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***Original Research Article***

# Acceptability of improved instant cassava-soybean based complementary food by weaning mothers

Most current research studies seek to produce instant complementary foods from expensive technologies such as extrusion and drum drying

ABSTRACT:

**Aims:** The objective of this study was to formulate and evaluate some functional properties and sensory qualities of cassava-soybean complementary food using a relatively cheaper method; Steam Blanching
**Study design:** Qualitative and quantitative
**Place and Duration of Study:** Department of Food Science and Technology, Kwame Nkrumah University of Science and Technology and Ayeduase Community Clinic in Kumasi, Ghana between August and May 2015.
**Methodology:** The processing and heat treatment used were varied (fermentation (24 h) and non-fermentation; steam blanching (15 min) and non-steam blanching) to obtain Fermented Steam Blanched (FSB) blend, Non-Fermented Steam Blanched (NFSB) blend, Fermented Non-Steam Blanched (FNSB) blend and Non-Fermented Non-Steam Blanched (NFNSB) blend. Four cassava-soybean blends in a 65:35 ratio were processed. The products were formulated using 75% cassava-soybean blend, 20% sugar and 5% mango. 50 mothers assessed the attributes of the formulated blends using preference test 5-pt hedonic scale.
**Results:** Results showed that the flavour and taste of steam blanched blends were most preferred while non-steam blanched blends were most preferred in terms of smoothness. There was no significant difference between the acceptability of the blends in terms of colour at pP = .05. Steam blanching significantly affected the sensory qualities and functional properties; FSB and NFSB scored 2.02±0.73 and 2.05±0.85 while FNSB and NFNSB scored 2.19± 0.74 and 2.12±0.83 respectively in terms of preference of their sensory attributes. Steam blanched blends had higher bulk densities and swelling index as compared to non-steam blanched blends. Fermentation decreased the swelling power of the blends but not at a significant level because of the shorter duration (less than 48 h) Fermented Steam Blanched product scored the highest in terms of all the sensory attributes and had low bulk density (0.70±0.02) and swelling index (2.63± 0.13).
**Conclusion:** The study showed that Steam Blanching could be employed in developing an instant cassava-based complementary food capable of meeting the nutritional needs of children 9-11 months old.

*Keywords: food formulation, food processing, fermentation, steam blanching*

## 1. INTRODUCTION

Children are a blessing in many homes, most mothers are very cautious about the nutrition and health of the child mostly within the 1st to 6th or 12th month of the child's life. It is reported that after the 6th month of the child's life, breastfeeding becomes insufficient in providing the nutrient needs of the child [1]. Mothers are therefore expected to provide in addition to the breast milk, complementary foods to provide the essential nutrients that are not fully met from the intake of only breast milk [2].

In many developing countries, maize, rice, cassava and banana are mostly the staple crops used in complementary feeding. In Ghana, a major stable crop, which is consumed in all parts of the ten administrative regions, is cassava [3]. These foods have water as the major constituent with high energy

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but low nutrient density [4,1]. This is confirmed by work done by Stupak [5] where the protein content among common cassava cultivars was found to be only about1%.

The standard of living of most mothers in the developing areas especially the rural areas is low, hence the provision of complementary foods containing the essential nutrients in their right proportions is a major problem [6,7]. High prevalence of kwashiorkor may also be due to the increased consumption of cassava, yam and other tubers which are poor sources of protein, vitamins and minerals by children living in areas where these staples are commonly grown and therefore people who predominately consume cassava are at a high risk of protein deficiency [8,9].

Many works have been done on fortification of most staple crops used for complementary feeding. Muoki *et al*. [10] developed a cassava-based complementary food fortified with soybean.

Most complementary foods found on the markets which contain the required nutrient level are instant or precooked. They therefore require just addition of warm water to prepare. The processing technologies mostly used in the production of instant foods are the extrusion and drum drying method. Work done by Muoki *et al*. [10] showed that most mothers prefer extruded complementary foods to the conventionally cooked ones. It has been reported from research that the cost of capitalization and operation confers an extra cost on the final product making it expensive for most mothers in the developing countries especially the rural areas [6]. Adeyemi *et al.* [11] proposed that steam blanching for 15 minutes can produce a product with similar characteristics as that extruded. This work therefore seeks to determine the practicability of the steam blanching method in producing an instant complementary food with good sensory properties

## 2. MATERIAL AND METHODS

### 2.1 Materials

The fresh cassava root (Debor variety) was obtained from CSIR-Crops Research Institute, Fumesua. Soybean (Anidaso) was purchased from a market in Tamale. Fresh mangoes (Rosemary variety) were also purchased at Sogakope in the Volta region and sugar was bought from the open market.

