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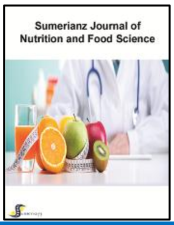

Original Article Open Access

Quality Parameters of Soy-Maize *Akamu* Paste from Maize and Sprouted Soybean Blends and Sensory Attributes of their Gruel for Complementary Feeding

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Abstract

Maize gruel (*akamu*) is widely relished by both young and old as breakfast as well as recovering patients and elderly persons. It is nutritionally deficient, hence the formulation with sprouted soybean for nutrient improvement to prevent hidden hunger. Sprouted soy cotyledons from 12h tap water steeped, 72h sprouted, 20 min boiled in 0.05% sodium bicarbonate solution and hand dehulled were blended with cleaned, 72h steeped and washed maize. Part of the blends (75: 25, 50: 50 and 25: 75, respectively for maize and soy cotyledons) were milled into soft paste, sieved and dewatered separately with double layered calico cloth to obtain hard pastes. The other blends were dried to constant weight at 60^0C in oven, cooled, milled and sieved into flour. With increase in sprouted soybean inclusion, there were significant ($p<0.05$) nutrient improvement in soy-maize *akamu* paste and the flour samples. Dried matter (86.23 - 86.97%), moisture (13.03-13.77%), protein (16.35-38.40%), fat (6.11-10.45%), fiber (2.05 - 4.11%) and ash (1.91 - 4.94%) increased while carbohydrate (60.41 - 38.32%) and energy (369.62 - 300.97Kcal) decreased. Bulk density (0.08 - 0.85 g/ml), swelling power (20.12 - 4.83), and gelatinization time (0.40 - 0.52 sec) increased while viscosity (90.50 - 83.26 μ Pas) and gelatinization temperature (59.00 - 57.00°C) decreased. Gruel from 75% maize and 25% sprouted soybean had the highest acceptability score (7.85) which translate to like very much while that from 25%maize and 75% sprouted soybean had the least score (5.25) signifying like slightly on the Hedonic scale. Sprouted soybean blending showed an improvement in the nutrients content of soy-maize *akamu* and decrease in acceptability beyond 25% sprouted soybean inclusion level.
Keywords: Soy-maize *akam* Paste; Maize; Sprouted soybean; Gruel; Complementary feeding.

1. Introduction

Cereal grains are the fruits of cultivated grasses. They provide humankind with more nourishment and about half of the total caloric requirement than any other food class. With about a dozen cereal crops used for food, only wheat, maize, and rice are important human food sources accounting for 94% of all cereal consumption. Consumption of these cereals varies widely with regions. The way in which maize is processed and consumed varies greatly from country to country with maize flour and meal being the most popular two products (FAO, 2012).

Maize or corn (Zea mays) is a plant belonging to the family of grasses (Poaceae). It is cultivated globally being one of the most important cereal crops worldwide (Dowswell *et al.*, 1996). Maize contains about 72% starch, 10% protein, and 4% fat, supplying an energy density of 365 Kcal/100 g compared to rice and wheat, but has lower protein content (Nuss and Tanumihardjo, 2010). Maize is not only an important human nutrient, but also a basic element of animal feed and raw material for manufacture of many industrial products. Dowswell *et al.* (1996), also reported that the products include corn starch, maltodextrins, corn oil, corn syrup and products of fermentation and distillation industries. In developed countries, maize is consumed mainly as second-cycle produce, in the form of meat, egg and dairy products (Shaw, 1988).

The legume seeds, sometimes termed 'grain legumes' are second only to the cereals as a source of human food and provide the needed proteins to our predominantly vegetarian and poor population (Ladizinsky, 1999). Legumes have been an important cultural heritage crop ever since man started domesticating plants.

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Soybeans or soya beans (Glycine max) are a type of legume often eaten whole in Nigeria, but in Western countries, soybean is processed into various soy products as soy flour, soy protein, tofu, soy milk, soy sauce, and soybean oil. Soybean seeds contain high quantity of protein and its amino acid composition is approximate to composition of animal proteins, therefore is often used as replacement component of meat protein. About 90% of soybean seeds make up cotyledons while 8% are hulls. There are accumulation of proteins and fats in the cotyledons. However, soybean seeds contain 40% crude protein, about 20% of fat, while soybean meal contains higher content of crude protein of 40-49% (Hany, 2011).

