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# Chemical Composition, Sensory and Physical Property of Home Processed Weaning Food Based on Low Cost Locally Available Food Materials (1)

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**Abstract:** A weaning diet was formulated from locally available least expensive food items, using local processing methods. The supplement mixtures were sweet potato and soybean. The ingredients were mixed in different ratio of 90:10, 80:20, 70:30, 60:40 and 50:50% of sweet potato and soy flour respectively. Nutritional composition of the supplements were within the following ranges, that is, protein 11.2–33.72%, carbohydrates 42.91-76.51%, fat 3.10 -12.78%, energy values 329.5 -366.74 Kcal 100 g and appreciable quantities of P, Zn, Fe, mg, Ca, K and Na. The soy-sweet potato flours had peak viscosity values between 180–365 BU. These values increased when cooled to 50°C, (420 -760 BU). SPS 0 (0% soy flour substitution) is the most stable followed by SPS 1 (10% soy flour substitution) and SPS 2 (20% soy flour substitution), with SPS 4 (40% soy flour substitution) and SPS 5 (50% soy flour substitution) being the least stable. SPS 1 had the highest retrogradation tendency (395 BU), while SPS 4 and SPS 5 had the lowest value (240 BU). The index of gelatinization was highest in SPS 1 (480 BU), followed by SPS 2 (430 BU) with SPS 4 having the lowest value (240 BU). Bulk density generally decreases with increasing in soy flour supplementation. SPS 1 had the highest (0.71g $mL^{-1}$) while SPS 5 had the lowest (0.56g $mL^{-1}$). SPS 1 had the highest water absorption capacity (WAC) (491 mL $g^{-1}$) followed by SPS 2 (462.87 mL $g^{-1}$) while SPS 5 had the lowest value (389.62 mL $g^{-1}$). Results showed that at 30% soy flour supplementation, the meal could meet satisfactorily the Recommended Dietary Allowances (RDA) for children of 1 to 3 years of age.

**Key words:** Nutritional composition, sensory and physical evaluation, soy-sweet potato

## INTRODUCTION

A large number of Nigerian households have become food insecure as a result of the downturn of the economy, as rising inflation and escalating of food prices have eroded their purchasing power. The major consequences of food insecurity are protein energy malnutrition and micronutrient deficiencies, particularly among the children (0-5 years)[1]. Infant and young child feeding are a cornerstone of care for childhood growth and development. Poor feeding practices and frequent infectious diseases or/a combination of the two are both major factors affecting physical growth and mental development of young children in developing countries[2,3]. Evidence has shown that poor feeding practices, such as inadequate breastfeeding, offering the wrong foods, giving insufficient quantities and not ensuring that the child gets balanced diet, contribute to malnutrition[3]. In recent studies, evidences have shown that protein malnutrition is a major public health problem in most of developing countries, especially among the children from low-income families, who weaned their children on foods that are high in carbohydrates (ogi, yam, cassava meal and other family diets), but low in quality proteins, vitamins and minerals[4,5].

Apart from cereals, tropical roots are the commonest staple food in the tropics. One of the most common root crops in the tropics is sweet potato *(Ipomoea batatas)*. It has considerable untapped potential as a nutritious food crop particularly for the poor and more vulnerable groups of society in developing countries[6]. Sweet potato has an advantage over cereals as it yields two or three times as much as calories as cereals and other valuable nutrients[7]. As a supplementary food for infants, sweet potatoes alone will not adequately supply protein. However, the protein quality of sweet potatoes can be greatly improved by combining it with other protein sources, such as soybeans, which are important sources of protein[8]. Several researchers have established the production of weaning foods from animal and plant sources[9-12]. However, some of these foods are either not readily available or become unaffordable to the target groups, especially the rural nursing mothers, as a result of some

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difficulties in the production process or availability of the recipe ingredients[7,11]. This necessitates the search for cheap, readily available, easy-to-prepare alternatives to cater for the nutritional needs of children.

However, before a definitive conclusion can be reached on the use of soy-sweet potato blend as weaning food, its nutritional composition and physical properties need to be evaluated. The study reported here, the first in the series, is concerned with the evaluation of the nutritional composition, sensory and physical properties of soy-sweet potato blends with a view to determine its suitability for use in weaning diets. The biological evaluation value of the blends is the subject of an on-going research work.

