Studies on the Potential of Malted *Digitaria exilis*, *Cyperus esculentus* and *Colocasia esculenta* Flour Blends as Weaning Food Formulation

*Onuoha, O.G.¹, Chibuzo, E.² and Badau, M.²*

**ABSTRACT**

This work was aimed at evaluating the functional properties of six varying percentage blends of locally abundant, under-utilized crops; malted acha (*Digitaria exilis*), aya (*Cyperus esculentus*) and ede (*Colocasia esculenta*) as a substitute for the traditional weaning food. The results of bulk density and starch digestibility showed a decrease with increasing percentage addition of malted acha with values from 5.889 ± 0.98 to 7.953 ± 0.103 and -5.45 to -13.6 respectively. While water absorption capacity, measure of dispersibility, wettability, swelling power, % solubility increased with increase in percentage addition of malted acha with values from 6.6 ± 0.712 to 8.1 ± 0.1, 2.12 to 37.225, 3.21 ± 0.04 to 3.6 ± 0.03 and 20.64 to 24.46 respectively. There was no significant difference between any of the formulae and the control. Results of pasting properties showed that the peak viscosity, break down, final viscosity and setback values ranges from -0.42 ± 0.085 to -3.67 ± 0.085, 5.63 ± 0.045 to 1.79 ± 0.04, -3.88 ± 0.045 to -1.475 ± 0.275 and 2.17 ± 0.045 to 2.93 ± 0.045 respectively. The formulae compared favourably with the control, a commercially sold weaning food.

**Keywords:** Weaning food, functional properties, under-utilized crops, blends.

**Introduction**

An infant between 6 and 12 months old, weighing 8.6 kg requires a daily food intake of about 98 Kcal/kg body weight or about 843 Kcal. This would require 1.258 litres of breast milk having 67 Kcal/100 ml, to meet the child’s caloric needs making most nursing mothers resort to the use of local weaning foods. Weaning foods in most parts of Africa are usually in the form of cereal gruels which are suspensions of cooked maize, rice or sorghum that are very much unlike the milk-based ones which are expensive (Onilude et al., 1999). These traditional weaning foods are thick paste, which are then diluted with large volume of water to produce thin drinkable consistency for infants.

This results in significant loss of nutrient when compared to consumption of the whole grain. There have been documented cases of infants weaned on local foods like *ogi*, a maize-based food (Onofiko and Nnanyelugo, 1992; Agu, 1976). Functional characteristics such as bulk density, water absorption, swelling power and pasting properties of the food materials are very important for the growing children (Otegbayo et al., 2009). This invariably influences the frequency of feeding and quantity of the diet consumed by the infant which are also important in determining the extent to which an individual will meet his or her energy and nutrient requirements (Otegbayo et al., 2009).

*Acha* (*Digitaria exilis*) also known as *Hungry rice* is a cereal grain crop grown abundantly in the Northern regions of Nigeria. It is used to produce porridges and is known to reduce the viscosity of...
high viscous foods significantly (Jideani, 1999). Furthermore, when acha is malted – a technology commonly practised by rural dwellers, it can result in the production of more enzymes like amylases, which if activated will dextrinify starch to simple sugars. This would allow for the production of low viscous foods that an infant can consume in significant quantities to supply needed nutrient and energy for infant growth. Similarly Tiger nut (Cyperus esculentus) also called Aya contains oil that has a mild, pleasant nutty flavour and of superior quality to olive oil (Mason, 2006) which have been observed to impact significantly on the texture of food especially drinks, giving a milk-creamy consistence to such drinks (Adekunle and Badejo, 2002). Ede (Colocasia esculenta; cocoyam) contains starch that has a small to medium polyhedral starch granules structure, low amylose content and low swelling power. Therefore, it could produce low viscous pastries and is moreover easily digestible (Mepba et al., 2009). This research work was aimed at evaluating the functional properties of the varying percentage blends of acha (Digitaria exilis), aya (Cyperus esculentus) and ede (Colocasia esculenta) flours potential for weaning foods formulation.