Pap also known as ogi is a fermented porridge or gruel which are usually prepared from cereals like maize Zzea mays), sorghum (Sorghum bicolor) or millet (Pennisetum glancum). It serves as a major weaning food for the infants in West Africa (Oyewole, 1997). When a child reaches about 4 to 6 months old, the breast milk alone cannot meet their nutritional and therefore is complemented with such food as akamu and processed baby foods from cereals, starchy tubers, legumes and vegetables (Adams and Moss, 1995). Akamu is also consumed as breakfast meal by many and choice food for the sick (Oyewole, 1997). One of the greatest problems affecting millions of people particularly children are lack of adequate protein intake in terms of quality and quantity. As cereals are generally low in protein, supplementation them with some locally available legumes high in protein content improves the protein levels (Achi, 2005) and predispose them as a good candidate for infant food.

Plain pap (ogi) produced from maize or sorghum alone is low in proteins, minerals and vitamins, which are the essential nutrients needed for the wellbeing, healthy growth and development of infants, children and adults who consume akamu. Protein Energy Malnutrition (PEM), continue to be a major nutritional problem resulting from under nutrition that affects children in most of the developing world. Efforts are currently on, in Africa to modify the processing of akamu with a view to enhancing its nutritive value, shelf life and possible therapeutic qualities (Olukoya *et al.*, 1994). One likely method of achieving this is by formulation with soybeans. Several authors have reported improvement in nutritional quality of soy-akamu (Adeleke and Oyewole, 2010). This work therefore streamlined at producing and evaluating the physicochemical properties and sensory characteristics of gruel (pap) from blends of maize and sprouted soybean.

2. Materials and Methods

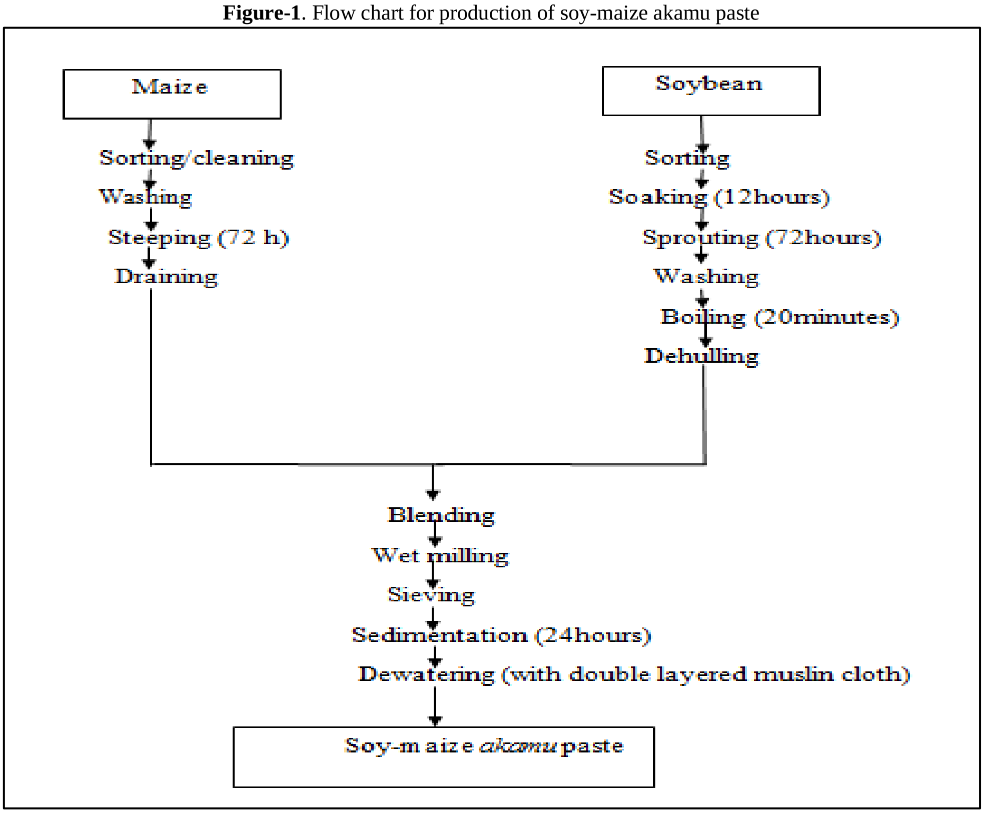
2.1. Material Procurement

Yellow maize and soybean used for this work were purchased from Urbani, Ibeku Ultra-modern market Umuahia Abia State, Nigeria.

