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Physicochemical, Sensory And Pasting Characteristics Of Soy-enriched Cassava 'Fufu' Flour

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ABSTRACT

The Physicochemical, Pasting and Sensory properties of cassava 'fufu' flour a fermented, dewatered and dried cassava meal, were studied. Four samples of cassava 'fufu' flour containing different levels of soy flour (5%, 10%, 15% and 20%) were prepared while two other samples were the control (0% Soy flour) and 100%soy flour respectively. The samples were subjected to Chemical, Pasting and Sensory evaluations. The results show that the soy-cassava 'fufu' composite flours containing 5.39% protein content at 5% level of inclusion increased to 16.63% at 20% level of inclusion. The ash content, fat, and fibre were 0.84%, 2.38% and 1.47% respectively at 5% level and then increased to 2.4%, 7.17% and 2.12% at 20% level of soy supplementation. Pasting characteristics of the composite flour such as the peak viscosity, trough, final viscosity and set back decreased with increased soy inclusion. The peak viscosity ranged from 314.17 RVU (Rapid Viscosity Unit) for 5% inclusion and decreased to 235.58 at 20% level of supplementation. The trough and final viscosity ranged from 223.17, 329.08 at 5% inclusion and then decreased to 142.50 and 198.17 at 20% supplementation level. The peak viscosity, trough, final viscosity and the set back for 100% cassava flour were 880.08, 876.42, 876.50, and 0.08 respectively. There were no significant differences in the sensory, chemical and pasting properties of control cassava 'fufu' (0%), and supplemented cassava 'fufu' flour up to 10% supplementation level. Therefore supplementation up to 10% level was found to be acceptable and therefore recommended.

KEYWORDS

Cassava 'fufu' flour;
Soy-cassava 'fufu';
Pasting characteristics;
Soy inclusion.

INTRODUCTION

Protein malnutrition is a major public health problem in some parts of the world, including Nigeria and the West Africa sub region. This is because diets in these areas are predominantly starchy, the major crops being roots tubers, and cereals[8]. Cassava is a very popular high – energy root crop consumed in the tropics and many regions of the developing world. It is normally processed before consumption so as to detoxify, preserve and modify them[14]. In West African sub region, cassava is one of the major crops, ranking fourth in terms of output behind sorghum, millet and yam, and it is used as a cheap source of carbohydrate food for man and livestock[10]. However, the utilization of cassava is limited by its low protein content and presence of ant nutritional components[3].

Osho and Dashiell[12] reported that across the continent of Africa, protein energy malnutrition affects 40% of children under three years with 5% of the children classified as severely malnourished. The low protein intake has been attributed to the increasingly high cost of traditional sources of animal protein[10]. The search for alternative sources of inexpensive protein has led to increased soybean utilization for household consumption, and industrial processing in Nigeria. It is a known fact that no single tuber of cassava contains protein with an ideally balanced amino acid composition for human nutrition. Therefore, soybean has been proposed as an ideal source for protein supplementation of starchy foods[10].

The objectives of this work are to produce soy-cassava 'fufu' composite flour of different levels of soy flour fortification, determine the effect of different levels of soy substitution on the chemical and pasting characteristics of the soy-cassava 'fufu' flour.

MATERIALS AND METHODS

Materials

Matured healthy cassava (*Manihot esculenta crantz*) obtained from research and experimental farm of Federal University of Technology, Akure while soy bean (*Glycine max*) was purchased from Akure main market.

The soybeans were handpicked to remove dirt and stones and the cassava was also peeled and washed.

Methods

Processing Methods

Odourless 'Cassava 'fufu'' flour was produced by the traditional (M1) method of Okpokiri *et al*[9] while the full fat Soy flour was produced by the method of Oluwamukomi *et. al.*,[8]. The cassava 'fufu' flour produced was supplemented with the full fat soybean flour at 0%, 5%, 10%, 15% and 20% and then mixed properly. The samples were then packaged in HDPE film and kept in a freezer at 0°C until required for further analyses.