Materials and Methods

Collection and treatment of samples
The acha (hungry rice; Digitaria exilis), Tiger nut (Cyperus esculentus) also called aya and corms of ede (coco-yam; Colocasia esculenta) were obtained from market in Bauchi Metropolis. The method described by Marero et al., (1988) was adopted in the malting of acha. The grains were cleaned in tap water and steeped in water (1:3) for 8 h and then spread evenly (1.5 cm depth) on a bench top and covered with a moist jute bag for 72 h with constant watering to maintain its moisture content. The resulting green malt was then dried in an oven dryer at 60°C for 20 h, and then de-sprouted and conditioned, while the aya nuts were washed, de-stoned and sun-air-dried separately. The corm of ede were washed, cooked-to-doneness, peeled, diced into pieces and sun-air-dried.

Weaning food formulation
The following six formulations were made: 50:40:10; 40:50:10; 20:70:10; 60:30:10; 30:60:10 and 70:20:10 for acha: aya: ede respectively. It was then milled using a disc attrition mill (Hunt No. 2A premier mill, Hunt and Co, UK) into flour of the percentage composition to an average particle size of less than 0.3 mm. The flour were then sieved through a fine mesh (0.5 µm) to obtain the composite meal (weaning formula) adopting method described by Mbata et al. (2009).

Evaluation of physical and functional properties

Bulk density
The method described by Onwuka (2005) was adopted. A 10 ml capacity graduated measuring cylinder was pre-weighed. The cylinder was then filled gently with the sample to the 10 ml mark. Bulk density was then calculated as:

\[
\text{Bulk density (g/ml) = \frac{\text{weight of sample (g)}}{\text{volume of sample (ml)}}}
\]

Swelling power
This was determined by the method described by Leach et al. (1959) with modification for small samples. 1g of the flour sample was mixed with 10 ml distilled water in a centrifuge tube and heated at 80°C for 30 min. This was continually shaken during the heating period. After heating, the suspension was centrifuged at 1000 × g for 15 min. The supernatant was decanted and the weight of the paste taken. The swelling power was calculated as:

\[
\text{Swelling power = \frac{\text{weight of the paste (g)}}{\text{weight of dry flour (g)}}}
\]

Determination of wettability of formulae
The method described by Onwuka (2005) was adopted. 1 g of sample was added into a 25 ml graduated cylinder with a diameter of 1 cm. And placing a finger over the open end of the cylinder, it was inverted and clamp at a height of 10 cm from the surface of a 600 ml beaker containing 500 ml of distilled water. The finger was removed and the
time required for the sample to become completely wet recorded as its wettability.

**Determination of water absorption capacity**

Water absorption capacity was determined using the method described by Onwuka (2005). 1 g of the sample was weighed in a conical graduated centrifuge tube. It was then mixed thoroughly with 10 ml distilled water using a Waring whirl mixer for 30 seconds. The sample was allowed to stand for 30 minutes at room temperature and then centrifuged at 5000 × g for 30 min. The volume of free water (supernatant) was then read directly from the graduated centrifuge tube.

**Measurement of dispersibility of formulae**

The method described by Balami et al. (2004) was adopted. 50 cm$^3$ of distilled water was added to 3 g of the sample and stirred to mixture for a minute at room temperature. The mixtures were filtered through dried cheese cloth of known weight then rinsed in a beaker with 50 cm$^3$ of distilled water and poured through the cheese cloth. The sieve and residue were dried in a hot air oven at 100°C for 10 min. The dispersibility was expressed as the percentage of the solids dissolved.

**Determination of in-vitro starch digestibility**

The Shekib et al. (1988) method was used. The principle of the method is based on iodine starch complex formation. The assay was carried out at room temperature (32°C) in a test tube containing 5 ml of the soluble samples, 4 ml of phosphate buffer (pH 6.6), sodium chloride (1.0 ml) and amylase enzyme (1.0 ml) (Sigma – EC 22.1.1 V, B – Sigma Chemical Company, Germany) was added and then mixed thoroughly to make reaction mixture. 0.2 ml aliquot of the mixture with the added enzyme was then taken at zero and after 1 h (complete hydrolysis as predetermined) and each dispensed into 10 ml lugols iodine solution (1:100 dilution) and the absorbance was measured at 620 nm using a colorimeter. In-vitro starch digestibility was calculated as:

\[
\text{In-vitro starch digestibility} = \frac{\text{absorbance at 0 h} - \text{absorbance at 1 h}}{\text{absorbance at 0 h}} \times 100
\]

**Pasting properties**

3 g each of the flour samples were mixed with 25 ml distilled water in the canister of a Rapid Visco-Analyzer (RVA, Model 3D, Newport Scientific, Sydney, Australia) monitored with RVA control software and operated. The following parameters were obtained from the plotted graphs: peak viscosity, pasting temperature, setback viscosity, breakdown viscosity, final viscosity and time to reach the peak viscosity.

