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CALORIFIC VALUE AND CONSUMERS' SUBJECTIVE KNOWLEDGE OF COMPLEMENTARY PUDDINGS FROM TWO COCOYAM VARIETIES BLENDED WITH RIPE PLANTAIN AND SPROUTED SOYBEAN PASTES

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ABSTRACT: *The authors studied the dietary energy levels and consumers' acceptability of puddings from Xanthosoma sagittifolium (ede-ocha) and Colocasia esculenta (ede-cocoindia). Dietary energy was calculated using Atwater General Factor System (AGFS) and Atwater Specific Factor System (ASFS). Wet paste of each cocoyam variety was blended separately with ripe plantain and sprouted soy bean pastes into four different blends in the ratio of 100, 90:10, 25: 65:10 and 45:45:10 respectively. Puddings from 100% cocoyam served as the control for each variety. The blends were mixed with equal quantities of seasonings, wrapped in plantain leave and boiled for 30 minutes separately. The puddings were evaluated using standard analytical procedures. The ede-ocha puddings had crude protein (3.35% to 4.51%), fat (1.94% to 2.46%), fiber (0.94% to 1.84%) and carbohydrate (34.34% to 35.46%).The ede-cocoindia puddings had protein (3.22% to 4.29%), fiber (1.21% to 1.49%), fat (1.64% to 2.11%) and carbohydrate (37.86% to 39.28%).The dietary energy levels of all the ede-cocoindia pudding samples were higher than their counterparts from ede-ocha in both methods of energy calculations used. The ede-ocha puddings were preferred to ede-cocoindia.*

KEYWORDS: Dietary Energy, Sensory Acceptability, Puddings, Cocoyam, Complementary Feeding

INTRODUCTION

Complementary Foods (CFs) are non-breast milk or nutritive foods (UNICEF, 2010) given to breast feeding infants beyond six months, during their transition to family foods, (Monte and Giugliani, 2004). The period within the transition is called complementary feeding period which lasts till two years of age (Iwe, 2010; UNICEF 2010). The (CFs) may be solids, semi-solids (Agostoni *et al*. 2008; Iwe, 2010) or liquids (Agostoni, *et al*. 2008; UNICEF, 2010) foods specially prepared from family meals (WHO, 2000; Monte and Giugliam, 2004) or foods specially prepared for infants.

Due to high cost of nutritious proprietary complementary foods, the use of local staples has been advocated for which had been severally emphasized as panacea for attaining complementary feeding. But their sources must be genuine and their nutrients desired coupled with how best they could be combined or mixed to achieve the expected result (Iwe, 2010). Every community has a staple food, main food eaten, which includes roots like cocoyam, plantain which provide energy, and soybean, a protein and fat rich food (WHO, 2000; Iwe, 2010).

Both cocoyam varieties were under-exploited tropical root crops including in pudding preparation. Puddings are popular steamed paste in Nigeria and other West African countries which could be formulated among others with other staple pastes like plantain, soybean to enhance their nutritional and acceptability status. Puddings are not common staple food in most Nigerian communities and are getting extinct which calls for their popularization and acceptability because of their complementary roles. These cocoyam species are valuable sources of the micronutrients needed (McClintock, 2004) to overcome their deficiencies problems often referred to as 'hidden hunger' (Johns, 2004).

Dietary energy, often expressed in kilocalories or kilojoules per person per day is a non-nutritive food ingredient supply to the body by oxidation of energy sources or substrates in the foods consumed. The body uses dietary energy for metabolic processes, physiological functions, muscular activity, heat production, growth, transport of substances around the body, synthesis of enzymes and hormones. Food energy sources include carbohydrates, proteins, fats and to a lesser degree alcohol (Mullan, 2006; ACP, 2017). Other sources include organic acid, fibers and artificial sweeteners. Physical activity is the most variable determinant of energy need and is the second largest user of energy after basal metabolic rate (NHMRC, 2016).

Aside from Bomb Calorimeter, dietary energy could be calculated by Atwater general factor system (AGFS) which is based on summing the heat of combustion of energy yielding substrates such as protein, fat, carbohydrate. As energy is lost through digestion, absorption, and urinary excretion of urea, it implies that human being can only utilize some fractions of energy from the food components such as 97% of carbohydrate, 97% of fat and 92% of protein which are called coefficients of digestibility often referred to as Atwater factors (Mullan, 2006; ACP, 2017). Atwater factor uses a single factor (average value) for each of the energy yielding substrate regardless of the food in which it is found (ACP, 2017). Another method of calculating dietary energy is by Atwater specific factor system (ASFS) which is a refinement of AGFS that uses different factors of energy substrates depending on the foods in which they are found. While AGFS gives the average value of energy (single factor), ASFS gives ranges of heat of combustion and the coefficient of digestibility of energy substrates by considering the food types. For instance, variations in protein amino acids will lead to variations in their heat of combustion. Again, heat of combustion of rice protein was found to be about 20% higher than that of potatoes and different energy factors should be used. Besides, digestibility fiber content of grain depends on how it is milled which in turn affect their available energy content. Energy conversion factors (ECF) for AGFS and ASFS have been recognized along with some current energy profiles of food energy substrates (Mullan, 2006; ACP, 2017).