Chemical analyses

Proximate analyses were carried out on the samples using standard methods (AOAC, 1990). The crude protein (N x 6.25) was determined by the micro – kjeldahl method. The total ash was determined after ashing for 12hours at 550°C. Total fat content was estimated by hexane or petroleum ether extraction while the carbohydrate content was determined by difference. The Gallenhkamp bomb calorimeter was used to determine the gross energy.

Pasting characteristics tests

The composite flours were subjected to rapid viscometry analysis test performed at the International Institute of Tropical Agriculture, Ibadan, Nigeria[6].

Statistical analysis

The statistical significance of the observed differences among means of triplicate readings of experimental results obtained were evaluated by analysis of variance (ANOVA), while means were separated using Duncan's multiple range test. These analyses were carried out using SPSS (11.0) computer package.

RESULTS AND DISCUSSION

Effect of different levels of soy-inclusion on the chemical composition of cassava 'fufu' flour

TABLE 1 shows the chemical composition of cassava 'fufu' flour supplemented with soy – flour at 5%, 10%, 15% and 20% level of inclusion respectively. The result showed that soy cassava 'fufu' protein, ash, fat and fibre increased from 5.39%, 0.84%, 2.38%, and 1.47% at 5% level and increased to 16.63%, 2.40%, 7.17% and 2.12% at 20% level of soy supplementation while the carbohydrate content decreased from 90.46% at 5% to 65.37% at 20% level of inclusion. These values were TABLE 2 shows the pasting temperatures and the viscosities of cooked slurries of the cassava 'fufu' composite flours (5%.10%, 15%, and 20%, 100%) and the control sample (0%soy) flour. The pasting temperature at which rapid gelatinisation takes place in the slurries and the time to reach the peak viscosities ranged between 78.4-95.00°C while the time ranged between.20-5.13mins. The soy enriched cassava 'fufu' samples had higher pasting temperatures and longer time to reach peak viscosity than the control 0% Soy-cassava 'fufu' flour. It took the control sample less than a minute to shoot up to the peak viscosity of 880.08RVU, while for the soy enriched samples it took more than a minimum of 4.87minutes. The pasting temperatures increased with increase in the supplementation levels. That is the higher the supplementation the higher the pasting temperatures.

TABLE 1: Proximate composition of enriched cassava 'fufu' and control flours*

Sample (%Soy)	Proximate Composition						
	Moisture(%)	Protein(%)	Ash(%)	Fat(%)	Crude Fibre (%)	Carbo hydrate(%)	Energy (kcal)
A (5%)	5.22 ± 0.05	5.39 ± 0.03	1.24 ± 0.01	2.38 ± 0.64	1.47 ± 0.01	84.30 ± 0.60	370.52 ±3.12
B (10%)	5.61 ± 0.02	8.76 ± 0.09	2.44 ± 0.06	4.99 ± 0.71	1.59 ± 0.05	76.61 ± 0.55	375.42 ±1.23
C (15%)	6.90 ± 0.06	12.4 ± 0.02	3.49 ± 0.04	5.59 ± 0.22	1.68 ± 0.03	69.94 ± 9.70	374.61 ±2.16
D (20%)	6.31 ± 0.03	16.63 ± 0.03	4.40 ± 0.03	7.17 ± 1.84	2.12 ± 0.02	63.37 ± 1.88	380.10 ±1.52
E (100%)	6.82 ± 0.17	42.71 ± 0.01	5.41 ± 0.03	22.94 ± 1.17	2.30 ± 0.01	20.82 ± 0.03	451.36 ±2.34
F (0%)	5.31 ± 0.13	1.81 ± 0.01	0.23 ± 0.02	0.95 ± 0.81	1.24 ± 0.01	90.46 ± 0.79	362.41 ±2.41

Peak viscosity

The peak viscosities of the cassava 'fufu' flours decreased with increase in the supplementation levels from 880.08RVU down to 235.58RVU at 20% soy supplementation level. This might have been due to the presence and interaction of components such as fats and proteins from the soy flour with the starch from the cassava 'fufu' flour which lowered their peak viscosities[2,17]. The baseline value of 15.33RVU for the 100% soy flour must have been due to the absence of the starch component from the cassava 'fufu' flour while the starch available in the soy flour must have been gelatinised by heating during processing. Thus, the subsequent heating in the rapid visco amylogram had little effect on its swelling capacity. High peak viscosities (Vp) reflects the fragility of the swollen starch granules which first swell and then on heating broke down under continuous mechanical stirring conditions[8].

