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Formulation of Breakfast Porridges from Three Nigerian Legumes-*Afzelia africana* (Counterwood Seed), *Detarium microcarpium* (Tallow Seed) and *Sphenostylis stenocarpa* (African Yambean Seed) Blended with Corn Flour: Their Nutrient Composition and Sensory Evaluation

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Abstract: In this study breakfast porridges were formulated based on three indigenous Nigerian legumes-*Afzelia africana*-AA, (Counterwood seed), *Detarium microcarpium*-DT (Tallow seed) and *Sphenostylis stenocarpa*-SS, (African Yam bean). The food items were processed into flour using the traditional methods. The flours were blended with corn and made into porridges: CAA (corn and *Afzelia africana*), CDM (corn and *Detarium microcarpium*) and CSS (corn and *Sphenostylis stenocarpa*) flours. The nutrients composition of the porridges was determined using standard methods and sensory evaluation was conducted using nine point Hedonic scale. Data was analyzed using descriptive statistics and ANOVA. The result revealed that the crude protein content of CSS (3.30%) was significantly higher ($p<0.05$) than CAA (2.02%) and CDM (2.55%). The CSS (3.21%) also had significant ($p<0.05$) higher fat than CAA (2.56%) and CDM (2.42%); CDM (1.96%) had significant ($p<0.05$) higher ash than CAA (1.65%) and CSS (1.52%). The breakfast porridge CDM (3.47%) contained significant ($p<0.05$) higher crude fibre than CAA (1.32%) and CSS (2.50%), while CAA (92.45%) had significant ($p<0.05$) higher carbohydrate content than CDM (89.60%) and CSS (89.47%). The calcium content of CAA (7.22 mg) was significantly higher at ($p<0.05$) than CDM (5.23 mg) and CSS (5.40 mg); CSS (38.30 RE) contained significant ($p<0.05$) higher beta carotene than CAA (12.80 RE) and CDM (9.28 RE); CAA (12.03 mg) contained significant ($p<0.05$) higher vitamin B2 than CDM (3.27 mg) and CSS (3.38 mg). These porridges contained considerable amount of nutrients. However, CAA porridge was more acceptable in terms of colour, taste and general acceptability compared to CSS and CDM.

Key words: Breakfast porridges, nutrient composition, sensory evaluation

INTRODUCTION

Leguminous foods that are high in water soluble non-starch polysaccharides (SNSP) such as guar gum have received wide spread attention as dietary agents that modulates gastrointestinal functions as well as lipid and carbohydrate metabolism. Studies in this area are of great importance in evaluating the role of SNSP in the aetiology and treatment of diseases such as diabetes mellitus and cardiovascular disease (Onyechi and Nwachi, 2010; Onyechi *et al*., 1998; Ellis, 1994) Studies have indicated that these polysaccharides when incorporated into starchy foods and glucose drink, attenuate the postprandial rise in blood glucose and insulin concentration in healthy and diabetic subjects (Ellis *et al*., 1991; Onyechi *et al*., 1998; Onyechi and Nwachi, 2010).

In the Southeastern Nigeria there are numerous plant foods like, *Afzelia Africana*, (AA) *Detarium microcarpium*, *(*DT), *Sphenostylis stenocarpa* (SS) that are used traditionally as thickening agents for soups. These foods increase the viscosity of liquid foods when added as low-moisture flours. This thickening effect could be caused by the presence of starch and/or soluble non-starch polysaccharide (SNSP). Preliminary analysis of these foods in powdered form showed that they contained significant amounts of NSP, the major fractions of which were SNSPs (Bell *et al*., 1993; Onyechi, 1995; Ene-Obong and Carnovale, 1992). These foods have been used to formulate diabetic bread (Onweluzo *et al*., 1999; Onyechi *et al*., 1998; Onyechi and Nwachi, 2010) and diabetic biscuits and muffins (Onyechi *et al*., 2013). Other foods include diabetic finger millet (Shobana, 2007).

The objective of the present study was to formulate acceptable breakfast porridges using legumes that are locally available that will be acceptable to urban diabetics in Nigeria. The flours of *Afzelia Africana*, *Detarium microcarpium* and *Sphenostylis stenocarpa* were selected and incorporated into corn flour to produce breakfast porridges. The nutrient analysis, sensory evaluation and acceptability of the porridges were studied.