## MATERIALS AND METHODS

The major raw materials used in this work are mature healthy, freshly harvested sweet potato ( *Ipomoea batatas*) and soybean (*Glycine max L. Merri*). Sweet potato and soybean were obtained from the local market. The raw materials were washed three times with tap water and later with distilled water, air- dried and collected into separate sterile plastic containers.

**Processing methods**

**Sweet potato (SP) flour:** Freshly harvested, washed and air-dried SP were peeled, sliced into chips of 2 mm thickness and soaked in 75 ppm sodium metabisulphite solution at 25°C for five min. It was then drained, blanched (100°C, 10 min), oven dried (60°C, 24 h), milled and sieved through a 0.4mm mesh screen.

**Soybean flour:** The soybean seeds were washed and soaked in 0.5% sodium hydrogen carbonate solution at a temperature of 30 °C for 2 h. The seeds were cooked for 30 min at a temperature of 100 °C. The seeds were dehulled , oven dried at a temperature of 60 °C 24 h in an air drought oven. The dried seeds were milled and sieved through a 0.4mm mesh screen.

The blends were prepared (homogenously) and labeled as shown in (Table 1).

Table 1: Sweet potato and soy flour blends

| Samples | Sweet Potato (%) | Soy beans (%) |
|---|---|---|
| SF 0 | 0 | 100 |
| SP 0 | 100 | 0 |
| SPS 1 | 90 | 10 |
| SPS 2 | 80 | 20 |
| SPS 3 | 70 | 30 |
| SPS 4 | 60 | 40 |
| SPS 5 | 50 | 50 |

SF = Soybean flour; SP = Sweet potato; SPS = Soy--sweet potato blend

**Chemical analyses:** Triplicate samples of each blend were analysed for moisture, fat, protein (N x 6.25), crude fiber and ash in accordance with the procedures of AOAC [13]. Total lipids were estimated by petroleum ether extraction. Carbohydrate content was estimated by difference. Gross energy was determined using a Gallenkamp Autobomb automatic adiabatic bomb calorimeter (London, UK). The total ash was estimated after ashing for 12 h at 550°C. Calcium and iron contents were determined on ash sample using a Buck Model 200A flame atomic absorption spectrophotometer, while phosphorous content was determined using the vanadomolybdate method[13].

**Physical analysis:** Water absorption capacity was determined as described by Beuchart[14], while the bulk density was determined according to thee procedures of Narayana and Narasinga[15].

**Pasting characteristics:** The pasting characteristics of the flours were evaluated using a Brabender visco-amylograph at the Federal Institute of Industrial Research, Oshodi, Lagos, Nigeria. Flour slurry containing 12% solids (w/w, dry basis) was heated up to from 30-95°C at the rate of 2.5°C/min, held at 95°C for 15 min and cooled at the same rate to 50°C [16]. The pasting performance was authomatically recorded on the graduated sheet of the amylograph. The pasting temperatures, peak viscosities, viscosity at 95°C, stability, cooking times and setback viscosities were read off the amylograph.

**Sensory evaluation:** The sensory evaluation was carried out on the following parameters: taste, appearance, aroma, mouth (texture), colour and overall acceptability by a panel of ten members using a 9-point Hedonic scale. The rating of the samples ranged from 1 (Dislike extremely) to 9 (Like extremely)

**Statistical analysis:** The statistical significance of the observed differences among the means of triplicate readings of experimental results were evaluated by analysis of variance (ANOVA), while means were separated using Duncan's Range Test. These analyses were carried out using GenStat 6.1 (2002) computer program.