**Results and Discussion**

The result of the functional properties of the weaning food formulae is shown in Table 1. Bulk density values ranged from 5.889 ± 0.98 to 7.953 ± 0.103 with formula 271 having the highest value. The result showed that bulk density decreased with increasing percentage addition of malted acha. There was however no significance differences between samples 721 and the control (p ≤ 0.05). This agrees with observation made by Akpapunam et al. (1996) that malting significantly affected the water absorption capacities as well as the viscosities of flours. The advantage of the low bulk density of these complementary diets is that the gruel or porridge made from this diet will have a lower dietary bulk. This is important in complementary foods because high bulk limits the caloric and nutrient intake per feed per child and infants are sometimes unable to consume enough to satisfy their energy and nutrient requirements. A diet with low dietary bulk implies that a thick gel will not be formed and the diet will have reduced viscosity, plasticity and elasticity (Desikachar, 1980). The bulk density is also important in the packaging requirement and material handling of the complementary diet (Karuna et al., 1996). Water absorption capacity values ranged from 6.6 ± 0.712 to 8.1 ± 0.1 indicating increase in values with increase in percentage addition of malted acha.
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Table 1: Functional properties of the weaning formulae

<table>
<thead>
<tr>
<th>Samples</th>
<th>Bulk Density (g/ml)</th>
<th>Water Absorption Capacity (g/100g)</th>
<th>Measurement of Dispersibility (% of Dispersibility)</th>
<th>Wettability (min)</th>
<th>Swelling Power (g/g)</th>
<th>% Solubility</th>
</tr>
</thead>
<tbody>
<tr>
<td>721</td>
<td>5.889 ± 0.098&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.6 ± 0.712&lt;sup&gt;b&lt;/sup&gt;</td>
<td>89.65 ± 3.37&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.12 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.21 ± 0.04&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.64 ± 1.225&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>631</td>
<td>6.32 ± 0.126&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.8 ± 0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>89.29 ± 2.15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.155 ± 0.155&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.59 ± 0.04&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.5 ± 0.215&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>541</td>
<td>6.696 ± 0.359&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.35 ± 0.477&lt;sup&gt;b&lt;/sup&gt;</td>
<td>87.35 ± 2.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.445 ± 0.075&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.21 ± 0.045&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.36 ± 1.235&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>451</td>
<td>6.476 ± 0.103&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.62 ± 0.283&lt;sup&gt;b&lt;/sup&gt;</td>
<td>85.07 ± 0.89&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>9.11 ± 2.06&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.38 ± 0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>23.96 ± 0.18&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>361</td>
<td>7.727 ± 0.229&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7.8 ± 0.327&lt;sup&gt;b&lt;/sup&gt;</td>
<td>84.88 ± 4.11&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>19.905 ± 0.675&lt;sup&gt;d&lt;/sup&gt;</td>
<td>3.6 ± 0.04&lt;sup&gt;a&lt;/sup&gt;</td>
<td>23.26 ± 0.68&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>271</td>
<td>7.953 ± 0.0103&lt;sup&gt;c&lt;/sup&gt;</td>
<td>8.1 ± 0.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>77.38 ± 3.64&lt;sup&gt;b&lt;/sup&gt;</td>
<td>37.225 ± 0.095&lt;sup&gt;e&lt;/sup&gt;</td>
<td>3.6 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>24.46 ± 1.3&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>Control</td>
<td>5.56 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.31 ± 0.24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>40&lt;sup&gt;i&lt;/sup&gt;</td>
<td>3.63 ± 0.048&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27.21 ± 0.015&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

*Figures bearing the same superscripts along vertical column are not significantly different from each other.