Background information of the foods

***Afzelia africana*:** Is known as counterwood tree in English, Akparata in the southeastern Nigeria among

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the Ibo, Kawo in the northern Nigeria among the Hausas and Apa in the southern Nigeria among the Yoruba. *Afzelia africana* belongs to the family leguminosea and sub-family caesalpinaceae. The plants are largely cultivated in the savannah, fringing forest and the drier parts of the forest regions of Africa (Aclaned, 1980; Ikhajiagbe *et al*., 2009). The seeds are black, smooth, ellipsoid or oblong and shiny. The seeds of Afzelia are very hard and woody, nearly black and bursting violently to discharge the seeds (Hutchinson and Dalziel, 1931) having waxy orange cup-like structure at the base. They are used in Nigeria generally as soup thickening ingredient (Ene-Obong, 2001; Onyechi, 1998). The seeds are edible and have high medicinal values (Okeke and Obizoba, 1986).

***Detarium microcarpium*:** Is a leguminous plant belonging to the subdivision Caesalpinoideae (Balogun and Fetuga, 1986) and it is considered to be synonymous with *Detarium senegalense* (Food and Agriculture Organization, FAO, 1988). Each pod produced by the plant contains one seed, which is usually rounded, oval or flattened and about 40 mm in diameter (FAO, 1988). *Detarium* is known as Tallow tree in English, known as ofor in the South Eastern part of Nigeria among the Ibo tribe and Taura in the Northern Nigeria (Hausa).The legume grows predominantly in West Africa, Chad and Sudan.

***Sphenostylis stenocarpa*:** Is known as African yam bean in English language, known as Ijiriji in Southeastern Nigeria among Ibo tribe. It is known as Odudu or Okpodudu in SouthEastern Nigeria. It is a leguminous crop of the family of leguminosea grown in tropical regions of Africa particularly in Cameroon, Cote d'ivoire, Volta region of Ghana, Nigeria and Togo (Okeke and Obizoba, 1986). It produces rounded or truncated seeds, which show considerable variation in size and colour, varying from creamy-white or brownish yellow to dark brown (Kouyate and Van Damme, 2006). The pods are long and up to 50cm long. Highest yields are obtained in mixed planting with yams, maize, okro and other vegetables (Okorie and Amachi, 2003). Tropical African yam bean is an under-utilized hardy legume.

MATERIALS AND METHODS

Source of material: Indigenous legumes (*Afzelia africana*, *Detarium microcarpium* and *Sphenostylis stenocarpa* seeds and the cereal (*Zea mays*) were purchased from local market in the Southeastern part of Nigeria.

Processing of raw materials into flour

***Afzelia africana* flour:** Fifteen kilograms of *Afzelia africana* was picked and cleaned to remove dirt. The seeds were roasted in aluminum stainless steel pan for 20 min at a temperature of 120°C before dehulling, using a hammer to crack open the endocarp of the seeds. These seeds were fermented for 48 h. The water used for fermentation was changed every 8 h for the 48 h period. The fermented seeds were sun dried for a week and milled into fine flour.

***Detarium microcarpium* flour:** Twenty kilograms of *Detarium microcarpium* was picked and cleaned to remove dirt. The seeds were boiled for 25 min at the temperature of 80°C dehulled manually by using a hammer to crack open the endocarp. The dehulled seeds were sun dried for a week and milled into fine flour.

***Sphenostylis stenocarpa* flour:** Fifteen kilograms of *Sphenostylis stenocarpa* was picked and cleaned to remove dirt. The seeds were roasted in a stainless steel pan for 10 min at the temperature of 90°C. The seeds were allowed to cool before milling into fine flour.

***Zea mays* (corn) flour:** Five kilograms of corn (*Zea mays)* was picked, cleaned and washed to remove dirt. The seeds were milled into fine flour and blended with the legumes for digestibility (Hernadez *et al*., 2007; FAO, 1993, 1992).

Formulation of the breakfast porridges: Three breakfast porridges which contained 50 g available carbohydrate per serving was formulated using *Afzelia africana* (AA), *Detarium microcarpium* (DM) and *Sphenostylis stenocarpa* (SS) seed flour, blended with corn to provide the same amount of carbohydrate for comparison. Forty grams of the available carbohydrate was provided from the cereal grain (corn), while 10 g was from the legumes, *Afzelia africana* (AA), *Detarium microcarpium* (DM) and *Sphenostylis stenocarpa* (SS). Thus, 114 g of corn was combined with 38 g of AA, 55 g of DT and 37 g of SS separately to produce CAA, CDM and CSS flour, respectively.