## RESULTS AND DISCUSSION

The moisture, protein, fat, crude fiber, ash and carbohydrate contents of soy-sweet potato flours varied from 5.64 to 5.77%, 11.19 to 33.72%, 3.10 to12.78%, 1.80 to2.55%, 1.63 to 2.40% and 42.91 to 76.51% respectively

Table 2: Macronutrients (g/100g) and mineral Composition ( mg/100g) composition of developed supplements

| Nutrients | BF 0 | SB 0 | SBF 1 | SBF 2 | SBF 3 | SBF 4 | SBF 5 | CS |
|---|---|---|---|---|---|---|---|---|
| Energy (Kcal) | 363.78 | 460.26 | 378.73 | 391.91 | 394.53 | 413.93 | 421.54 | 397.00 |
| Energy (KJ) | 1521.0 | 1887.0 | 1531.0 | 1638.0 | 1649.0 | 1730.0 | 1762.0 | 1659.0 |
| Moisture (g) | 6.74$^{c}$ | 5.11$^{a}$ | 5.77$^{a}$ | 5.76$^{bc}$ | 5.75$^{bc}$ | 5.74$^{bc}$ | 5.64$^{ab}$ | 4.14$^{a}$ |
| Protein (g) | 6.89$^{a}$ | 39.07$^{f}$ | 11.19$^{b}$ | 20.04$^{c}$ | 23.44$^{c}$ | 28.48$^{d}$ | 33.72$^{e}$ | 16.00$^{c}$ |
| Fat (g) | 0.70$^{a}$ | 23.34$^{f}$ | 3.10$^{b}$ | 6.02$^{c}$ | 6.69$^{d}$ | 10.82$^{f}$ | 12.78$^{g}$ | 9.00$^{c}$ |
| Fiber (g) | 1.80$^{a}$ | 4.90$^{c}$ | 1.80$^{a}$ | 1.80$^{a}$ | 1.85$^{b}$ | 2.10$^{c}$ | 2.55$^{d}$ | 5.00$^{f}$ |
| Ash (g) | 1.40$^{a}$ | 3.41$^{d}$ | 1.63$^{b}$ | 1.99$^{c}$ | 2.12$^{d}$ | 2.21$^{e}$ | 2.40$^{f}$ | 2.75$^{g}$ |
| CHO (g) | 82.48 | 23.48 | 76.51 | 64.39 | 60.15 | 50.66 | 42.91 | 63.11 |
| Mineral composition | | | | | | | | |
| Na | 57.09$^{a}$ | 67.71$^{d}$ | 66.72$^{b}$ | 66.90$^{c}$ | 67.13$^{d}$ | 67.37$^{e}$ | 67.54$^{f}$ | 91.85$^{h}$ |
| K | 72.85$^{a}$ | 75.28$^{c}$ | 74.01$^{b}$ | 74.25$^{c}$ | 74.34$^{d}$ | 74.59$^{e}$ | 74.70$^{f}$ | 75.07$^{g}$ |
| mg | 61.44$^{a}$ | 83.90$^{f}$ | 72.92$^{b}$ | 73.45$^{c}$ | 73.89$^{d}$ | 74.88$^{e}$ | 75.49$^{f}$ | 78.31$^{g}$ |
| Zn | 7.22$^{a}$ | 16.29$^{f}$ | 9.22$^{b}$ | 9.91$^{c}$ | 10.44$^{d}$ | 11.18$^{e}$ | 12.00$^{f}$ | 32.58$^{h}$ |
| Ca | 57.42$^{b}$ | 62.12$^{c}$ | 60.30$^{c}$ | 60.59$^{d}$ | 60.66$^{e}$ | 60.72$^{f}$ | 61.60$^{g}$ | 55.45$^{a}$ |
| P | 10.25$^{a}$ | 260.42$^{g}$ | 35.85$^{b}$ | 82.78$^{c}$ | 92.25$^{d}$ | 137.8$^{f}$ | 173.13$^{g}$ | 122.67$^{e}$ |
| Fe | 12.47$^{a}$ | 14.21$^{b}$ | 13.89$^{b}$ | 13.94$^{bc}$ | 13.97$^{bc}$ | 14.04$^{bc}$ | 14.11$^{c}$ | 16.49$^{d}$ |