** Means (± SD) of triplicate analyses

***Cerelac used as control

721- 70% malted hungry rice, 20% tiger nut; 10% cocoyam.
631- 60% malted hungry rice, 30% tiger nut; 10% cocoyam.
541- 50% malted hungry rice, 40% tiger nut; 10% cocoyam.
451- 40% malted hungry rice, 50% tiger nut; 10% cocoyam.
361- 30% malted hungry rice, 60% tiger nut; 10% cocoyam.
271- 20% malted hungry rice, 70% tiger nut; 10% cocoyam.

However, statistically, there was no significant difference at p ≤ 0.05 for all the samples. This implies that all the samples will respond in similar fashion in water. This is significant for as at a lower water absorption capacity, the formulae will have lower water absorption and binding capacity which is desirable for making thinner gruels with high caloric and nutrient density per unit volume which is in agreement with the findings of Ijarotimi and Oluwalana (2013) and Elkahalifa et al. (2005). Measure of dispersibility values ranged from 89.65 ± 3.37 to 77.38 ± 3.64 indicating a reduction in value with increasing percentage addition of malted acha. The dispersibility of a mixture in water indicates its reconstitutability. The higher the dispersibility the better and more preferred. This increased solubility could be as a result of the increase in amount of soluble sugars present in the malt and the particle size fraction. The relatively high dispersibility value is based on the easily digested carbohydrate, low sucrose and starch content, enzymatically hydrolyzed proteins and particle size distribution. The variation among the experimental formulations was negligible, however, these values were significantly different. The commercial weaning food had a very poor dispersibility of only 40%. Dispersibility tended to increase with increase in malted acha fraction. Wettability values ranged from 2.12 to 37.225. Wettability is time dependent. The wettability decreased with decrease in the quantity of malted acha in the formulae. The decrease in the wettability may be due to disruption of the nature of the molecule in the malted sample which resulted to low interfacial tension between the particles and the liquid (Elemo and Adu, 2005). Swelling power values ranged from 3.21 ± 0.04 to 3.6 ± 0.03. The formulae had relatively high values in terms of swelling power which compare favourably with the control. There was no significant difference between all the formulae and the control. Swelling power refers to the expansion accompanying spontaneous uptake.
of solvent. According to Kinsella (1976), swelling causes changes in hydrodynamic properties of the food thus impacting characteristics such as body, thickening and increase in viscosity to foods. This implies that the formulae will produce viscous gruel that compares favourably with the control; a commercially sold infant food. This is probably due to similar carbohydrate content in the formulae and the control. Furthermore, WHO (2003) stipulates that complementary diets are required to produce a gruel or porridge that is neither too thick (when it is too thick, it will be difficult for the infant to ingest and digest because of limited gastric capacity) for the infant to consume nor so thin that energy and nutrient density are reduced. The % solubility values ranged from 20.64 to 24.46 with sample 271 having the highest value and sample 721 having the least value (Table 1). There was significant difference at p < 0.05 for the values of sample 271 and sample 721. This could be as result of the increasing percentage addition of tiger nuts, which are rich in simple sugar (Oladele and Aina, 2007). % solubility is an index which measures the amount of reducing sugars or solubility of sugar present in the foods. This indicates the capacity of the food to be eaten without extra addition of sucrose which are both economical for the local mother and also reduces the problem of flatulence as a result of microbial metabolism of sucrose in the colon of the infant.

The result of the starch digestibility of the weaning formulae is shown in Table 2. The highest values (-13.6) was reported in formula 271 while the least value (-5.45) was reported for formula 721. However, there was no significant difference at p (<0.05) between the weaning formulae 721, 631 and the control. The test indicated the amount of residual starch left over after enzyme digestion.

The result suggests that increasing the addition of malted acha will result in reducing amounts of starch in the weaning formula. It is evident that in developing countries, most complementary foods are starch and cereal based. Starch is often the principal source of energy, but when heated with water, starch granules gelatinize to produce a bulky, thick (viscous) porridge. Therefore, with low starch content, less bulky and thin gruels can be produced. Thus, the liquid consistency can make them easy to consume in the volumes needed to meet infant energy and nutrient requirement.