Current estimations of total energy requirement for infants younger than two years are based on age, amount and type of feeding (breastfed and non-breastfed) ingested, fat content and gender (Dewey and Brown 2003; Rarback, 2011). Dependency of infant dietary energy requirement on the above factors results in development of a range of recommended calorie intake. At present, estimated energy to be provided by complementary foods for infants with "average" breast milk intake in developing countries are 200 kcal a day for infants aged 6 to

8 months, 300 kcal for 9 to 11 months and 550k kcal for 12 to 23 months. These estimates differ in industrialized countries due to variations in the above factors which amount to 130, 310 and 550 kcal a day, respectively (WHO 2002; PAHO/WHO, 2003). Various complementary studies have confirmed that these energy variations could be met through intake of energy giving macronutrient fortified foods and timely introduction of age appropriate complementary foods along with appropriate feeding practices. The aim of this study is to compare the calculated dietary energy content and consumer acceptability of complementary puddings from *ede-ocha* and *ede-cocoindia*.

MATERIALS AND METHODS

Sources of raw materials: Both cocoyam varieties used in this study were procured from the cocoyam programme of the National Root Crops Research Institute (NRCRI), Umudike. Soybean, firm ripe plantain and ingredients used were purchased from Urbani main market in Umuahia, Abia State, Nigeria.

Preparation of cocoyam and ripe plantain pastes: Both pastes were prepared as shown in Figure 1.

Preparation of sprouted soybeans paste: Sprouting of soybean was carried out according to Okwunodulu and Okwunodulu (2016) while the paste was prepared by milling with kitchen blender (Figure1).

Production of complementary puddings: All the complementary pudding samples were formulated (Figure 1) with same quantity of seasonings (Table, 1) as samples 101 (100% *ede-ocha*), 102 (90% *ede-ocha*, 10% soybean), 103 (25% *ede-ocha*, 65% plantain, 10% soybean), 104 (45% *ede-ocha*, 45% plantain, 10% soybean) 105 (100% *ede-cocoindia*), 106 (90% *ede-cocoindia*, 10% soybean), 107 (25% *ede-cocoindia*, 65% plantain, 10% soybean) and 108 (45% *ede-cocoindia*, 45% plantain, 10% soybean). Each sample was wrapped in banana leaves, boiled separately for 30min and allowed to cool to room temperature before the analyses.

Table 1: Seasonings and their Quantities used for Preparation of the Pudding Samples

Ingredients	Quantity
Cocoyam, plantain and soybean Paste	600 g
Onion	25 g
Water	150 ml
Palm oil	120 ml
Crayfish	120 g
Salt	1.5 g