Mean with similar alphabets are not significantly different from each other at the 5% statistical level. (SP 0 = 100% sweet potato; SF 0 = 100% soy flour, SPS 1 = 90:10% of sweet potato and soybean; SPS 2 = 80:20% of sweet potato and soybean; SPS 3 = 0:30% of sweet potato and soybean; SPS 4= 60:40% of sweet potato and soybean; SPS 5 = 50:50% of sweet potato and soybean, CS = control sample (Nutrend) )

and the energy values varied from 378.73 to 421.54Kcal (Table2). There were significant improvements in the protein status and energy values of soy-enriched SP flours; the protein content and energy values increased with increasing soy flour substitution. This trend with increasing soy flour substitution is however, not unexpected since soybean is rich in proteins and fats. The protein contents of all the soy-sweet potato flours, except SSP 1, were higher than the control sample. The protein content of 10% soy flour supplementation was significantly ($p<0.05$) lower than others, but there was no significant difference between the control sample and 20 and 30% soy flours supplementations. The increased in the protein and energy values of food that was fortified with soybeans had been reported by many investigators[9,17].

Also Table 2 shows the result of mineral compositions of sweet potato and soy-sweet potato flours. Sodium and potassium contents of the food samples varied from 66.72 to 67.37 mg and 74.01 to 75.70 mg respectively. The 50% soy flour supplementation had significantly ($p<0.05$) higher sodium and potassium contents than other food samples, but the sodium and potassium contents of other soy-sweet potato flours were significantly different ($p<0.05$) from each other. Magnesium was found to vary from 72.92 to 74.49 mg. The values of magnesium in all the food samples were significantly different ($p<0.05$) from each other.

Iron and zinc contents of soy-sweet potato flours varied from 13.89 to 14.04 mg and 9.22 to 12.0 mg respectively. The Zinc content was significantly different in all the soy-sweet potato flours and the iron content of 50% soy flour supplementation was significantly higher than others and there were no significant ($p<0.05$) different among other soy-sweet potato flours. Calcium and phosphorous contents were found to vary from 60.3 to 61.60 mg and 35.85 to 173.13 mg respectively. The samples differ significantly among themselves with regard to calcium and phosphorous contents.

Table 3 shows the result of sensory evaluation. It was observed that there was significant different between the control samples and other soy-sweet potato flours in term of overall acceptability. The control food sample was rated higher than soy-sweet potato flours. This could be attributed to the fact that consumers have been used to control sample, which consist of maize and soybeans. The 50% soy flour supplementation was rated next to the control food sample, but there was no significant different between it and 30% soy flour supplementation in overall acceptability and also, in term of meeting the RDA requirement of the infants. This suggests that supplementation above 30% soy protein

Table 3: Sensory evaluation scores for reconstituted soy-Sweet potato and commercial infant formular

| Sample | Appearance | Taste | Aroma | Mouth feel | Overall acceptability |
|---|---|---|---|---|---|
| SPS 1 | 2.5$^{a}$ | 2.9$^{a}$ | 2.3$^{a}$ | 4.8$^{a}$ | 2.9$^{a}$ |
| SPS 2 | 2.6$^{a}$ | 3.3$^{a}$ | 2.8$^{a}$ | 4.1$^{a}$ | 3.2$^{a}$ |
| SPS 3 | 4.4$^{b}$ | 3.8$^{ab}$ | 2.8$^{a}$ | 4.3$^{a}$ | 3.7$^{ab}$ |
| SPS 4 | 3.9$^{ab}$ | 3.5$^{a}$ | 2.3$^{a}$ | 3.6$^{a}$ | 2.8$^{a}$ |
| SPS 5 | 4.1$^{ab}$ | 3.5$^{a}$ | 3$^{a}$ | 4.2$^{a}$ | 4$^{ab}$ |
| CS | 5$^{b}$ | 5$^{b}$ | 5$^{b}$ | 5$^{b}$ | 5$^{b}$ |

*Means with similar alphabets are not significantly different from each other at the 5% statistical level. (SPS 1 = 90:10% of sweet potato and soybean; SPS 2 = 80:20% of sweet potato and soybean; SPS 3 = 70:30% of sweet potato and soybean; SPS 4 = 60:40% of sweet potato and soybean; SPS 5 = 50:50% of sweet potato and soybean; CS = Nutrend (a commercial infant formula)