### 2.2 Sample Preparation

#### 2.2.1 Preparation of mango flour

Six kilograms of mangoes at the breaker and turning stage were sorted and washed with clean water. The fruits were peeled into thin strips about 3mm thick using a fruit slicer. The sliced flesh was spread on metal trays and placed in the oven at a temperature of 80 degrees Celsius for 3 h. The dried mangoes were milled, sieved into a particle size of 762 µm and stored in a low density polyethylene bags [12]

#### 2.2.2 Preparation of soybean flour

Four kilograms of soybean was sorted to remove unwanted materials such as stones and washed. About 30 litres of water was brought to a boil and then the soybean was added to it and allowed to boil for 25 minutes without covering with a lid. The water was afterwards drained and the soybean was washed and dehulled with cold water. The beans were separated from the hulls and top pan roasted for 15 minutes; roasting 500g of the beans at a time. The roasted beans were milled, sieved into flour using a 762 µm sieve and packaged in a low density polyethylene bags.

#### 2.2.3 Preparation of cassava- soybean blend

About 20 kg of the fresh cassava roots were weighed. The roots were peeled using a sharp knife, washed in clean water and grated. The grated cassava (500 g each) was blended with 500 ml of water for 40 sec and sieved using a muslin cloth. Two bowls were labelled FERMENTED CASSAVA-SOYBEAN (FCS) and NON-FERMENTED CASSAVA-SOYBEAN (NFCS). About 1.7 kg of the squeezed cassava was

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weighed separately into each bowl as well as about 0.9 kg of the soybean flour. The cassava and soybean were mixed thoroughly to ensure a uniform mixture. The bowl labelled FCS was covered with a polyethylene bag and kept in a cool place to ferment for 24 h while the non-fermented cassava-soybean was then further processed skipping the fermentation stage.

**2.2.4 Heat processing methods**

The fermented cassava-soybean blend as well as the unfermented cassava-soybean blend was divided into 2 equal parts. One part of the fermented cassava-soybean blend as well as the unfermented cassava-soybean blend was oven dried at a temperature of 60 ℃ for 8 h. The other parts (250 g at a time) were steam blanched for 15 minutes over boiling water (2 litres) and then dried in an oven for 8 h at 60 ℃. The dried samples were milled separately, sieved to a particle size of 762 µm and finally packaged into a polyethylene bag