Holding period

After a 15 minute hold at 95°C the viscosities (Vb) were reduced considerably in all the samples. The reduction in the viscosities were consistent in all the samples and increased with the increase in the level of supplementation ranging from 223.17RVU for 5%

TABLE 2: Pasting characteristics of enriched cassava 'fufu' and control flours

Samples (% Soy)	Peak Viscosity (V_p) (RVU)	Through at 95°C (V_b)	Final Viscosity at 50°C (Vc)	Stability/Break down tendency (Vp-Vb)	Consistency/gel index(Vc-Vb)	/Retrogradation index Set back ($V_c - V_p$)	Pasting Temp (°C)	Peak Time (min)
F(0%)	880.08	876.42	876.50	3.66	0.08	3.58	78.40	1.19
A (5%)	314.17	223.17	329.08	91.00	105.92	14.0	79.10	5.07
B (10%)	268.83	189.00	264.83	79.83	75.83	-4	79.95	5.13
C (15%)	236.69	155.50	219.75	81.19	64.25	-16.9	94.00	5.07
D (20%)	235.58	142.50	198.17	93.08	55.67	-37.4	95.00	4.87
E(100%)	15.33	9.17	22.83	6.16	13.67	-7.5	94.00	1.19

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TABLE 3: Mean sensory scores of enriched cassava 'fufu' and control flours

Treatments	Colour	Taste	Aroma	Texture (Mould ability)	Overall Acceptability
F(0% Soy)	6.20[a]	6.05[a]	6.20[a]	6.20[a]	6.85[a]
A (5%)	6.40[a]	6.00[a]	6.60[a]	6.20[a]	6.65[a]
B (10%)	5.85[a]	6.00[a]	6.25[a]	5.90[ab]	6.66[a]
C (15%)	4.35[bc]	5.20[ab]	5.65[ab]	4.90[ab]	5.80[ab]
D (20%)	5.45[ab]	4.70[bc]	5.20[bc]	4.60[bc]	5.80[ab]
E(100% Soy)	3.40[c]	3.35[c]	4.00[c]	3.15[c]	3.85[c]

Values are means of 20 replicates
[a, b, c]Mean values with similar superscripts are not significantly different.

to 143.50RVU for 20% supplementation. This viscosity after being held at 90oC is an indication of the stability or breakdown tendency of the hot paste[6]. The 0% soy sample showed the highest stability or lowest breakdown tendency while the soy supplemented samples showed lower stability or higher breakdown tendency of the hot paste. Results showed that the higher the level of supplementation, the lower the stability and the more the breakdown tendency during further cooking and mixing.

Cooling

When the hot pastes were cooled to 50°C the viscosities increased significantly in all the samples with values decreasing with increase in supplementation levels. The degree of increase in viscosity on cooling to 50°C is an indication of retrogradation or setback tendency (Vc-Vp) of the samples ranging from 14.91 to 37.4 increasing with increase in the supplementation levels. Sample with 0% soy had the least retrogradation or setback tendency of 3.58RVU while the sample with 20% supplementation had the highest set back or retrogradation tendency value. This increase in setback tendency with supplementation might be due to increased hydrogen bonding during cooling due to the hydrothermal treatment and the interaction between polysaccharides and proteins in the soybean flour. This might have led to the growth of gel miscella region and hence increases in index of retrogradation making entrapped water more prone to expression (syneresis) [5].