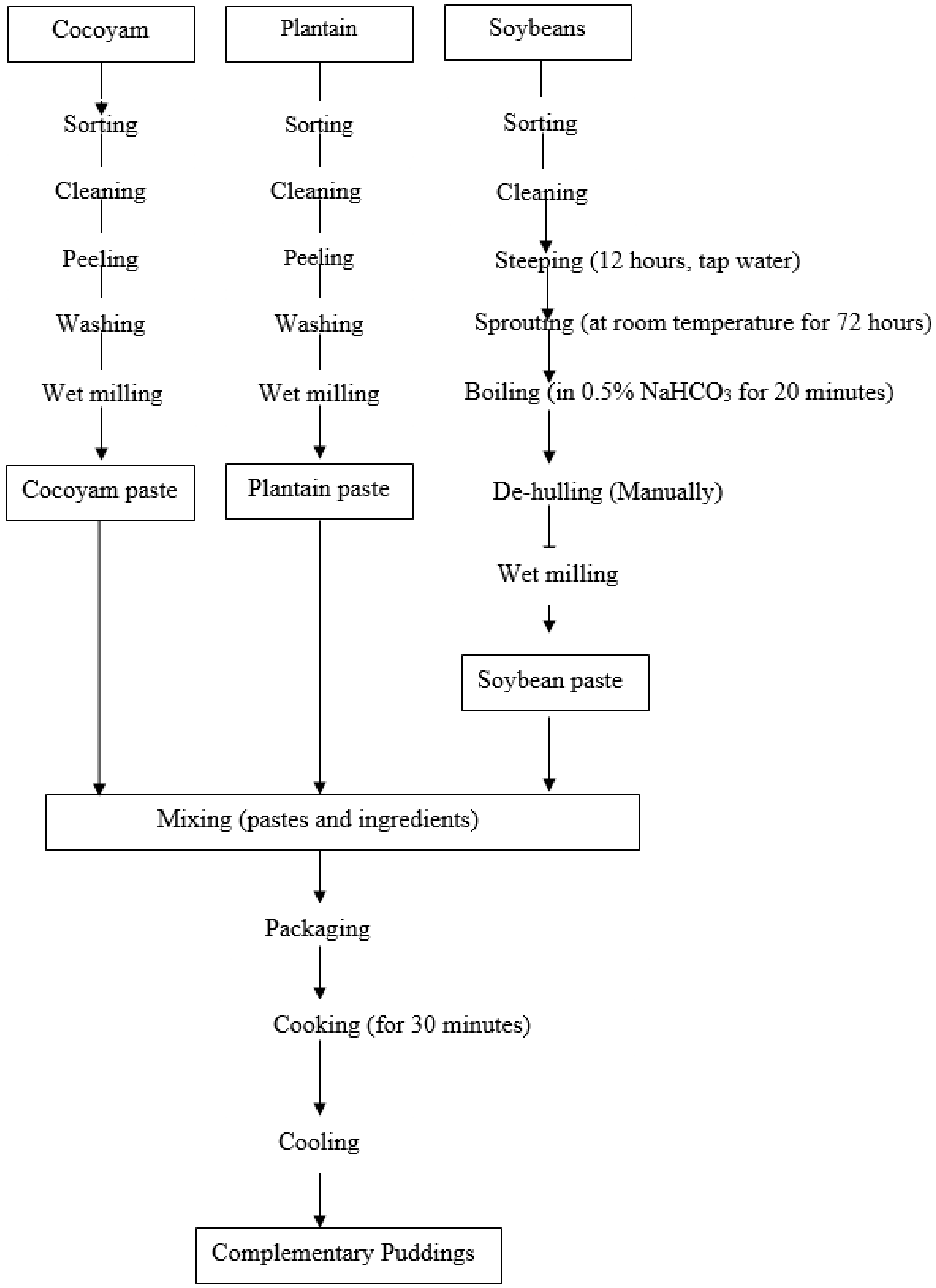

Figure 1: Flow Chart for Preparation of Complementary Pudding Samples

Analyses: Crude fiber and protein were determined according to Onwuka (2005) while fat was by soxhlet extraction method. Carbohydrate content was by difference.

Calorific value: The calorific values of the puddings were calculated by Atwater general factor system (AGFS) and Atwater specific factor system (ASFS) using food energy yielding substrates.

Statistical analyses: Data obtained from both energy yielding substrates and calculated energy profiles were subjected to analysis of variance (ANOVA). A completely randomized design using SPSS version 22 for personal computer was used to analyze the data. Means were separated using Duncan multiple range test at 95% confidence level ($p<0.05$).

RESULTS AND DISCUSSION

The results of major food dietary energy-substrates of the puddings from both varieties of cocoyam are presented in Table 2.

Crude protein (CP): The CP values obtained from puddings prepared with *ede-ocha* varied from 3.35% in sample 101 (100% *ede-ocha*) to 4.51% in sample 102 (90% *ede-ocha*, 10% soybean). The values were higher than those reported by Adepoju and Etukumoh (2014) and Olapade *et al*. (2015), but in agreement with those of Olapade *et al*. (2015 and Islamiyat *et al*. (2016). The difference could be attributed to cocoyam variety used and inclusion of soybean, a protein rich legume (Iwe, 2003) and confirmed the report of Olayiwola *et al*. (2013) that cocoyam does not have substantial amount of crude protein. Crude proteins differed significantly ($p<0.05$) in *ede-ocha* puddings except between samples 103 (25% *ede-ocha*, 65% plantain, 10% soybean) and 104 (45% *ede-ocha*, 45% plantain, 10% soybean) which were similar.