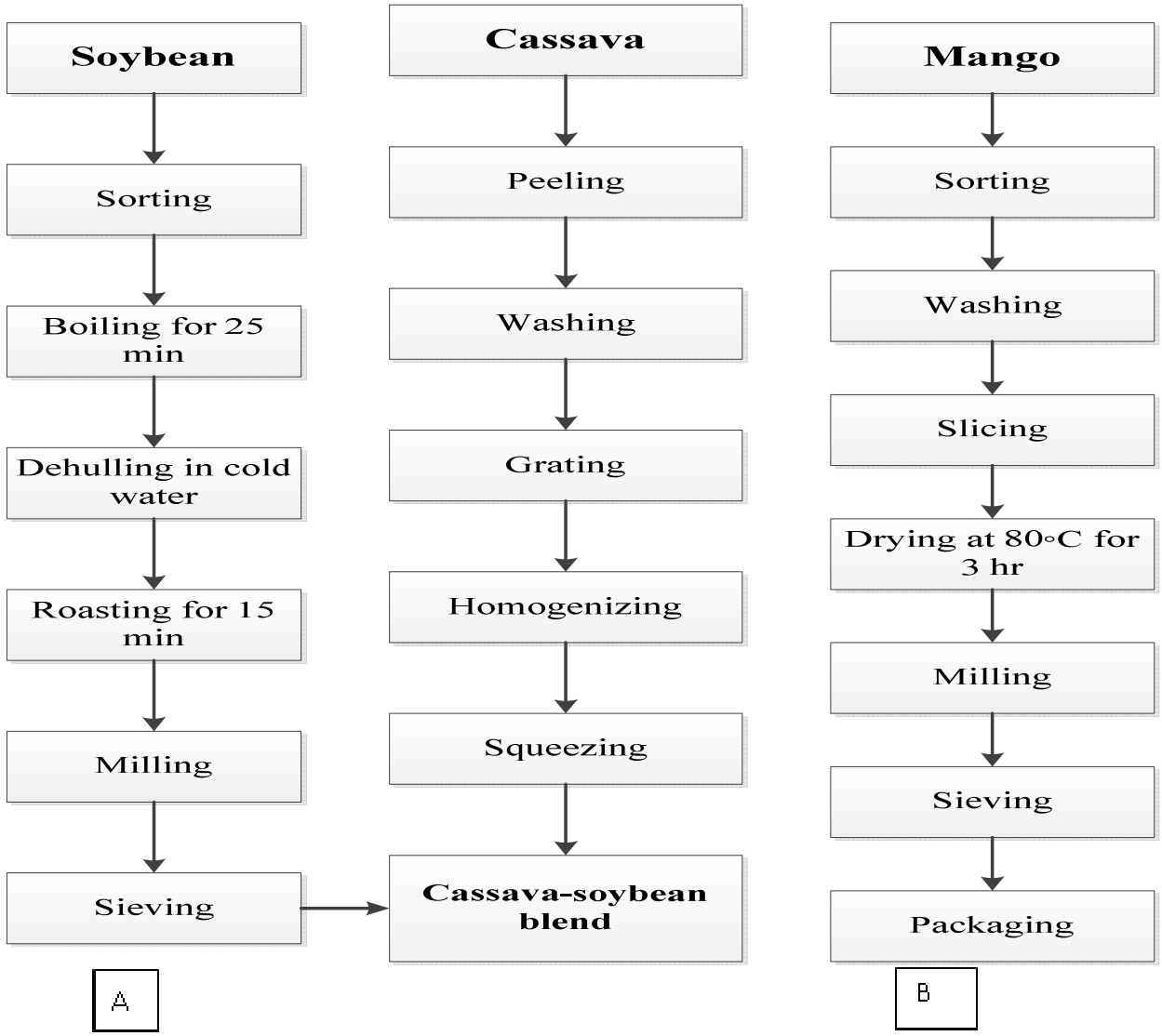


**Figure 1 : Preparation of cassava-soybean blend (A) and mango flour (B)**

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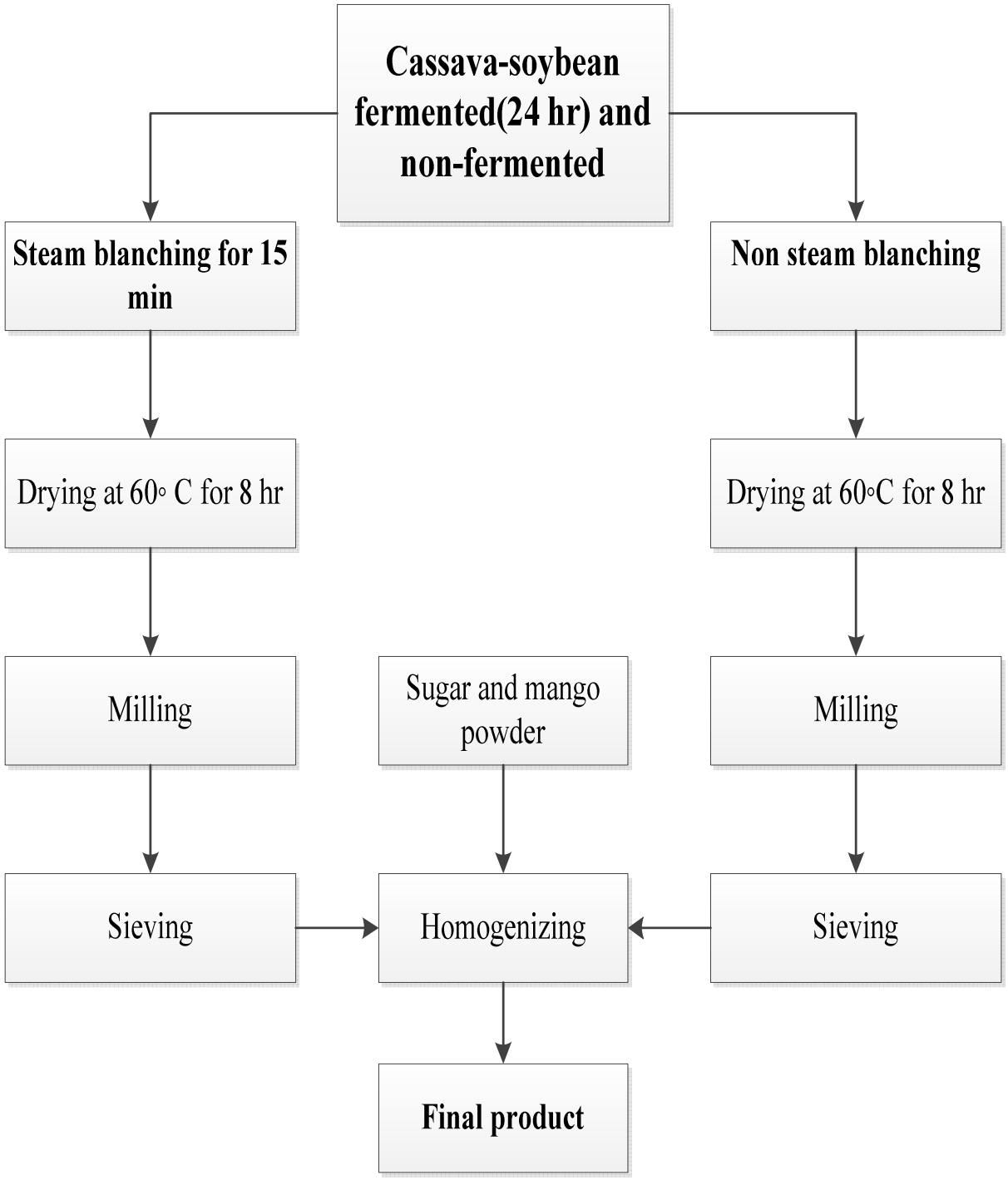