Table 4: Amount of soy-sweet potato needed to meet rda of infant with reference to sps 3 (30% soy flour and 70% sweet potato flour)

| Nutrient | Infant's RDA (1-3 years) | SPS 3 | Amount needed to meet RDA (g) |
|---|---|---|---|
| Energy (MJ) | 5.5 | 1.65 | 333.3 |
| Protein (g) | 16 | 23.44 | 76.9 |
| Magnesium ( mg) | 70.0 | 73.89 | 94.7 |
| Zinc ( mg) | 5.0 | 10.44 | 47.9 |
| Calcium ( mg) | 540 | 60.66 | 890.2 |
| Phosphorous ( mg) | 360 | 92.25 | 390.2 |
| Iron ( mg) | 15 | 13.97 | 107.4 |
| Sodium ( mg) | NR | 67.13 | - |
| Potassium ( mg) | NR | 74.34 | - |

NR = No Reference  Source: FAO/WHO 1974

Table 5: Comparative cost of developed supplement and Commercial formulae

| Product Name | Cost =N= | | K |
|---|---|---|---|
| Developed product | 250 | : | 00 |
| Nutrend | 650 | : | 00 |
| Cerelac | 850 | : | 00 |
| SMA Gold | 1450 | : | 00 |
| SMA | 800 | : | 00 |

=N= Naira, K = Kobo ($1 =N= 150:00)

only causes minimal alteration in the nutritive value of soy-sweet potato. It is, therefore, suggested that 30% soy protein supplementation (which can be obtained by mixing three part soy bean flour to seven parts sweet potato flour) could be used for soy-sweet potato weaning diet formulation.

In respect to sample SPS 3 (30% soy flour and 70% sweet potato flour), the amount of soy-sweet potato flour that could adequately meet the RDAs of children (1-3 years) was calculated (Table 4). The cost of production of soy-sweet potato supplemented diet (=N= 250) was less than the commercial weaning foods that cost between =N= 650 and =N=1450 per tin (Table 5). Based on this fact, the low-income family cannot afford to purchase these commercial weaning foods and for such people an alternative low cost weaning formula are helpful.

**Pasting characteristics:** Amylographic studies (Table 6a) showed that the Brabender viscosities of the soy-sweet potato flours are generally lower than the SP flour. The apparent gelatinization temperature of SP flour was 70.5°C, while those of soy-sweet potato flours varied from 72.5-82.5°C. This may be due to the buffering effect of fat (from soybean) on starch which interferes with the gelatinization process[18]. The peak viscosity (Vp) of SP flour is 480 BU. The soy-sweet potato flours had lower values in the range of 180-365 BU. This suggests that the presence and interaction of components like fats and proteins (from soybeans) with starch lowers its peak viscosity[18,19]. High Vp reflects fragibility of the swollen granules, which first swell and then break down under the continuous mechanical stirring of the Brabender. Thus they require careful cooling with good agitation in order to pass through the Vp and achieve a properly cooled past. However, after 15 min hold at 95°C, viscosity decreased. The highest percent decreased was recorded for SPS 3 (32%), SPS 2 (22%) and SPS 1 (11 %); while SPS 0, SPS 4 and SPS 5 had 3.37, 2.77 and 11.11% decreased respectively. There were significant increases in the viscosity of the soy-sweet potato flours when cooled to 50°C, with values ranging from 420-760 BU. When held for 15 min at 50°C, the final viscosities of the soy-sweet potato flours dropped, with SPS 3 and SPS 4 having the highest percentage drop (24.1 and 28.6% respectively) the final viscosity after 15 min is a measure of the stability of the cooked paste[20]. It can be concluded from the results obtained that SPS 0 (0% SF substitution) is the most stable followed by SPS 1 (10% SF substitution) and SPS 2 (20% SF substitution), with SPS 4 and SPS 5 being the least stable. The extent of increase in viscosity on cooling to 50°C reflects the retrogradation tendency (Vc-Vp) of the products. Of the SPS flours studied, SPS 1 had the highest retrgradation tendency (395 BU), followed by SPS 2 (360 BU) and SPS 3 (320 BU), while SPS 4 and SPS % had the lowest values (240 BU). The increase in the index of retrogradation (i.e. set back value) in soy-sweet potato flours may be due to increased hydrogen bonding during cooling and the high amylose content of the starch of SP[21]. This increased hydrogen bonding activity may be due to the hydrothermal treatment and the interaction between the polysaccharide and protein (peptide bonds). This lead to the growth of gel micellar regions, hence