Crude protein values obtained from *ede-cocoindia* puddings was highest (4.29%) in sample 106 (90% *ede-cocoindia*, 10% soybean) and lowest (3.22%) in sample 105 (100% *ede-cocoindia*). There was significant difference ($p<0.05$) between all the samples except between samples 107 (25% *ede-cocoindia*, 65% plantain, 10% soybean) and 108 (45% *ede-cocoindia*, 45% plantain, 10% soybean) which were similar. Higher protein value (4.51%) of sample 102 (90% *ede-ocha*, 10% soybean) than 4.29% from its counterpart sample 106 (90% *ede-cocoindia*, 10% soybean) could be due to variety. This result is validated by significant ($p<0.05$) higher (3.35%) protein content of sample 101 (100% *ede-ocha*) than 3.22% from 105 (100% *ede-cocoindia*). Besides, Slavin and Carlson (2014) reported that protein has an inverse correlation with carbohydrate and *ede cocoindia* puddings were generally higher in carbohydrate than their counterpart *ede-ocha* (Table 2). Therefore, protein content of the pudding can be enhanced with inclusion of soybean or other protein-rich food in the formulation.

Aside from energy, protein is crucial for regulation and maintenance of infants’ and young children’s body. The CP range obtained in this study is liable to prevent marasmus and kwashiorkor as well as help in meeting the recommended protein content for complementary foods of 13g/d for infants aged from 0 to 2years (Byrd-Bredbenner *et al*., 2013) by consuming between 300 to 400g/d of the pudding samples. This is possible considering infant stomach capacity of 200ml (Uwaegbute, 2008). Therefore, puddings from both cocoyam varieties are good sources of crude protein and could meet a reasonable percent of protein RDI (NFH, 2001).

Table 2: Dietary energy substrates and calculated dietary energy content of the pudding samples

Samples	CP	CFt	CF	CHO	Energy Factor Conversion			
					AGFS		ASFS	
					Kj/g	Kcal/g	Kcal/g	Kj/g
101	3.35^{a} ±0.01	0.95^{f}± 0.01	1.94^{a}± 0.01	35.46^{e}± 0.01	686.75^{h} ± 0.08	162.09^{h}±o.oo	704.17^{h}±0.04	167.99 ±0.07^{h}
102	±.51^{a}+ 0.28	1.82^{a}± 0.02	1.98^{a}± 0.02	34.34^{b}± 0.01	715.96 ± 0 .03	169.57^{g}± 0.00	729.824^{g}±0.0 0	174.14±0.02^{g}
103	4.47^{b}± 0.02	1.82^{a}± 0.01	2.46^{a}± 0.01	34.52^{g}± 0.01	724.15^{g} ± 0 .02^{f}	171.20^{f}± 0.00	756.72^{e}±0.13	180.55±0.03^{e}
104	4.45^{b}± 0.02	1.84^{a}± 0.01	2.41^{b}± 0.01	34.65^{f}± 0.01	726.30^{e} ±0 .02	171.70^{e}±0.14	742.33^{f}±0.01	176.73±0.03^{f}
105	3.22^{f}± 0.01	1.21^{a}± 0.01	1.64^{g}± 0.01	39.28^{a}± 0.03	754.64^{d} ± 0 .02	178.10^{d}±0.00	771.25^{d}±0.12	183.99±0.06^{d}
106	4.29^{c}± 0.01	1.36^{d}± 0.03	1.77^{f}± 0.01	38.99^{b}± 0.01	773.01^{a} ±0 .01	182.48^{a}±0.13	786.21^{a}±0.14	187.57±0.06^{a}
107	4.20^{a}± 0.01	1.43^{e}± 0.01	2.10^{c}± 0.01	37.86^{d}± 0.03	758.12^{c} ±- .02	179.04^{c}±0.13	774.09^{c}±0.01	184.68±0.07^{c}
108	4.17^{d}+ 0.01	1.49^{b}+ 0.02	2.11^{c}+ 0.02	38.03^{c}+ 0,01	762.69 +.42^{b}	180.13^{b}+0.014	778.89^{b}±0.01	186.16+.04^{b}

Values are mean triplicate determinations ± standard deviation. Samples 101 = 100% ede-ocha, 102 = 90% ede-ocha, 10% soybean, 103 = 25% ede-ocha, 65% plantain, 10% soybean, 104 = 45% ede-ocha, 45% plantain, 10% soybean, 105 = 100% ede-cocoindia, 106 = 90% ede-cocoindia, 10% soybean, 107 = 25% ede-cocoindia , 65% plantain, 10% soybean, and 108 = 45% ede-cocoindia, 45% plantain, 10% soybean, CP is crude protein, CFt is crude fat, CF is crude fiber, CHO is carbohydrate, AGFS is calculated energy using Atwater general factor system and ASFS is calculated energy using Atwater specific factor system.