**Figure 2 : Preparation of the instant food using steam blanching and non-steam blanching method**

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## 2.3 Product formulation

**Table 1. Formulation of cassava-soybean complementary food per 500g**

| Sample | Cassava-Soybean. 75% | Mango 5% | Sugar 20% |
|---|---|---|---|
| NFNSB | 375 | 25 | 100 |
| FNSB | 375 | 25 | 100 |
| NFSB | 375 | 25 | 100 |
| FSB | 375 | 25 | 100 |

*Key: FSB (Fermented steam blanched), NFSB (Non-fermented steam blanched), FNSB (Fermented non-steam blanched), NFNSB (Non-fermented non-steam blanched)*

*Product preparation and sensory evaluation*

The samples were reconstituted by dissolving 8 g of sample in 32 mL of already boiled water (40-50 ℃) and then served in plastic cups to panelists for evaluation. Samples were coded with three-digit random numbers. Panelists were asked to express their liking for colour, flavour, taste and smoothness using a 5-point hedonic scale where 1= like very much, 2= like slightly, 3= neither like nor dislike, 4= dislike slightly and 5= dislike very much. Females (n=50) aged >20 years with children aged below 2 years participated in the study. These mothers were recruited from the Ayeduase Community Clinic in Kumasi. Consent forms were obtained from the Anatomy Department of the School of Medical Science (Kwame Nkrumah University of Science and Technology. Method used in sensory evaluation was as according to Muoki *et al.* ([10]

## 2.4 Analytical methods

### 2.4.1 Determination of tapped Bulk Density (B.D)

The method of Onwuka [13], was used with little modifications. Fifty grams of each sample was measured into a clean 180 $cm^3$ graduated cylinder and its volume was recorded in each case. The bottom of the cylinder was tapped repeatedly on a padded table till there was no visible drop in volume. The volume was then recorded as the packed volume. The bulk density was calculated for the packed volume using the general formula below:

$$Bulk\ Density\ (g/cm^3) = \frac{weight\ of\ sample\ (g)}{Volume\ occupied\ (cm^3)}$$

### 2.4.2 Swelling index (S.I)

Swelling index was calculated using method of Ojinnaka *et al.* [14], with little modifications. The sample was filled to the 2 mL mark of a 15 mL measuring tube and topped up with water to the 10 mL mark. The tube was closed and shook until even mixture of the water and the sample was attained and the tube was

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allowed to stand for 1 h. The final volume occupied by the sample was then recorded and the swelling index calculated as the ratio of the final volume of the sample to the initial volume of the sample.