The gelatinisation or consistency index (Vc-Vb) is a notable quality of starch dough. Paste consistency affects the hand feel, mouth feel and ease of swallowing of dough[16]. This is measured as cold paste consistency or index of gelatinisation. Results showed that consistency decreased with the increase in the level of soy supplementation ranging from 105.9RVU to 13.6RVU for 5% to 100% respectfully. The index decreased with increase in the level of supplementation This may have been due to the presence of protein and fat acting as surfactant thus inhibiting the gelatinisation process. This raised the gelatinisation temperature and reduced the rate of swelling[7]. The probable mechanism is that a complex might have been formed between the protein fat matrix of the soy flour and the amylase of the cassava 'fufu' flour. This might have reduced the tendency of the amylase to retrograde thus delaying rate of firming during heating and the cooling stages. In general, Setback/ Retrogradation tendency, and Breakdown increased with increase in level of soy inclusion while the consistency/gelatinisation index decreased.

Effect of levels of soy inclusion on the sensory qualities of cassava 'fufu' flour

TABLE 3 shows the result of the mean values of sensory quality characteristics of the levels of soy inclusion on the sensory qualities of reconstituted soy-cassava 'fufu' flour.

Although sample F (the control sample) was rated the best in terms of sensory qualities such as taste, texture, aroma and overall acceptability but sample A and B (5% and 10% level of soy supplementation still have the same rating ($p > 0.05$) for colour, taste, aroma and overall acceptability. There is a significant difference ($p < 0.05$) between samples D and C in terms of colour, taste, aroma, and texture but there is no difference in their overall acceptability. In descending order, samples A, B, and F are rated higher with sample F having the best rating in overall acceptability followed by sample A and then B respectively.

Sample E is the least rated in all the sensory parameters (colour, taste, texture, aroma and overall acceptability).

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study has shown that adding soy flour to cassava 'fufu'- fermented cassava flour will result in considerable improvement in the composite flour's nutritional composition especially the protein. It can be generally concluded that in order to have

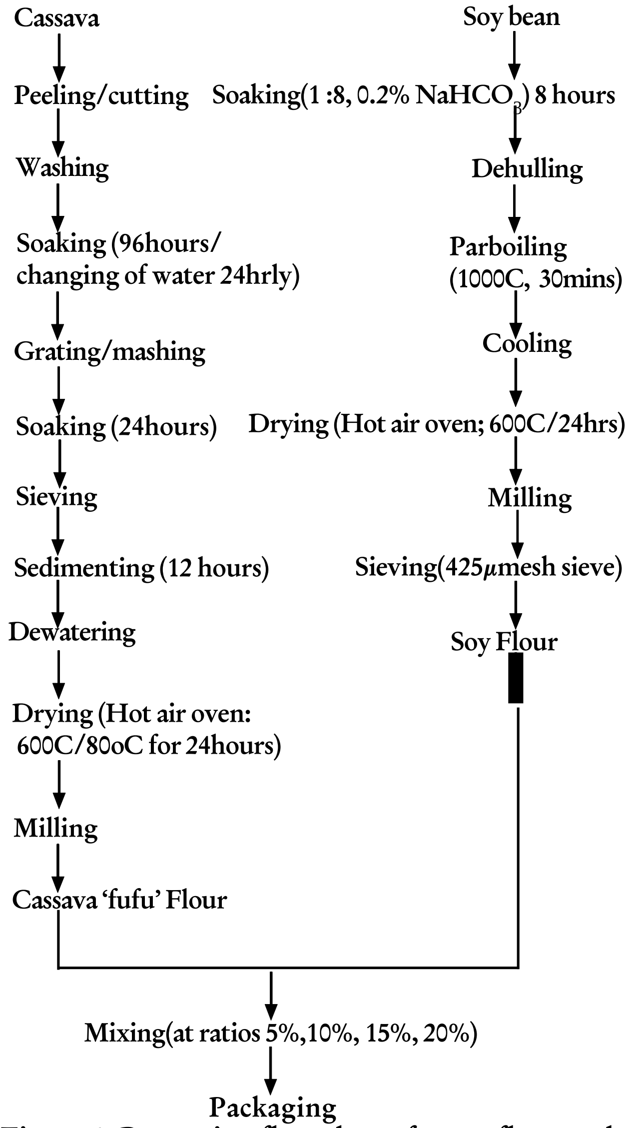

Figure 1: Processing flow charts for soy flour and odourless fufu flour.