Fat: Fat content of *ede-ocha* puddings was highest (1.84%) in sample 104 (45% *ede-ocha*, 45% plantain, 10% soybean) and lowest (0.95%) in sample 101 (100% *ede-ocha*). There was significant difference (p<0.05) between all the samples except in 101 (100% *ede-ocha*). Similarly, fat content of *ede-cocoindia* pudding samples increased from 1.21% in sample 105 (100% *ede-cocoindia*) to 1.49% in sample 108 (45% *ede-cocoindia*, 45% plantain and 10% soybean) with significant difference (p<0.05) between all the samples.

Fat content ranges obtained from both samples were within 1.63 to 2.37% obtained by Olapade *et al*. (2015) from plantain and cowpea complementary food formulation. Significant (p<0.05) higher (1.84%) fat content of sample 104 (45% *ede-ocha*, 45% plantain, 10% soybean) than 1.49% from 108 (45% *ede-cocoindia*, 45% plantain and 10% soybean) may mean higher oil absorption capacity probably due to higher fiber content. However, linear increase in crude fat with increase in sprouted soybean paste observed in both samples conformed with the reports of Ojinnaka *et al*. (2013) and Ogundele *et al*. (2015) and could be attributed to high oil content of soybeans (Iwe, 2003). Fat contribution by soybean in this study agrees with the FAO/WHO (1998) recommendations that vegetable oils be included in foods meant for infants and children to increase the energy density and transport of fat-soluble vitamins. Besides, soy products are good source of energy to enhance general intake of nutrient (WHO/UNICEF, 1998) and for infants' growth and brain development especially in the first 2 years of life.

Crude fiber (CF): The CF content of *ede-ocha* puddings ranged from 1.94% in sample 101 (100% *ede-ocha*) to 2.46% in sample 103 (25% *ede-ocha*, 65% plantain, 10% soybean) with significant differences (p<0.05) between all the samples except between samples 101 (100% *ede-ocha*) and 102 (90% *ede-ocha*, 10% soybean). Crude fiber content of *ede-cocoindia* puddings increased from 1.64% in sample 105 (100% *ede-cocoindia*) to 2.11% in sample 108 (45% *ede-cocoindia*, 45 %plantain and 10% soybean) with significant differences (p<0.05) between only samples 105 (100% *ede-cocoindia*) and 106 (90% *ede-cocoindia*, 10% soybean) which may be due to differences in their formulations. Significant (p<0.05) higher (2.46%) fiber content of sample 103 (25% *ede-ocha*, 65% plantain, 10% soybean) than 2.10% from its counterpart sample 107 (25% *ede-cocoindia* , 65% plantain, 10% soybean) could be traced to variety as could be seen in significant (0<0.05) higher fiber content (1.94%) of sample 101 (100% *ede-ocha*) than 1.64% from sample 105 (100% *ede-cocoindia*).

Crude fiber values obtained from both samples of cocoyam varieties were lower than 2.54% obtained by Olayiwola *et al*. (2013) from pudding prepared with cocoyam flour probably due to variety and drying. However, these values were slightly higher than the fiber contents (0.04% to 2.27%) of complementary food produced from sorghum, plantain and soybean blends by Onoja *et al*. (2014). The variations could be attributed to difference in cocoyam variety and fiber contributions of plantain and soybean. Esteves *et al*. (2010) had reported that soybean contains crude fiber, likewise plantain with dietary fiber content of 2.3% (Islamiyat *et al*., 2016). Dietary fiber is the indigestible component of plant material (Ogundele, *et al*., 2015) which lowers serum cholesterol, obesity, enhances intestinal health, (Rehinan *et al*., 2014) normalizes bowl movements, prevents constipation and helps control blood sugar (SFGATE, 2017) in infants and young children. Consumption of 203g to 258g of *ede-ocha* and 237g to 305g of *ede-cocoindia* puddings will meet fiber RDI of 5g/d (SFGATE, 2017). Both puddings are good sources of fiber.

Carbohydrate: Carbohydrate content of *ede-ocha* puddings was highest (35.46%) in sample 101 (100% *ede-ocha*) and lowest (34.34%) in sample 102 (90% *ede-ocha*, 10% soybean) with significant difference (p<0.05) between all the samples. Carbohydrate content of *ede-cocoindia* puddings increased from 37.86% to 39.28% respectively from samples 107 (25% *ede-cocoindia*, 65% plantain and 10% soybean) and 105 (100% *ede-cocoindia*) with significant difference (p<0.05) between all the samples. Carbohydrate values obtained from both pudding samples were within the range (30.10 to 87.20%) reported for complementary food from sorghum, plantain and soybean blends by Onoja *et al*. (2014) but above 8.96 to 16.87% obtained by Adepoju and Etukumoh (2014). Significant higher carbohydrate content of *ede-cocoindia* puddings (39.28%) than (35.46%) from *ede-ocha* could be due to variety. None of the pudding of both cocoyam varieties met the recommended daily intake of carbohydrates per serving, but consumption of 150 to 280 g/d will meet the RDI (60 to 95g/d) for infants aged between 6 to 12 months (Byrd-Bredbenner *et al*., 2013).