2.2. Production of Soy-Maize Akamu Paste

Yellow maize was steeped in tap water for 72 h, drained, washed and wet milled together according to the formulation (Table 1) with the sprouted soybean cotyledons obtained from cleaned, sorted, 12 h steeped, 72 h sprouted, washed, boiled with 0.05% sodium bicarbonate, and dehulled (Okwunodulu *et al.*, 2017). The samples were then sieved, allowed to sediment for 24 h, and dewatered with a double layered calico cloth (Okwunodulu *et al.*, 2019) to obtain sprouted soy-maize akamu paste (Figure 1).

Figure-1. Flow chart for production of soy-maize akamu paste



2.3. Preparation of Sprouted Soybean-Maize Flour Blends

Sprouted dehulled soybean cotyledons and steeped maize were dried in oven at 60°C to constant weight, milled and sieved separately after cooling, and blended (Table 1) to obtain their flour blends (Akambi *et al.*, 2010).

Table-1. Formulation blends for soy- maize akamu paste

Products	Maize	Soybean
102	100	0
103	75	25
105	50	50
107	25	75

2.4. Proximate Analyses

2.4.1. Moisture Content

The method described by Onwuka (2018) was used and the value was calculated thus:

% moisture content =(W2-W3) /(W2 -W1)×100/1

WhereW1 =Weight of empty moisture can

W2 =Weight of empty can + sample before drying

W3= Weight of can + sample dried to constant weight.

2.4.2. Crude Fibre Content

The Weerde method described by Onwuka (2018) was used and the weight of the fibre was determined as a percent weight of sample analyzed thus:

% Crude fibre =100(W2-W3) / (weight of sample)

Where: W2=Weight of crucible + sample after boiling, washing and drying

W3=Weight of crucible + sample as ash

2.4.3. Fat Content

Soxhlet fat extraction method described by Onwuka (2018) was adopted and percent fat calculated thus:

% fat = W2-W1/W3 ×100/1

Where: W1=Weight of empty flask

W2=Weight of flask + extract

W3=Weight of sample used

2.4.4. Protein Determination

Kjedahl method described by James (1995) involving digestion, distillation and titration was used to determine the total nitrogen while the protein content was calculated by multiplying with a factor as shown:

%N2 = [100×N×14×VF / W×1000×VA] × t/1

Where W = Weight of the sample

N = Normality of the filtrate

VF = Total volume of the digest = 100ml

VA = Volume of the digest distilled

T = Titre volume

% Crude protein = %N ×6.25

2.4.5. Carbohydrate Determination

Carbohydrate content of the samples was calculated by difference as the Nitrogen Free Extract (NFE) according to the method described by James (1995) thus:

% NFE = 100% - % (a + b + c + d + e)

Where a =protein

b=fat

c=crude fibre

d=ash

c=moisture

2.4.6. Ash Content

Ash content was evaluated using the furnace incineration gravimetric method described by Onwuka (2018); The weight of the ash was calculated by difference expressed as a percent of the weight of the samples analyzed and shown:

% ash=100× (W2-W1) ÷ (weight of sample)

Where; W1=weight of empty crucible

W2=weight of crucible + ash

2.4.7 Energy Value

This was determined by calculation. EV= (CP×4) + (EE×9) + (CHO×4).

Where; EV=Energy value

CP=Crude protein
EE=Ether extract
CHO=Carbohydrate

2.5. Functional Properties

2.5.1. Bulk Density

This was determined using the method as described by Okezie and Bello (1988). Bulk density was determined as the ratio of the weight of the sample to its volume and calculated as shown below:

Bulk density = w/v (g/dm3)
Where W = weight of sample in grams
V = volume of sample (dm3)

2.5.2. Viscosity

The method described by Onwuka (2018) was used by measuring viscosity with Oswald type of viscometer and the readings recorded.