Table 6a: Pasting characteristics (a) and physical properties (b) of Soy – sweet potato flours

| Sample | Ta | GT | Tp | Tvp | Ec | Vp | Va | Vb | Vc | Vf | Vp-Vb | Vc-Vp | Vc-Va | Vc-Vb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SP 0 | 70.5 | 16 | 97.5 | 27 | 11 | 480 | 445 | 430 | 800 | 690 | 50 | 320 | 355 | 370 |
| SF 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| SPS 1 | 72.5 | 17 | 97.5 | 27 | 10 | 365 | 360 | 320 | 760 | 650 | 85 | 395 | 400 | 480 |
| SPS 2 | 73.5 | 17.4 | 95 | 26 | 8.6 | 320 | 320 | 250 | 680 | 580 | 70 | 360 | 360 | 430 |
| SPS 3 | 77.5 | 19 | 93.7 | 25.5 | 6.5 | 220 | 220 | 150 | 540 | 410 | 70 | 320 | 320 | 390 |
| SPS 4 | 71.25 | 16.5 | 105 | 30 | 13.5 | 180 | 180 | 175 | 420 | 300 | 0 | 240 | 240 | 240 |
| SPS 5 | 82.5 | 21 | 147.5 | 74 | 26 | 180 | 160 | 150 | 420 | 360 | 30 | 240 | 360 | 270 |

Ta = Gel temperature; GT=Gelation; Tp =temperature at peak viscosity; Tvp = Time taken to reach peak viscosity; Ec = ease of cooking; Vp = peak viscosity; Va = Viscosity at 95oC; vb = Viscosity after 15 min. at 95°C; Vc = Viscosity at 50°C; Vf = final viscosity after 15 min. at 50°C; Vp-Vb = Stability during cooking ; Vc- Va = Consistency; Vc-Vp = Set back value; Vc- Vb = Gelatinisation index ; All viscosity values are expressed in BU, Brabender unit.


Fresh sclerotium of Pleurotus tuber - regium


Fruitbodies resulting from treated sclerotium of P. Tuber-regium

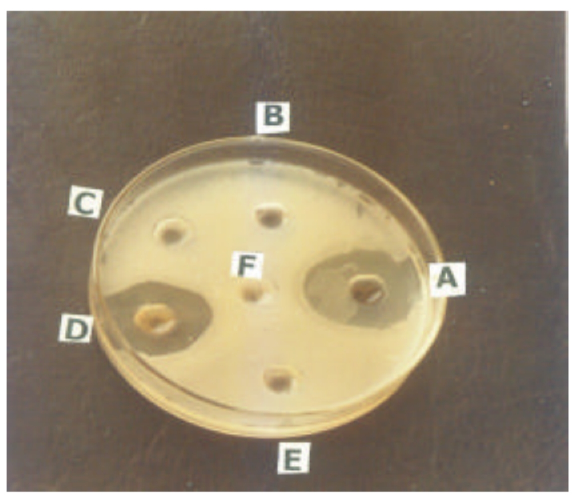
Table 6b: Bulk density and water absorption capacity

| Sample | Bulk Density (g mL$^{-1}$) | WAC (% mL g$^{-1}$) |
|---|---|---|
| SP 0 | 0.96d | 526.77g |
| SF 0 | 0.56a | 301.67a |
| SPS 1 | 0.71c | 491. 00f |
| SPS 2 | 0.61b | 462.87d |
| SPS 3 | 0.56ab | 452.75d |
| SPS 4 | 0.58a | 431.34c |
| SPS 5 | 0.56a | 389.62b |

increase in index of retrogradation[22], making entrapped water more prone to expression. High proportion of linear amylose (from sweet potato) favours rapid retrogradation process and the gelling on cooling[21]. The low apparent viscosity and retrogradation in the soy-sweet potato flours after cooling for 15 min at 50°C is an advantage nutritionally, in that it enhances the production of nutrient dense product that does not require the addition of water to enhance child feeding [23, 24]. In the traditional ogi and maize flours products, it is usually necessary to dilute the products with water before feeding because of their viscous nature. This reduces the energy and nutrient density, resulting into child malnutrition in areas where starchy foods are the staple diets[24]. The use of soy-sweet potato flours with low set back viscosity values eliminate the need for dilution before feeding as well as the use of specialized processes such as germination, enzymatic treatment and extrusion (to reduce the dietary bulk).