Table 2: Starch digestibility of the weaning food formulae

<table>
<thead>
<tr>
<th>Samples</th>
<th>Absorbance at 0 (h) (mg/l)</th>
<th>Absorbance at 1 h (mg/l)</th>
<th>0 h – 1 h (mg/l)</th>
<th>(0 h – 1 h/0 h) x 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>721</td>
<td>550</td>
<td>560</td>
<td>-10</td>
<td>-5.45^a</td>
</tr>
<tr>
<td>631</td>
<td>590</td>
<td>630</td>
<td>-40</td>
<td>-6.78^a</td>
</tr>
<tr>
<td>541</td>
<td>620</td>
<td>680</td>
<td>-60</td>
<td>-9.67^b</td>
</tr>
<tr>
<td>451</td>
<td>640</td>
<td>710</td>
<td>-70</td>
<td>-10.93^b</td>
</tr>
<tr>
<td>361</td>
<td>650</td>
<td>730</td>
<td>-80</td>
<td>-12.3^c</td>
</tr>
<tr>
<td>271</td>
<td>660</td>
<td>750</td>
<td>-90</td>
<td>-13.6^c</td>
</tr>
<tr>
<td>Control</td>
<td>350</td>
<td>370</td>
<td>20</td>
<td>-5.71^a</td>
</tr>
</tbody>
</table>

*Figures bearing the same superscripts along vertical column are not significantly different from each other.
721-70% malted hungry rice, 20% tiger nut; 10% cocoyam.
631-60% malted hungry rice, 30% tiger nut; 10% cocoyam.
541-50% malted hungry rice, 40% tiger nut; 10% cocoyam.
451-40% malted hungry rice, 50% tiger nut; 10% cocoyam.
361-30% malted hungry rice, 60% tiger nut; 10% cocoyam.
271-20% malted hungry rice, 70% tiger nut; 10% cocoyam.
The result of the pasting characteristics of the weaning formulae is shown in Table 3. The peak viscosity values ranged from -0.42 ± 0.085 to -3.67 ± 0.085; breakdown values ranged from 5.63 ± 0.045 to 1.79 ± 0.04; final viscosity values ranged from -3.88 ± 0.045 to -1.475 ± 0.275; setback values ranged from 2.17±0.045 to 2.93 ± 0.045 where not significantly different in all the weaning formula but was significantly different from the control. There was no significant difference in the peak time for all the weaning formula but there was significant difference between the peak time for all the weaning formula and the control in terms of peak time. However, no significant difference was observed in the temperature required to form paste for all the weaning formula and the control. Pasting is the result of a combination of processes that follows gelatinization from granule rupture to subsequent polymer alignment due to mechanical shear during the heating and cooling of starches. The low peak viscosity and low final viscosity of the diet implies that the weaning diet will form a low viscous paste rather than a thick gel on cooking and cooling. This is in agreement with observations made by Otegbayo et al. (2006). This means that the gruel will be a high caloric density food per unit volume (Desikachar, 1980) rather than a dietary bulky (high volume/high viscosity) gruel (Ikujenlola, 2008). Setback viscosity of starch-based foods has been correlated with texture of various food products. The low set back value of the gruel indicates that the complementary diet on cooking will not be a cohesive gruel. This is in agreement with the report of Kim et al. (1995) who observed that with cooked potato paste, the lower the setback values, the more in-cohesive was the paste. The low set back is an indication that the starch has a low tendency to retrograde or undergoes syneresis during freeze-thaw cycles. These suggest that all the weaning formulae can be stored at low temperature with low tendency to retrograde just like the control. The pasting temperature is an indication of the minimum temperature to cook the sample. From this result, the pasting temperature of all the weaning formula are comparable to that of the control. This indicates that the diet has a low gelatinization temperature, hence, a shorter cooking time.