$S=V_2/V_1$

Where, S= Swelling index (ml/ml)

$V_1$= Initial volume occupied by the sample, $V_2$ =Final volume occupied by the sample

**2.4.3 Proximate analysis of most preferred blend (FSB); AOAC, (1984)**

***Moisture determination***

A clean coded dish was placed in an oven at 105 ℃ for 20 minutes. The dish was then transferred into a desiccator using tongs. The dish was allowed to cool after which the weight was determined. About 5 g of the Fermented Steam Blanched (FSB) blend was weighed separately into a dish and accurately distributed over the bottom of the dish. The dish was placed in the oven for 24 hours at 110 ℃ and afterwards transferred to the desiccator to cool and the weight recorded immediately. The weight of the sample after drying was taken and the moisture content calculated as percentage moisture lost as indicated in the formula below

$$\%Moisture\ content = \frac{weight\ of\ sample - weight\ of\ dried\ sample}{weight\ of\ sample} \times 100$$

***Ash determination***

The porcelain crucible was ignited, cooled and the weight measured. About 5g of the sample was weighed into different crucibles. The sample was placed in the muffle furnace and ash for 4 hours at 550 degrees Celsius. The furnace was allowed to cool below 200 ℃ and the temperature maintained for 20 minutes. The crucible was removed from the furnace, placed in a desiccator, cooled and then weighed.

The ash content was calculated as follows;

(A + B) – A = B; (A + C) - A = C; % Ash = C/B x 100

Where A = crucible weight, B = sample weight, C = ash weight.

***Protein determination***

The balance was first calibrated with a 1g weight. Filter paper was used to support the weight of the sample. The sample was homogenized and weighed after which the filter paper was folded and placed in a labelled digestion tube. A blank solution was prepared. About 0.2-1 g of the sample weighed was digested by adding 15 mL of concentrated sulphuric acid in a digestion tube. A Kjeldahl tablet was added to serve as a catalyst. After the acid digestion, the sample was placed in a digestor for two hours at 400±5 ℃ for complete digestion after which it was distillated using the kjeltec distillation apparatus. Eighty milliliters (80 mL) of 40% NaOH and distilled water was fed into the apparatus. Two to three drops of screened methyl red was added to twenty five mL of 4 % boric acid in a conical flask and connected to the apparatus. Distillation was started and allowed to run till the boric acid solution changed colour from pink to light blue. After distillation, the resulting solution was titrated against 0.1 N HCl. The nitrogen content was calculated using the formula below:

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$$\% \, nitrogen = \frac{(ml\ acid \times normality\ of\ standard\ acid)}{weight\ of\ sample\ (g)} \times 0.014 \times 100$$

% Crude Protein (CP) = total nitrogen ($N_T$) × 6.25 (protein factor)

***Fat determination***

About 2-5 g of the cassava-soybean blend was weighed unto a filter paper separately, folded and placed into thimble and stuff with grease-free cotton. The thimble with the sample was placed in the extractor of the Soxhlet apparatus. A clean dried Soxhlet flask was weighed and attached to the lower end of the extraction unit. The extraction unit was filled with about 240 mL petroleum ether. The extractor and the extraction flask were attached to the reflux condenser and place on the electric thermal unit. Cold water was passed through the condenser and the electric thermal unit turned on. The heater was adjusted to allow the solvent to drop from the condenser on the center of the thimble at the rate of 6 to 8 drops per second. The extraction was continued for 15 h. Afterwards the heating was discontinued, the flask removed and the ether distilled off. The flask was placed in a water bath to evaporate traces of ether until no odour of ether remains. The flask was carefully wiped to eliminate any moisture on the outside of the flask and dried in the oven at 103 degrees Celsius for an hour. The flask and its content was then transferred into a desiccator, cooled and weighed. A blank was also carried out using the same procedure. The fat content was calculated using the formula;

$$\frac{100\ (W1 - W2)}{W}$$

Where,

W1= weight in g of the Soxhlet flask with the extracted oil
W2 = weight in g of the empty Soxhlet flask
W = weight in g of the dry sample taken for analysis.