Chemical and physical analysis of the plant foods: The seed flours were determined for moisture by AOAC (2005) using standard hot air oven. The crude protein was determined using Micro-Kjeldahl method, (N x 5.7) (AOAC, 2005). Fat was determined using the Soxhlet extraction method (AOAC 2005). The ash content was determined. The crude fibre determination was done using AOAC (2005). The total carbohydrate content of the samples were obtained by difference (subtracting the percentages of moisture, crude protein, fat, crude fibre and ash from 100).

The vitamins Beta-carotene and vitamin B_2 (riboflavin) were determined using Pearson (1976) method of analysis. The minerals content determined were calcium, iron and zinc using standard methods. The

available carbohydrate was determined using AOAC (2005) method of analysis.

The sensory evaluation was conducted using a nine point Hedonic scale, 9 represent liked extremely, 8 liked very much, 7 liked moderately, 6 liked slightly, 5 neither liked nor disliked, 4 dislike slightly, 3 disliked moderately, 2 disliked very much and 1 disliked extremely. The organoleptic attributes evaluated were colour, flavour, texture, taste and overall acceptability of the products.

Statistical analysis: Data collected were analyzed using mean, standard deviation and analysis of Variance (ANOVA).

RESULTS

Table 1 shows the composition of the breakfast porridges made from *Afzelia africana* (AA), *Detarium microcarpium* (DM) and *Sphenostylis stenocarpa* (SS) seed flour blended with *Zea mays* (corn) seed flour.

Table 2 shows the proximate composition of the three formulated breakfast porridges based on wet weight. The moisture content of the breakfast porridges varied from 66.76-70.37% with CSS having the highest percentage moisture (70.37%). The crude protein ranged from 0.67-0.98%. The breakfast porridge CSS contained more crude protein (0.98%) than the other two breakfast porridges-CAA (0.67%) and CDM (0.78%). The fat content of the breakfast porridges differed, CSS also had the highest fat (0.95%) compared to CAA and CDM which had 0.85 and 0.74%, respectively. The breakfast porridges had varied ash values that ranged from 0.45-0.60%. CDM had the highest ash (0.60%), CAA had (0.55%) and CSS contained the least ash (0.45%). The crude fibre content of the breakfast porridges ranged from 0.44-1.06%. The breakfast porridge CDM had the highest percentage (1.06%) of crude fibre, while CAA contained the least value (0.44%). The percentages of carbohydrate of the breakfast porridges varied from 26.51-30.73%, CAA had the highest (30.73%) value, CDM had (27.40%) and CSS 26.51% had the least value.

Table 3 shows the proximate composition of the three breakfast porridges on dry weight basis. The breakfast porridges contained more nutrients on dry weight compared to the wet weight. The crude protein of the breakfast porridges ranged from 2.02 to 3.30%. CSS had significant ($p<0.05$) higher percentage of crude protein (3.30%) than CDM (2.55%) and CAA (2.02%). The fat content of the breakfast porridges differed and ranged from 2.42 to 3.21%. CSS contained significantly ($p<0.05$) higher fat (3.21%) compared to CAA (2.56%) and CDM (2.42%). The ash contents of the breakfast porridges differed; CDM had the highest percentage (1.96%), compared to 1.65% and 1.52% for CAA and CSS respectively. However, there was no significant ($p>0.05$) difference in the ash content of the breakfast porridges. The crude fibre content of the breakfast porridges ranged from 1.32-3.47%. CDM contained the highest crude fibre (3.47%), CSS (2.50%) and CAA and (1.32%). CDM was also statistically ($p<0.05$) different from CSS and CAA. The carbohydrate values of the breakfast porridges ranged from 89.47 to 92.45%. The breakfast porridge CAA contained higher carbohydrate (92.45%) compared to CDM (89.60%) and CSS (89.47%). CAA was also significantly ($p<0.05$) different from CDM and CSS.

Table 4 reveals the mineral and vitamin composition of the three breakfast porridges produced on wet basis. The calcium content of the breakfast porridges ranged from 1.60 to 2.40 mg. CAA contained the highest calcium (2.40 mg) while CDM and CSS had the same amount of calcium (1.60) each. The iron content of the breakfast porridges varied. CDM and CSS contained higher and the same amount of iron (0.87 mg) each, while CAA had (0.70 mg). The zinc values of the breakfast porridges differed from one another with CDM and CSS having higher and the same quantity (18.75 mg) each. This was