The index of gelatinization (Vc-Vb) was highest in SPS 1 (480 BU), followed by SPS 2 (420 BU) with SPS 4 having the lowest value (BU). Thus, the presence of protein and fat (which act as surfactants) inhibits the gelatinization process, thus raising the temperature and retarding the rate of swelling. The mechanism of action is that a complex is formed between the protein-fat matrix of the soy product and the amylose in the starch of SP. The formation of complex with amylose reduces the tendency of the amylose to associate, gel and retrograde thus delaying the rate of firming during the heating and the cooling stages[25,26], this effect is particularly pronounced because about 30% of the starch in SP is amylose. This is reflected in the values obtained for ease of cooking in SPS 1 to 3. As soy flour supplementation increase the sweet potato level decrease, thus reducing the amount of available amylose for forming complex with proteins.

**Physical properties:** The bulk density generally decreases with increasing SF supplementation. SPS 1 had the highest (0.71g mL$^{-1}$) while SPS 5 had the lowest (0.56g mL$^{-1}$) (Table 6b). Increase in bulk density is desirable in that it offers greater packaging advantage




Antibacterial screening of test of crude polyscccharide extracts (100mg mL$^{-1}$) of *P.* Tuber regium on enterococcus faecalis
A: Gentamycin-positve control (0.5 mg mL$^{-1}$)
B: Aqeous extract of sclerotium (100mg mL$^{-1}$)
C: Ethanolic extract of sclrotium (100 mg mL$^{-1}$)
D: Ethanolic extract of fruitbody (100mg mL$^{-1}$)
E: Aqueous extract of fruitbody (100 mg mL$^{-1}$)
F: Normal saline (Nagative control)

as greater quantity may be packed within a constant volume[27]. SPS 1 had the highest water absorption capacity (WAC) (491 mL $g^{-1}$) followed by SPS 2 (462.87 mL $g^{-1}$), while SPS 5 had the lowest value (389.62 mL $g^{-1}$). This trend shows that increasing SF supplementation leads to reduce WAC and that the presence of proteins interferes with the ability of sweet potato starch to absorb water. The ability to absorb water is particularly important during reconstitution into the dough form before consumption. The WAC is a measure of the ability of the flour to associate with water, particularly in products where hydration is required to enhance handling characteristics, such as dough and pastes[28].

## CONCLUSIONS

This study has shown that the nutritional status of sweet potato can be enhanced through soy flour supplementation and the developed soy-sweet potato diets were nutritious, inexpensive and can easily be prepared from locally available raw food materials by using simple domestic processing techniques. The developed weaning diet can be incorporated into the diet of children to prevent protein energy malnutrition in the community.

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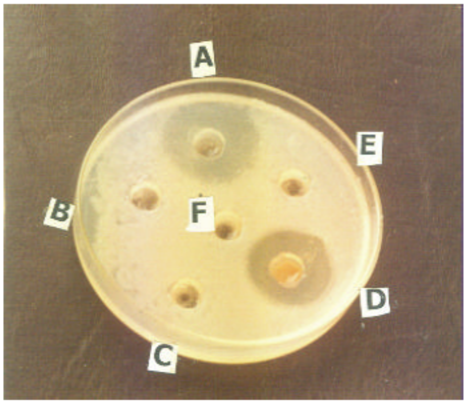


Antibacterial screening of test of crude polysccharide extracts (100mg $mL^{-1}$)
of *P.* Tuber regium on enterococcus faecalis
A: Gentamycin-positve control (0.5 mg $mL^{-1}$) B: Aqeous extract
of sclerotium (100mg $mL^{-1}$)
C: Ethanolic extract of sclrotium (100 mg $mL^{-1}$) D: Ethanolic
extract of fruitbody (100mg $mL^{-1}$)
E: Aqueous extract of fruitbody (100 mg $mL^{-1}$) F: Normal saline (Nagative control)