**Conclusion**

This study was designed to investigate the functional properties of blends of malted acha, aya and ede flour as weaning formulae. Percentage increase in malted acha and decrease in aya respectively resulted in products with improved functional properties (Bulk density, water absorption capacity, measurement of dispersibility, wettability, swelling power, % solubility, starch digestibility and pasting characteristics).The findings showed that the formulated diets particularly formulae 721 and 631 showed properties that compare favourably with
Table 3: Pasting characteristics of the weaning formulae

<table>
<thead>
<tr>
<th>Samples</th>
<th>Peak</th>
<th>Trough</th>
<th>B/D</th>
<th>Fv</th>
<th>SB</th>
<th>Pt</th>
<th>P/Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>721</td>
<td>-0.42 ± 0.085(^c)</td>
<td>-6.04 ± 0.04(^a)</td>
<td>5.63 ± 0.045(^d)</td>
<td>-3.88 ± 0.045(^ab)</td>
<td>2.17± 0.085(^b)</td>
<td>3.94 ± 0.0(^b)</td>
<td>50.13 ± 0.075(^d)</td>
</tr>
<tr>
<td>631</td>
<td>-1.42 ± 0.165(^bc)</td>
<td>-5.38 ± 0.125(^a)</td>
<td>3.96 ± 0.04(^c)</td>
<td>-3.13 ± 0.045(^b)</td>
<td>2.25± 0.08(^b)</td>
<td>4.16 ± 0.085(^b)</td>
<td>50.2 ± 0.05(^a)</td>
</tr>
<tr>
<td>541</td>
<td>-4.13 ± 0.875(^a)</td>
<td>-6.59 ± 0.605(^ba)</td>
<td>2.46 ± 0.21(^b)</td>
<td>-4.21 ± 0.46(^a)</td>
<td>2.33± 0.045(^b)</td>
<td>4.06 ± 0.015(^b)</td>
<td>50.18 ± 0.075(^a)</td>
</tr>
<tr>
<td>451</td>
<td>-2.0 ± 0.25(^b)</td>
<td>-4.0 ± 0.17(^b)</td>
<td>2.0 ± 0.08(^ab)</td>
<td>-1.475 ± 0.275(^c)</td>
<td>2.42± 0.0(^b)</td>
<td>3.87 ± 0.015(^b)</td>
<td>50.25 ± 0.05(^a)</td>
</tr>
<tr>
<td>361</td>
<td>-1.34 ± 0.085(^bc)</td>
<td>-5.04 ± 0.04(^ab)</td>
<td>3.71 ± 0.125(^c)</td>
<td>-2.17 ± 0.085(^bc)</td>
<td>2.88± 0.125(^c)</td>
<td>4.25 ± 0.1(^b)</td>
<td>50.18(^a)</td>
</tr>
<tr>
<td>271</td>
<td>-3.67 ± 0.085(^a)</td>
<td>-5.42 ± 0.04(^a)</td>
<td>1.79 ± 0.04(^a)</td>
<td>-3.34 ± 0.085(^b)</td>
<td>2.93± 0.045(^b)</td>
<td>3.83 ± 0.05(^b)</td>
<td>50.25 ± 0.05(^a)</td>
</tr>
<tr>
<td>Ctrl</td>
<td>-4.09 ± 0.085(^a)</td>
<td>-5.75 ± 0.25(^a)</td>
<td>1.67 ± 0.165(^a)</td>
<td>-4.21 ± 0.21(^a)</td>
<td>1.54± 0.04(^a)</td>
<td>2.835 ± 0.585(^a)</td>
<td>50.18 ± 0.025(^a)</td>
</tr>
</tbody>
</table>

*Figures bearing the same superscripts along vertical column are not significantly different from each other.

**Means (± SD) of triplicate analyses

***B/D – break down; Fv – final viscosity; SB – setback; Pt – peak time; P/Temp – pasting temperature.

****Ctrl = Cerelac

721- 70% malted hungry rice, 20% tiger nut; 10% cocoyam.
631- 60% malted hungry rice, 30% tiger nut; 10% cocoyam.
541- 50% malted hungry rice, 40% tiger nut; 10% cocoyam.
451- 40% malted hungry rice, 50% tiger nut; 10% cocoyam.
361- 30% malted hungry rice, 60% tiger nut; 10% cocoyam.
271- 20% malted hungry rice, 70% tiger nut; 10% cocoyam.

that of the control (a commercially sold weaning food) and probably can be consumed in similar quantities too. The frequency of feeding and quantity of the diet consumed by the infant are important determinants of the extent to which an individual will meet his or her energy and nutrient requirements. These weaning formulae provide a potential substitute for the local complementary foods (ogi) especially for low income families in third world countries.

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