***Carbohydrate content***

The carbohydrate content of the FSB blend was calculated using the formula below;

Carbohydrate (excluding fibre) = 100% - sum of (ash, moisture, fat, protein, fibre) %

Apparent energy= (4kcal/g of protein and carbohydrate, 9kcals/g for fat) x proximate composition values

Available energy= apparent energy x 0.95 (crude fibre above 2.0%)

**2.4.4 Statistical analyses**

SPSS was used to analyze data. Data obtained from the analysis was statistically analyzed using analysis of variance (ANOVA) at a significance probability of $P$ = .05. Comparison between sample treatment and heat treatment methods was done using a two-way ANOVA at 95% confidence level. The means of the consumer ratings was analyzed using one-way ANOVA and LSD. All Experiments were repeated three times and results expressed as mean ± standard deviation.

## 3. RESULTS AND DISCUSSION

### 3.1 Sensory acceptability by mothers

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The highest mean consumer sensory acceptability score was 2.19 on the 5-point hedonic scale where 1= like very much 3= neither like nor dislike 5= dislike very much (Table 2). The average rating for steam blanched and non-steam blanched porridges were not significantly different for all attributes.

#### 3.1.1 Colour

Colour is one of the attributes that is known to influence the acceptability of a product. Blends that were steam blanched had a brownish colour while those that were not steam blanched had a relatively white colour. The non-fermented blends were most preferred in terms of colour and the Non-Fermented Steam Blanched (NFSB) scored the highest; 1.66. Fermented non-steam blanched had the lowest score of 1.84 as shown in Table 2. There was no significant difference among all the blends in terms of colour. This is because most mothers were not particular about the colour, most commented that sensory attributes that mostly influence the child's acceptability to a food were mainly the taste and flavour. This could be due to the fact that children before 12 months may not know meanings of food colors.

#### 3.1.2 Flavour

The mean score for flavour for the blends were ≤ 2.16 with the highest score being 1.76 for Non-fermented steam blanched (NFSB) and the lowest being Non-Fermented Non-Steam Blanched (NFNSB) as shown in Table 2. Most mothers ranked the flavour of the steam blanched blends higher than the non-steam blanched. This may mean steam blanching improves the flavour of foods as is known. No significant difference ($P = .05$) was observed among the blends in terms of flavour.

#### 3.1.3 Taste

The tastes of the formulated blends were liked slightly on a 5-point hedonic scale. The taste of FSB was most preferred and the least preferred was FNSB. Blends that were steam blanched had the highest scores as compared to the non-steam blanched. Most mothers preferred the steam blanched blends and this could be due to the fact that the steam blanched products require less cooking time and hence it retained most of the additives (especially mango powder). There was no significant different between the blends except for FSB and FNSB which were significantly different at ($P = .05$).

#### 3.1.4 Smoothness

Steam blanching significantly affected the smoothness of the blends. The smoothness of the non-steam blanched blends were most preferred. Mothers preferred a smoother texture for children below 1 year and this could be due to the fact that most of the mothers were cognizant with the conventional porridge type of complementary foods which usually have a smoother texture. There was a significant difference between the smoothness of the NFSB to FNSB and NFNSB. The most preferred blend in terms of smoothness was the NFNSB. Acceptability of the blends in terms of smoothness was liked slightly as shown in Table 2.

For overall acceptability, mothers rated steam blanched porridges higher for taste and flavour with significant difference ($P = .05$) in taste only. Smoothness of the non-steam blanched porridges was most preferred. Fermented Steam Blanched (FSB) porridge was the most preferred porridge as shown in table 2 below. The mean scores for the overall acceptability of the formulated porridges were higher (2 and below) than those done by Muoki *et al.* [10] (3 and below).

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**Table 2. Sensory evaluation of cassava-soybean complementary food**

| Sample | Colour | Flavour | Taste | Smoothness | Overall Acceptability |
|---|---|---|---|---|---|
| **FSB** | 1.68±0.89[a] | 1.92±1.05[a] | 2.08±1.21[a] | 2.38±1.31[a] | 2.02±0.73[a] |
| **NFSB** | 1.66±0.82[a] | 1.76±0.92[a] | 2.14±1.37[a] | 2.64±1.35[a] | 2.05±0.85[a] |
| **FNSB** | 1.84±0.87[a] | 2.12±0.92[a] | 2.66±1.39[b] | 2.14±1.14[ab] | 2.19±0.74[a] |
| **NFNSB** | 1.68±0.89[a] | 2.16±1.18[a] | 2.58±1.49[a] | 2.04±1.18[ab] | 2.12±0.83[a] |