2.5.3. Gelatinization Temperature

The method described by Onwuka (2018) was adopted. Exactly 10% suspension of flour sample was prepared in a test tube. The aqueous suspension was heated in a boiling water bath with continuous stirring. Then, the temperature was recorded 30 seconds after gelatinization is visually noticed as the gelatinization temperature.

2.5.4. Swelling Power Index

This was determined according to the method described by Tester and Morrison (1990). Swelling power was calculated as shown:

Swelling power=W2 × 100
Wdm (100-solubility)
Dry matter weight = Ws (1-MC).

2.5.5. Gelatinization Capacity

The method described by Onwuka (2018) was used. The gelation capacity determined as the least gelation concentration determined when the sample from inverted test tube will not fall or slip.

3. Sensory Evaluation

The method described by Iwe (2010) was used with 25 semi-trained panelists randomly selected from the students of Food Science and Technology Department, Michael Okpara University of Agriculture, Umudike, within the age bracket of 17 to 30 y who are familiar with the gruel. The coded samples were presented to each panelist separately in same types of plates along with bottled water under bright illumination. They were asked to taste the samples one after the other, rinse their mouths after each tasting and score the samples using 9- point Hedonic scale; where 9 represents like extremely, 1 dislike extremely, and 5 neither like nor dislike. Appearance, flavour, taste, texture and general acceptability were evaluated.

4. Statistical Analysis

Data obtained from the analysis were subjected to analysis of variance (ANOVA) using SPSS version 20 software package. Means were separated using Duncan Multiple Range test to determine the significant difference at 5% probability.

5. Results and Discussion

5.1. Proximate Composition

The results are presented in Table 2.

5.1.1. Dry Matter

Dry matter (DM) content of the soy-maize akamu pastes samples decreased significantly ($p<0.05$) with increase in soy paste proportion. Inverse relationship of DM with moisture implied that the moisture content of the soy-maize pastes will increase with increase in soy paste inclusion levels probably due to soybean steeping which will likely improve their nutrient content than 100% maize paste (control).

Table-2. Effect of soybean inclusion on the proximate composition of soy-maize akamu paste

	%DM	%MC	%CP	%EE	%CF	%ASH	% CHO	EV(Kcal)
102	$86.35^{c}\pm0.03$	$13.65^{b}\pm0.02$	$4.21^{d}\pm0.02$	$0.37^{d}\pm0.01$	$0.28^{h}\pm0.01$	$0.72^{d}\pm0.00$	$80.76^{a}\pm0.03$	$343.230^{c}\pm.03$
103	$86.97^{a}\pm0.04$	$13.03^{d}\pm0.04$	$16.35^{c}\pm0.01$	$6.11^{c}\pm0.02$	$2.05^{f}\pm0.01$	$1.91^{c}\pm0.02$	$60.41^{b}\pm0.00$	$369.62^{a}\pm0.15$
105	$86.34^{b}\pm0.03$	$13.16^{c}\pm0.03$	$23.16^{b}\pm0.02$	$9.48^{b}\pm 0.01$	$3.47^{d}\pm0.01$	$2.94^{b}\pm0.00$	$47.91^{c}\pm0.00$	$362.07^{b}\pm0.17$
107	$86.23^{d}\pm0.02$	$13.77^{a}\pm0.02$	$38.40^{a}\pm0.00$	$10.45^{a}\pm0.01$	$4.11^{b}\pm0.00$	$4.94^{a}\pm0.01$	$28.32^{d}\pm0.00$	$300.97^{d}\pm0.05$

Values are mean of triplicate determinations ±standard deviation. Mean with the same superscript within the same column are not significantly different (p>0.05). DM=Dry matter, MC=Moisture contents, CP=Crude protein, EE=Ether extract, CF=Crude fibre, EV=Energy value, CHO=Carbohydrate.102= 100% maize, 103=75% maize and 25% sprouted soybean, 105=50% maize and 50% sprouted soybean, 107=25% Maize and 75% sprouted soybean.