Dietary energy profiles of the pudding samples: Results of dietary energy content of the puddings from both varieties of cocoyam calculated with Atwater general factor system (AGFS) and Atwater specific factor system (ASFS) are presented in Table 2

Dietary energy calculated with ASFS in this study was significantly (p<0.05) higher than that from AGFS which agrees with the report that ASFS introduces major difference which are more than 3-fold for some foods. This also attested to the report that ASFS is superior to AGFS as it takes into account different energy content of foods based on their different nutrient composition instead of average used by AGFS (ACP, 2017). Dietary energy content of all puddings samples from both cocoyam varieties was high which affirmed the report that cocoyam has substantial amounts and digestible crude protein, (Green, 2003; Chukwu *et al*., 2008), dietary fiber (Niba, 2003), highly digestible starch because of their small size starch granules, (Ojinnaka *et al*., 2009) and high carbohydrates (Akpan and Umoh, 2004). Besides**,** the nutrient densities are an index of energy content of food (BNF, 2004; Mullan, 2006)**.** Ijeh *et al.* (2010) earlier reported that high carbohydrate in diets provides energy needed to do work. Dietary energy superiority of all *ede-cocoindia* puddings over their *ede-ocha* counterparts could stem from their higher carbohydrate and fat both of which had 97% coefficient of digestibility than protein. Though protein and crude fiber content of *ede-ocha* were higher than their corresponding *ede-cocoindia* puddings, both had lower coefficient and will result in lower energy value. There was significant (p<0.05) difference between the dietary energy content of both cocoyam varieties which may be attributed to their significant (p<0.05) nutrient difference (Table 2). Varietal difference may contribute to their energy difference too. Despite lower dietary energy content of *ede-ocha* puddings than *ede-cocoindia*, all the pudding samples were good sources of dietary energy and micronutrients which validated the report of McClintock (2004).

Consumers' Acceptability: Table 3 shows the sensory scores of the puddings from different blends of two cocoyam varieties. The attributes evaluated includes appearance, flavor, taste, texture and general acceptability.

Appearance: Appearance ratings of the *ede-ocha* puddings ranged from 4.55 to 6.75 with sample 102 (90% cocoyam, 10% soybean) having the highest score While 103 (25% *ede-ocha*, 65% plantain, 10% soybean) the least. The *ede-cocoidia* puddings ranged from 4.95 to 6.45 with sample 105 (100% *ede-cocoindia*) having the highest score while sample 107 (25% *ede-cocoindia*, 65% plantain, 10% soybean) the least. There was no significant difference (p<0.05) in appearance ratings between samples 101 (100% *ede-ocha*) and 105 (100% *ede-cocoyam*). Significant (p< 0.05) higher difference (6.75) between sample 102 (90% *ede-ocha*, 10% soybean) than it counterpart sample 106 (90% cocoyam, 10% soybean) could be ascribed to variety and inter-component interactive effects (Kilara and Sharkasi, 1986). Lower carbohydrate content of all *ede-ocha* puddings than their *ede-cocoindia* counterparts may have contributed too. Carbohydrates impact brown colour in foods when heated (Slavin and Carlson, 2014). Same trend holds with other counterpart samples except in 103 (25% *ede-ocha*, 65% plantain, 10% soybean) and 107 (25% *ede-cocoindia*, 65% plantain, 10% soybean). This result implies that *ede-ocha* puddings had a better acceptable colour as physical appearance is an important sensory feature of any food product as it influences

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acceptability. Consumers eat with their eyes and use the appearance of foods to predict quality (Oluwole, 2009).

Table 3: Sensory scores of puddings prepared from two varieties of cocoyam blended with plantain and soybean