*Values are mean±standard deviation of fifty scores. Colum means with different superscripts are significantly different at 95% probability level (P = .05). Key: FSB (Fermented steam blanched), NFSB (Non-fermented steam blanched), FNSB (Fermented non-steam blanched), NFNSB (Non-fermented non-steam blanched)*

## 3.2 Impact of Processing Method and Heat Treatment on the Formulated Porridges

From the results, processing method (Fermentation and Non-fermentation) had no significant effect on all the attributes of the formulated porridges. This was because fermentation was done at a shorter duration (below 48 h). Oyewole and Ogundele [15] reported that fermentation below 48 h had no significant effect on cassava flour. There was no significant effect of the heat treatment (Steam blanching and non-steam blanching) on the colour of the porridges. In terms of flavour and taste, porridges that were steam blanched were liked significantly ($P$ = .05) than those non-steam blanched. In contrast to the latter, non-steam blanched porridges were liked significantly ($P$ = .05) in terms of their smoothness to those steam blanched. From research it is shown that steam blanching affects colour, taste and flavour of products [16]. The non-significant effect on colour of the porridges could be due to the fact that most babies are mostly influenced by the flavour and taste of foods as compared to colour and hence most mothers did not have any problem with the colour of the products. Also results from this work confirms the fact that steam blanching for 15 min can make instant foods as proposed by Adeyemi *et al*. [11].

### 3.2.1 Bulk density

The bulk densities of the formulated blends were between 0.5 and 0.7 g/cm$^3$ as shown in table 3 below. Porridges which were not steam blanched had significantly ($P$ = .05) lower densities as compared to those steam blanched. Bhattacharya and Prakash [17] reported that bulk density of foods increase with increase in starch content. Meanwhile Okezie and Bello [18] stresses that high bulk density of food material is important in relation to its packaging. There was no significant difference between porridges that were fermented and those non-fermented. According to Oyewole and Ogundele [15], fermentation below 48 hours does not have any significant effect on the bulk density of foods but fermentation above 48 h resulted in foods with increased bulk densities due to the increase in the fibre content. The bulk density of the Fermented Steam Blanched (FSB) and Non- Fermented Steam Blanched (NFSB) were close to those stated by Makinde and Ladipo [19] and Ojinnaka *et al.* [14] (0.71g/cm3). Research has shown that steam blanching affects the bulk density of foods. Work done by Amankwah et al. [20] confirms that steam blanching increases bulk density of foods. Complementary foods are expected to have low bulk densities. The low B.D values implies that more of the samples could be prepared using a small amount of water and yet give the desired energy nutrient density and semi-solid consistency which can easily be fed to an infant [21,14]. According to Akubor and Ukwuni, [22] cassava-soybean composite usually have low bulk density which could be an advantage in the formulation of supplementary foods.

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**3.2.1Swelling power**

The swelling power of the cassava-soybean complementary food ranged from 2.000 to 2.792 ml/ml as shown in table 3. Steam blanched porridges had a significantly ($P$ = .05) higher swelling power compared to non-steam blanched porridges. Bainbridge *et al.* [23] stated that good quality starch with high starch content and paste viscosity will have high swelling power. Also from work done by Amankwah *et al*. [20], swelling power may be affected by the fat content of the food which can be confirmed from the low fat content of the FSB blend in table 4. This is because high levels of fat leads to the formation of amylose-lipid complexes that restrict swelling. Soni *et al.* [24] also attributed high swelling power to the highly ordered internal arrangement of starch granules as found in yam with a swelling capacity of 9%. Steam blanching increases the swelling power of foods [20]; which confirms the higher values in porridges that were steam blanched. There was no significant difference between fermented and non-fermented blends in relation to their swelling power. The lower values of the fermented blends according to Muekatete *et al*., (2012) could be due to their low viscosity. Muekatete *et al.* [25] reported that fermentation reduces the viscosity (pasting property) of flours hence more of the flour will be needed during porridge making hence giving a food with a high nutrient density. Complementary foods with high swelling power absorb more water and have less solids resulting in low nutrient density for the infant [14]. From the results, the swelling powers of the samples are similar to that stated by Ojinnaka *et al.* [14] (2.56 ±0.05). According to Nelson and Cox [26], high swelling power is due to the water binding capacity of the legume protein.