5.1.2. Moisture Content (MC)

The MC of the soy-maize paste samples increased with significant ($p<0.05$) variation as the quantity of the soy paste increased. This may be attributed to water imbibed during soybean steeping which indicated that the sprouted soybean was the major moisture contributor to the soy-maize paste. Similar moisture level had been reported Odusola *et al.* (2015).

5.1.3. Crude Protein Content

Protein content of soy-maize akamu paste samples increased significantly ($p<0.05$) with increase in soy paste inclusion levels. This protein improvement (16.35-38.40%) was more than the control (4.21%) which could majorly be attributed to the sprouted soybean paste. This validated higher proteins content of sprouted soybeans. This projected soy-maize akamu as a good candidate for weaning and special food for recovering patients.

5.1.4. Lipid Content

Significant ($p<0.05$) fat content increase was recorded in soy-maize akamu paste samples with increase in soy paste inclusion levels. The fat increment was an improvement in not only fat content, but also in fat soluble vitamins as well as energy level compared to control paste sample. This improvement was due to soy paste inclusion. Soybean contains considerable amount of polyunsaturated oil which is very unique as it contains omega-3 fatty acid and linolenic fatty acids which are very much desired in infant, children and adult diets (Odusola *et al.*, 2015).

5.1.5. Crude Fibre

Crude fibre contents increased significantly ($p<0.05$) in soy-maize akamu paste samples than the control as soy paste inclusion levels increased. This could be attributed to sprouted soybean paste which presumably may have higher crude fibre contents than control. It has been documented that dietary fibre helps in the prevention of several diseases such as cancer, constipation, diabetes and diverticulosis (Elleuch *et al.*, 2011). Therefore, soy-maize akamu is an improvement of the control.

5.1.6. Ash Content

Ash content of the soy-maize akamu paste samples also increased significantly ($p<0.05$) with soy paste substitution levels more than the control. This shows that sprouted soybean has more ash content than maize, and the ash contents is an indication of mineral contents of the gruel products. The mineral improvement predisposed this soy-maize akamu as special food for infants, recovering patients and elderly persons.

5.1.7. Carbohydrate Content

Conversely, carbohydrate contents of soy-maize akamu paste samples decreased with increase in soy paste level of inclusion. This could be attributed among others to steeping and sprouting which decreased carbohydrate content of soybean. Low carbohydrate content of soybeans may have contributed too. Soybean contained mostly sucrose while starchyose and raffinose were removed during steeping and sprouting (Elleuch *et al.*, 2011). Low carbohydrate content of the soy-maize akamu and soybean sprouting which lowered their viscosity than control paste may result in their desirable consistency to the infants recovering patients and elderly persons.

5.1.8. Energy Value

Soy-maize akamu paste samples recorded significant ($p<0.05$) decrease in energy values with increase in soy paste substitution levels. This indicated that the presence of the sprouted soy paste with reduced carbohydrate contents, one of the major energy sources, decreased the energy value of the paste samples. Sprouted soy paste contains more of protein, fat, fibre while maize contains only carbohydrate with little protein, fat and fibre energy sources.

5.2. Functional Properties

Results of functional properties of the flour blends of sprouted soybean and steeped maize were presented in Table 3.

5.2.1. Bulk Density

Bulk density of flour blends of sprouted soybean and maize increased (0.08-0.85 g/ml) with significant ($p<0.05$) variation as soybean flour substitution levels increased more than the control (0.78 g/ml). This signified higher bulk density of soybean flour than that maize. Hydrolysis of soybean macromolecules during sprouting that result in smaller particle sizes with larger surface areas may have been responsible. Bulk density depends on the intensity of attractive inter-particle forces, particle sizes as well as the number of contact points (Oluwaseun *et al.*, 2015).

5.2.2. Viscosity

Viscosity of flour blends of sprouted soybean and maize decreased significantly ($p<0.05$) from 90.50 to 83.26 μ/pa with increase in soybean inclusion levels. This is not an improvement compared to the control which is justified by sprouting that thins down viscosity as a result of hydrolysis of carbohydrates unlike in control that was only steeped. Similar decreasing viscosity trend had been reported in sorghum-soy akamu (Okwunodulu *et al.*, 2019). Viscosity is an indication of viscous gel after cooling and resistance to shear forces during shearing (Badejo *et al.*, 2017).