Samples	Appearance	Flavour	Taste	Texture	General acceptability
101	$6.40^{ab} \pm 1.60$	$6.70^{b} \pm 0.80$	$6.60^{b} \pm 1.70$	$6.05^{ab} \pm 1.19$	$6.85^{abc} \pm 0.99$
102	$6.75^{a} \pm 1.45$	$4.90^{d} \pm 1.83$	$4.40^{d} \pm 2.14$	$6.25^{ab} \pm 1.12$	$6.00^{d} \pm 1.45$
103	$4.55^{d} \pm 1.61$	$6.80^{b} \pm 1.32$	$7.35^{ab} \pm 1.63$	$5.70^{b} \pm 2.11$	$6.70^{bcd} \pm 1.66$
104	$6.25^{ab} \pm 1.02$	$7.75^{a} \pm 1.02$	$7.90^{a} \pm 1.02$	$6.60^{ab} \pm 1.05$	$7.50^{a} \pm 0.76$
105	$6.45^{ab} \pm 1.23$	$5.75^{c} \pm 1.12$	$6.75^{b} \pm 0.91$	$6.80^{a} \pm 0.77$	$6.65^{bcd} \pm 0.59$
106	$6.35^{ab} \pm 0.81$	$5.20^{cd} \pm 1.40$	$5.70^{c} \pm 1.34$	$6.80^{a} \pm 1.11$	$6.10^{cd} \pm 0.85$
107	$4.95^{cd} \pm 1.57$	$6.75^{b} \pm 1.12$	$6.80^{b} \pm 1.06$	$6.00^{ab} \pm 1.56$	$6.60^{bcd} \pm 1.39$
108	$5.50^{bc} \pm 1.91$	$6.60^{b} \pm 1.10$	$7.30^{ab} \pm 1.08$	$6.50^{ab} \pm 1.85$	$7.20^{ab} \pm 1.06$

***a-d**: Values are Means ± Standard deviations of duplicate determinations. Mean values in same column with different superscripts are significantly different (P<0.05). Samples 101-105 are produced from ede ocha and samples 105-108 from ede cocoindia. 101 = 100% ede-ocha, 102 = 90% ede-ocha, 10% soybean, 103 = 25%ede-ocha, 65% plantain, 10% soybean, 104 = 45% ede-ocha, 45% plantain, 10% soybean, 105 = 100% ede-cocoindia, 106 = 90% ede-cocoindia, 10% soybean, 107 = 25% ede-cocoindia, 65% plantain, 10% soybean, 108 = 45% ede-cocoindia, 45% plantain, 10% soybean.*

Flavour: Flavour of *ede-ocha* puddings ranged from 4.90 in sample 102 (90% *ede-ocha*, 10% soybean) to 7.75 in sample 104 (45% *ede-ocha*, 45% plantain, 10% soybean) with significant difference between only samples 101 (100% *ede-ocha*) and 103 (25% *ede-ocha*, 65% plantain, 10% soybean). Similarly, ede-*cocoindia* puddings ranged from 5.75 in sample 105 (100% *ede-cocoindia*) to 6.75 in sample 107 (25% *ede-cocoindia*, 65% plantain, 10% soybean). Only samples 107 (25% *ede-cocoindia*, 65% plantain, 10% soybean) and 108 (45% *ede-cocoindia*, 45% plantain, 10%) soybean were similar. Higher significant (p<0.05) flavour rating (7.75) of sample 104 (45% *ede-ocha*, 45% plantain, 10% soybean) than its counterpart sample 108 (45% *ede-cocoindia*, 45% plantain, 10% soybean) may be ascribed to variety as well as inter-component interactions (Kilara and Sharkasi, 1986) within the sample. Besides, flavor rating of sample 101 (100%*ede-ocha*) was significantly (p<0.05) higher than that of sample 105 (100% *ede-cocoindia*). Flavour is the sensory impression of a food or other substance and is determined mainly by the chemical senses of taste and smell (Science of Cooking, 2018). The *ede-ocha* puddings may have better taste and smell than *ede-cocoindia* puddings and therefore very much preferred.

Taste: There was no significant (p<0.05) taste different between all the *ede-ocha* puddings which increased from 4.40 in sample 102 (90% *ede-ocha*, 10% soybean) to 7.90 in sample

104 (45% *ede-oocha* 45% plantain, 10% soybean). Significant (p>0.05) difference only exist between samples 105 (100% *ede-cocoindia*) and 107 (25% *ede-cocoindia*, 65% plantain, 10% soybean) in *ede-cocoindia* puddings which also increased from 5.70 in sample 106 (90% *ede-cocoindia*, 10% soybean) to 6.80 in sample 107 (25% *ede-cocoindia*, 65% plantain, 10% soybean). Higher taste rating of sample 104 (45% *ede-ocha*, 45% plantain, 10% soybean) than its counterpart sample 108 (45% *ede-cocoindia*, 45% plantain, 10% soybean) with 7.30 rating could be credited to variety as well as component interactive effects. Taste of food is limited by sweet, sour, bitter, salty, umami and other basic taste (Science of Cooking, 2018) which may mean that component interactions in *ede-ocha* puddings may have favoured taste than in *ede-cocoindia* puddings.