odourless cassava 'fufu' of high protein content and pasting characteristics, soy inclusion up to 10% was still desirable; because at this level, there were no serious significant differences between the enriched and the un-enriched (control) Cassava 'fufu' flour in terms of their Chemical, Sensory and Pasting Characteristics.

Recommendation

Since supplemented cassava 'fufu' flour up to 10% level has not shown any significant difference from those of the un-enriched (control cassava 'fufu' flour), in terms of chemical, sensory and pasting properties, enrichment up to 10% is therefore recommended as the maximum level of supplementation of cassava 'fufu' cassava flour with soy flour to still maintain its physicochemical, pasting and sensory qualities.

REFERENCES

[1] AOAC; Official methods of Analysis (15th Ed.) Washington DC, Association of Official Analytical Chemist **(1990)**.
[2] M.Egounlety, O.C.Aworh; In,D.S.Sofa(Ed), Proceedings of Seminar on Development of the Protein Energy Foods from Grain Legumes, February 5-7, University of Lagos **(1991)**.
[3] O.O.Famuyiwa, A.OAkanji, B.O.Osuntokun; Afr.J. Med.Sci., **2**, 151-157 **(1995)**.
[4] FAO: Technology of Production of edible flours and Protein Products from Soybeans, FAO Agricultural **(1992)**.
[5] J.E.Hodge, E.M.Osman; Carbohydrates, In, O.R.Fenema (Ed.), 'Principles of Food Science' (Part 1-Food Chemistry), New York, Mercel Dekker Publishers, 41-138 **(1976)**.
[6] E.G.Mazurs, T.J.Schoch, F.E.Kite; Cereal Chemistry, **34(3)**, 141-152 **(1957)**.
[7] F.A.Numfor, J.M.Walter, Jr, S.J.Swartz; Inter.J.Food Science & Tech., **33**, 455-460 **(1998)**.
[8] M.O.Oluwamukomi, A.F. Eleyinmi., V. N. Enujuigha; J.Food Chemistry, **91**, 651-657 **(2005)**.
[9] A.O.Okpokiri, B.C.Ijioma, S.O.Alozie, A.N.Ejiofor; Nigerian Food Journal, **2(2-3)**, 145-148 **(1984/1985)**.
[10] S.M.Osho; Small scale and home processing of soybeans, Paper presented at UNICEEF sponsored soybean utilization workshop, 19-22 **(1994)**.
[11] S.M.Osho; Nutrition and Food Science, **33(6)**, **(2003)**.
[12] S.M.Osho, K.Dashiell; Expanding Soybean Production, Processing, and Utilization in Africa, Proceedings, Conference on Post Harvest Technology and Commodity Marketing in West Africa, 29 Nor to 1 Dec. 1995, Accra, Ghana **(1995)**.
[13] O.B.Oyewole; J.Appl.Bact., **68,** 49-54 **(1990)**.
[14] O.B.Oyewole; Fermentation of Cassava for Lafun and Cassava 'fufu' Production in Nigeria, Fd.Lab. New, **7(2)**, 29-31 **(1991)**.
[15] J.Ruales, S.Valensia, B.Nair; Starch, **46(1)**, 13-19 **(1993)**.
[16] T.A.Shittu, O.O.Lasekan, L.O.Sanni, M.O.Oladosu; The effect of drying methods on the functional and sensory characteristics of pukuru- a fermented cassava product, ASSET Series A, **1(2)**, 9-16 **(2001)**.
[17] U.Svanberg; Dietary bulk in weaning foods, Sweden:Department of Food Science, Chalmers University of Technology, 3 **(1987)**.