5.2.3. Swelling Power

Swelling power of the dried soy-maize blends increased significantly ($p<0.05$) with increase in soy flour substitution levels. This could be attributed to sprouting of soybean. Swelling power is related to protein and starch contents. High protein contents obtained due to sprouting may have embedded the starch granules within their stiff matrix and gradually reduces their access to water thereby restricting the swelling power (Aprianita *et al.*, 2009). Therefore, soybean paste inclusion may likely contribute to the stability of the soy-maize akamu paste. As amylopectin is primarily responsible for starch granules welling; therefore, the higher swelling power of sprouted soybean hints to higher amylopectin contents than maize starch and higher digestibility of the gruel made from soy-maize akamu. Besides, low amylose content is associated with high swelling power due to low reinforcement in the internal network by amylase molecules (Fagbemi, 1999).

5.2.4. Gelatinization Temperature

Gelatinization temperature of the flour blends of sprouted soybean and maize decreased with significant ($p<0.05$) variation as soy flour increased. The variation could as well be traced to sprouting which hydrolyzed the starch molecules and lowered their gelatinization temperature. This implies that maize starch gelatinizes at relative higher temperature than soybean with little starch content that was hydrolyzed during sprouting. This variation is a function of variety, particle size of the starch, and the proportion of amylose and amylopectin content of the starch.

Table-3. Functional Properties of Sprouted Soybean-Sorghum and Sprouted soybean-maize

Products	Bulk density (g/ml)	Viscosity (μ/pa)	Swelling power	G-temperature (^{0}C)	G-time (seconds)
102	$0.76^c±0.00$	$91.25^a±0.02$	$18.46^d±0.03$	$71.00^a±0.00$	$0.45^b±0.01$
103	$0.08^d±0.00$	$90.50^b±0.01$	$20.12^c±0.01$	$59.00^b±0.00$	$0.40^d±0.00$
105	$0.82^b±0.00$	$87.61^c±0.01$	$21.70^b±0.01$	$58.50^c±0.50$	$0.43\ ^c±0.00$
107	$0.85^a±0.00$	$83.26^d±0.01$	$24.83^a±0.00$	$57.00^d±0.00$	$0.52^a±0.01$

Values are means of triplicate determinations ±standard deviation. Mean with the same superscript within the same column are not significantly different ($p>0.05$). 102=m100% maize, 103=75% maize and 25% sprouted soybean, 105=50% maize and 50% sprouted soybean, and 107=25% maize and 75% sprouted soybean.

5.2.5. Gelatinization Time

Sprouted soybean and steeped maize flour blends recorded increase in gelatinization time with soy flour substitution increase. This implied that soy flour requires longer time (0.52s) to gelatinize than maize flour (0.45s) but points to their high solubility level. This therefore predisposed the flour blends for complementary food formulation and foods for elderly and recovering patients. This may be attributed to higher amylopectin and lower amylose reported earlier in gelatinization temperature as well as smaller starch granule of soy flour that requires lower temperature and longer time to gelatinize than maize with larger starch granule sizes.

5.3. Sensory Attributes

Results of the sensory attributes of gruel products made from soy–maize akamu paste samples were presented in Table 4.

Table-4. Sensory attribute of soy-maize akamu gruels

Sample	Appearance	Taste	Consistency	Smoothness	G. acceptability
102	$7.30^a±1.92$	$6.85^{ab}±1.81$	$7.20^a±1.67$	$6.45^{ab}±1.50$	$7.40^b±1.46$
103	$6.95^{ab}±1.50$	$7.65^a±1.09$	$6.80^{ab}±1.44$	$6.95^a±1.85$	$7.85^a±1.27$
105	$6.85^{ab}±1.87$	$6.90^{ab}±1.86$	$6.05^c±1.23$	$7.00^a±1.08$	$6.75^{bc}±1.52$
107	$6.20^c±2.07$	$5.65^c±2.43$	$4.55^d±2.28$	$6.00^b±2.18$	$5.25^c±2.75$

Values are mean of triplicate determinations ±standard deviation. Values with the same superscript within the same column are not significantly different ($p>0.05$).102= 100% Maize grain, 103=75% maize and 25% sprouted soybean, 105=50% maize and 50% sprouted soybean, 107=25% maize and75% sprouted soybean.