Texture: Texture is very vital in a complementary food as it will determine the amount of food an infant would consume since they can only swallow more smooth puddings than coarse one. Texture ratings of *ede-ocha* puddings increased from 5.70 in sample 102 (90% *ede-ocha*, 10% soybean) to 6.60 in 104 (45% *ede-ocha*, 45% plantain, 10% soybean). Sample 102 (90% *ede-ocha*, 10% soybean) was similar to 104 (45% *ede-ocha*, 45% plantain, 10% soybean). The texture of *ede-cocoindia* puddings ranged from 6.00 in sample 107 (25% *ede-cocoindia*, 65% plantain, 10% soybean).to 6.80 in samples 105 (100% *ede-cocoindia*) and 106 (90% *ede-cocoindia*, 10% soybean). Samples 105 (100% *ede-cocoindia*) and 106 (90% cocoyam, 10% soybean) had no significant difference (p<0.05) as well as samples 107 (25% *ede-cocoindia*, 45% plantain, 10% soybean) and 108 (45% *ede-cocoindia*, 45% plantain, 10% soybean). There was significant (p<0.05) higher (6.80) textural rating of samples 105 (100% *ede-cocoindia*) and 106 (90% *ede-cocoindia*, 10% soybean) than their counterparts samples 101 (100% *ede-ocha*) and 102 (90% *ede-ocha*, 10% soybean) with respective ratings of 6.05 and 6.25.The difference could be traced to significant (p<0.05) higher carbohydrate content of all *ede-cocoindia* puddings than their counterparts *ede-ocha* puddings probably due to varietal difference. Carbohydrates impact some functional properties like viscosity, texture, browning and body in foods (Slavin and Carlson, 2014). Higher carbohydrate content of *ede-cocoindia* may have been responsible for their higher textural preference by the panels.

General Acceptability: There was significant (p<0.05) general acceptability difference between all the *ede-ocha* puddings which increased from 6.00 in sample 102 (90% *ede-ocha*, 10% soybean) to 7.50 in sample 104 (45% *ede-ocha*, 45% plantain, 10% soybean). Similarly, acceptability of *ede-cocoindia* puddings increased from 6.10 in sample 106 (90% *ede-cocoindia*, 10% soybean) to 7.20 in sample 108 (45% *ede-cocoidia*, 45% plantain, 10% soybean). All the samples were significantly (p<0.05) different except between samples 105 (100% *ede-cocoindia*) and 107 (25% *ede-cocoindia*, 45% plantain, 10% soybean). Higher acceptability level (7.50) of sample 104 (45% *ede-ocha*, 45% plantain, 10% soybean) than 7.20 from its counterpart sample 108 (45% *ede-cocoindia*, 45% plantain, 10% soybean) could due to variety and level of inter-component interactions within each sample (Kilara and Sharkasi, 1986). In addition, general acceptability depends on combination of all other sensory parameters of which any product with maximum acceptability levels in most of the attributes will have maximum overall acceptability (Oluwole, 2009). The *ede-ocha* puddings had maximum score in all the attributes mostly from sample 104 (45% *ede-ocha*, 45% plantain, 10% soybean) except in texture.

Highest rating of sample 104 (45% *ede-ocha*, 45% plantain, 10% soybean) than all the pudding samples of both cocoyam varieties might be due to higher values of taste (7.90) and flavour (7.75) which probably could mean that inter-component interactions may have enhanced its flavour than other samples. Conversely, least general acceptability level (6.00) of sample 102 (90% *ede-ocha*, 10% soybean) could be as a result of lowest flavour (4.90) and taste (4.40) among all the pudding samples which translate to dislike slightly in the hedonic scale. Both results attested the support of Ojinnaka and Nnorom (2015) that flavour of a food ultimately determines its acceptance or rejection even though its appearance evokes the initial response.

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CONCLUSION

Both cocoyam varieties are potential complementary pudding candidates compatible to firm ripe plantain and sprouted soybean pastes in enhancing acceptability, but *ede-ocha* variety was better than *ede-cocoyam*. The *ede-ocha* pudding with 45% cocoyam, 45% plantain, 10% soybean blends were the most acceptable which ranked between like moderately to like very much in the 9-point Hedonic scale. Though the energy content of puddings from *ede-cocoindia* was higher than that of *ede-ocha,* both varieties are good sources of energy capable of meeting the energy requirements of complementary food for infants aged between 6 months and 2 years. Their puddings will prevent weaning deficiency most especially protein-energy deficiency which results in marasmus, a severe limit of physical growth, mental and intellectual capabilities in infants. As good sources of micronutrients, the puddings will prevent hidden hunger while meeting the energy requirements of fast growing and active infants and toddlers that require plenty of energy. The ASFS is better in evaluating dietary energy content of foods as attested by the superiority of its results over AGFS in this study.

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