6.74 ± 1.66^{a}	6.87 ± 1.42^{a}	7.26 ± 1.45^{a}
MS90	5.32 ± 1.56^{bcd}	5.59 ± 1.71^{bc}	6.32 ± 1.49^{b}	5.36 ± 1.62^{bc}	5.32 ± 1.32^{bc}	5.77 ± 1.85^{bc}
MS80	5.13 ± 1.57^{bcd}	4.96 ± 1.88^{C}	4.71 ± 1.92^{d}	5.17 ± 1.66^{bc}	4.92 ± 1.77^{bc}	4.79 ± 1.79^{cd}
MS70	4.39 ± 1.85^{d}	4.96 ± 1.82^{c}	5.09 ± 1.34^{cd}	5.35 ± 1.58^{bc}	4.96 ± 1.67^{bc}	4.87 ± 1.82^{cd}

Mean ± S.D of the 23 Panelists Scores; C 100 = 100% Cubed "poundo" yam; M 100 = 100% Mashed "poundo" yam; CS 90 = 90% Cubed "poundo" yam + 10% Defatted soy bean; MS 90 = 90% Mashed "poundo" yam + 10% Defatted soy bean; CS 80 = 80% Cubed "poundo" yam + 20% Defatted soy bean; MS 80 = 80% Mashed "poundo" yam + 20% Defatted soy bean; CS 70 = 70% Cubed "poundo" yam + 30% Defatted soy bean; MS 70 = 70% Mashed "poundo" yam + 30% Defatted soy bean

CONCLUSION

In conclusion, substitution of yam flour with soy flour at levels of 10 to 30 % resulted in notable increase in protein content, which could be nutritionally advantageous to the less privileged who use yam as their staple food and who can hardly afford high proteinous food, because of the costs. Since soybean is cheaper and readily available, soybean enrichment of yam flour would have little or no effect on the price of the product. Enriching yam flour with soybean flour up to 10% level produced "poundo" yam flour with similar characteristics to the "poundo" yam flour without soy flour enrichment (Control). This will offer a strategy of alleviating the problem of food insecurity especially in the sub Sahara region of Africa where malnutrition due to protein deficiency is prevalent. The mashed "poundo" yam flour was the most preferred among the reconstituted yam flour samples; therefore subjecting boiled yam to mashing before drying rather than cubing and drying was found to be the best method for producing "poundo" yam flour.

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