5.3.1. Appearance

Appearance is an important sensory feature of any food product which decides acceptability as consumers eat with their eyes and use what they observed to predict quality (Okwunodulu *et al.*, 2018) (Okwunodulu et al., 2018).Sensory scores of the appearance of the gruel samples from soy-maize akamu paste decreased with increase in soy paste inclusion levels. Therefore, for maximum acceptability, soy substitution level should not exceed 25%, though 50% level may still be acceptable. There were no significant difference ($p>0.05$) between samples 103 and

105 which may mean that the difference (50 - 25 = 25%) in their soy inclusion levels had no significant ($p>0.05$) contributions to appearance.

5.3.2. Taste

Increasing the soy paste in the soy-maize akamu decreased the taste scores of their gruel samples significantly ($p<0.05$). May be the panelists were not familiar with blends' taste. Despite the decrease, taste scores of samples 103 (75% maize and 25% sprouted soybean) and 105 (50% maize and 50% sprouted soybean) were still higher than the control. Sample 103 (75% maize and 25% sprouted soybean) had the highest taste score (7.65) while sample 107 (75 % sprouted soybean and 25 % maize) had the least score (5.65). Soy levels substitution therefore becomes a matter of choice and should not exceed 50% to avoid total rejection.

5.3.3. Consistency

Significant ($p<0.05$) decrease in consistency of the soy-maize akamu gruel samples with increasing soy substitution levels of inclusion could be attributed to sprouted soy paste which thinned down the viscosity. The decreases (6.80 – 6.05 - 4.55) which were lower than the control (7.20) could be attributed among others to decreasing viscosity associated with soy inclusion which is the major acceptability attribute of gruel. Just like in taste scores, sample 103 (75% maize and 25% sprouted soybean) had the highest consistency score (6.80) while sample 107 (75 % sprouted soybean and 25 % maize) had the least score (4.55). Substitution levels of 25-50% still proved to be the best, but higher levels within this range may likely give the desired consistency for the infants, elderly and recovering patients as the control had higher viscosity that need to be thinned down with water for desirability. Thinning down implies nutrient reduction.

5.3.4. Smoothness

Though smoothness of the soy-maize akamu gruel samples decreased with increasing levels of soy substitution, the decrease was significantly ($p<0.05$) higher than the control except sample 107 (25% maize and 75% sprouted soybean). Higher rating of soy smoothness than maize despite the decreasing trend could be due to sprouting which resulted in smaller starch molecules sizes. Non significant ($p>0.05$) variation in smoothness between samples 103 (75% maize and 25% sprouted soybean) and 105 (50% maize and 50% sprouted soybean) still points at soy substitution levels of 25-50% as the best.

5.3.5. General Acceptability

Despite the decreasing trend of general acceptability of soy-maize akamu gruel samples with increasing soy substitution levels, acceptability level (7.85) of sample 103 (75 % maize and 25 % sprouted soybean) was significantly ($p<0.05$) higher than control (7.40). Mean (8) general acceptability score of sample 103 (75 % maize and 25 % sprouted soybean) was liked very much while 7 from sample 105 (75 % maize and 25 % sprouted soybean) was rated liked moderately in the Hedonic scale. The least acceptable (6) from sample 107 (75 % sprouted soybean and 25 % maize) was like slightly. General acceptability scores also justified sample 103 as the beat followed by 105 (75 % maize and 25 % sprouted soybean).

6. Conclusions

The results of this study showed that supplementation of maize with sprouted soybean paste in soy-maize akamu preparation improved significantly their nutrient composition especially protein contents, ash, fat and fiber. Their functional properties like bulk density, swelling power and gelatinization time were also improved significantly. Substitution level of 75% maize and 25% sprouted soybean paste was the best acceptable blend though as high as 50% soy substitution may be adopted but not exceeded to avoid total rejection. Therefore, the paste blends could be a potential higher nutrient breakfast, complementary foods, and special food for the recovering patients and elderly persons. The blends could be a good vehicle for any additional compatible nutrients to fight hidden hunger, weaning deficiency and protein energy malnutrition (PEM) problems among developing countries like Nigerian and Africa at large.

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