**Table 3. Functional properties of cassava-complementary food**

| Sample | Tapped Bulk density(g/cm$^3$) | Swelling power (ml/ml) |
|---|---|---|
| **FSB** | 0.70±0.02$^a$ | 2.63±0.13$^a$ |
| **NFSB** | 0.73±0.05$^a$ | 2.79±0.19$^a$ |
| **FNSB** | 0.62±0.02$^b$ | 2.00±0.13$^b$ |
| **NFNSB** | 0.59±0.01$^b$ | 2.08±0 .07$^b$ |

*Values are mean±standard deviation of triplicate scores. Colum means with different superscripts are significantly different at 95% probability level (P = .05). Key: FSB (Fermented steam blanched), NFSB (Non-fermented steam blanched), FNSB (Fermented non-steam blanched), NFNSB (Non-fermented non-steam blanched)*

## 3.3 Proximate composition of Fermented Steam Blanched (FSB) complementary food

The moisture content of the most preferred sample (Fermented Steam Blanched blend) was 6.20%. The moisture content was within the normal moisture contents of dried foods (flour blends), that is below 12.5% for shelf stable storage [27]. It is believed that materials such as flour and starch containing more than 12.5% moisture have less storage stability than those with lower moisture content. For this reason, a water content of not more than 12.5% is generally specified for flours and other related products. Moisture content is known to have influence on general energy and nutrient density. Low moisture content has been reported to influence the energy and nutrient density of foods; the lower the moisture content, the greater the energy content due to the high carbohydrate content [28].

The ash content of the blend also recorded a low value of 2%. The value is comparable to the value reported by Adedeji *et al*. [29] from the production of soy-sorghum-roselle complementary food. The fat content of the blend was 8% and the protein was 16.32%. The fat content of the blend was within

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stipulated standard fat content for complementary foods by Codex [30]. Fat content of 11g in 100g of the sample is preferred as it is reported to provide 20-25 % energy [31].

**Table 4. Proximate composition (%) of Fermented Steam Blanched (FSB) blend**

| Sample | Moisture | Ash | Fat | Crude Protein | Crude Fibre | Carbohydrate |
|---|---|---|---|---|---|---|
| **FSB** | 6.20±0.00 | 2.00±0.00 | 8.00±0.00 | 16.32±0.45 | 3.34±0.48 | 64.15±0.92 |

The protein content was also a little higher than that recommended (15%) in complementary foods. The fibre content was 3.34%. The fibre content was within the accepted range for home-made complementary food but higher than that for commercially processed complementary food which is 2% [30]. It is recommended that the fibre content of complementary food be low since high fibre content increases the bulk and satiety as well as reduce the nutrient digestibility and energy density. It has been reported that dehulling legumes removes phytate to some extent. Completely removing phytate in soybean is difficult since it is located in the cotyledon and not the hull [31]. Milling has also been reported to reduce fibre and antinutrient in whole grains. The carbohydrate content was 64.15.

**Table 5. Energy needed from complementary foods for breastfed and non-breastfed older infants and young children in developing countries and estimated gastric capacity**

| Age of child (mo.) | Recommended daily feeding frequency (meals/snacks) | | Energy needs from complementary foods | | Gastric capacity (ml) | |
|---|---|---|---|---|---|---|
| | **Breastfed** | **Not breastfed** | **Breastfed (kcal/day)** | **Not breastfed (kcal/day)** | **Average child ml/meal** | **Growth retarded child ml/meal** |
| 6-8 | 2-3 | 4-5 | 200 | 600 | 249 | 192 |
| 9-11 | 3-4 | 4-5 | 300 | 700 | 285 | 228 |
| 12-23 | 3-4 | 4-5 | 550 | 900 | 345 | 273 |

The apparent energy was 393.86Kcal and the available energy was 374.167kcal. The blend (Table 5) is therefore suitable for infants within 9-23 months of age who are breast fed.

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## 4. CONCLUSION

The study revealed that steam blanching for 15 minutes could be employed in developing cassava-based instant complementary food. Sensory analysis showed that Fermented Steam Blanched (FSB) blend was the most preferred in terms of the attributes assessed. The bulk density and swelling power of the FSB blend was low making it ideal complementary food. The proximate composition of the most preferred sample (FSB), showed that the blend can be used to improve the nutritional needs of children from 9-11 months of age, however, the fat content could be increased to the recommended level which is 11%.

## ETHICAL APPROVAL (WHERE EVER APPLICABLE)

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