Table 1: Composition of the breakfast porridges

Breakfast porridges	Corn (g)	Legumes (g)	Water (mL)	Raw weight of the mixture (g)	Cooked weight of the porridges (g)
CAA	114	38	600	752	650
CDM	114	55	680	849	720
CSS	114	37	530	681	549

g: gram. mL: milliliter

CAA: Breakfast porridge based on corn and *Afzelia africana* flours

CDM: Breakfast porridge based on Corn and *Detarium microcarpium* flours

CSS: Breakfast porridge based on Corn and *Sphenostylis stenocarpa* flours

Table 2: Proximate composition of the three breakfast porridges/100 g on wet weight basis

Breakfast porridges	Moisture (%)	Crude protein (%)	Fat (%)	Ash (%)	Crude fibre (%)	Carbohydrate (%)
CAA	66.76±0.01	0.67±0.01	0.85±0.01	0.55±0.01	0.44±0.01	30.73±0.01
CDM	69.42±0.01	0.78±0.01	0.74±0.01	0.60±0.01	1.06±0.01	27.40±0.01
CSS	70.37±0.01	0.98±0.01	0.95±0.01	0.45±0.01	0.74±0.01	26.51±0.01

CAA: Breakfast porridge based on corn and *Afzelia africana* flours

CDM: Breakfast porridge based on Corn and *Detarium microcarpium* flours

CSS: Breakfast porridge based on Corn and *Sphenostylis stenocarpa* flours

Table 3: Proximate composition of breakfast porridges/100 g on dry matter basis

Breakfast porridges	Crude protein (%)	Fat (%)	Ash (%)	Crude fibre (%)	Carbohydrate (%)
CAA	2.02^{c}	2.56^{b}	1.65^{b}	1.32^{c}	92.45^{a}
CDM	2.55^{b}	2.42^{c}	1.96^{b}	3.47^{a}	89.60^{b}
CSS	3.30^{a}	3.21^{a}	1.52^{b}	2.50^{b}	89.47^{c}

Mean scores on the same column with different superscripts are significantly different ($p<0.05$) while those with the same superscripts are statistically the same or similar even though there may be variations in the numbers
CAA: Breakfast porridge based on corn and *Afzelia africana* flours
CDM: Breakfast porridge based on Corn and *Detarium microcarpium* flours
CSS: Breakfast porridge based on Corn and *Sphenostylis stenocarpa* flours

Table 4: Mineral and vitamin composition of the breakfast porridges/100 g on wet weight basis

Breakfast porridges	Calcium(mg)	Iron(mg)	Zinc (mg)	Beta-carotene (RE)	Vitamin B2 (mg)
CAA	2.40±0.01	0.70±0.01	18.13±0.01	2.13±0.01	4.00±0.01
CDM	1.60±0.01	0.87±0.01	18.75±0.01	1.42±0.01	1.00±0.01
CSS	1.60±0.01	0.87±0.01	18.75±0.01	5.68±0.01	1.00±0.01

Mean scores on the same column with different superscripts are significantly different ($p<0.05$) while those with the same superscripts are statistically the same or similar even though there may be variations in the numbers
CAA: Breakfast porridge based on corn and *Afzelia africana* flours
CDM: Breakfast porridge based on Corn and *Detarium microcarpium* flours
CSS: Breakfast porridge based on Corn and *Sphenostylis stenocarpa* flours

Table 5: Mineral and vitamin composition of the breakfast porridges/100 g on dry matter basis

Breakfast Porridges	Calcium (mg)	Iron (mg)	Zinc (mg)	Beta-carotene (RE)	Vitamin B2 (mg)
CAA	7.22^{a}	2.11^{b}	54.54^{c}	12.80^{b}	12.03^{a}
CDM	5.23^{b}	2.84^{a}	61.31^{b}	9.28^{c}	3.27^{b}
CSS	5.40^{b}	2.94^{a}	63.28^{a}	38.30^{a}	3.38^{b}

Mean scores on the same column with different superscripts are significantly different ($p<0.05$) while those with the same superscripts are statistically the same or similar even though there may be variations in the numbers
CAA: Breakfast porridge based on corn and *Afzelia africana* flours
CDM: Breakfast porridge based on Corn and *Detarium microcarpium* flours
CSS: Breakfast porridge based on Corn and *Sphenostylis stenocarpa* flours

Table 6: Sensory properties of the breakfast porridges (n = 25)

Breakfast porridges	Colour	Taste	Texture	General acceptability	Total scores
CAA	7.44±1.4^{a}	5.20±2.3^{a}	6.32±2.2^{a}	5.80±2.2^{a}	24.76
CDM	4.36± 1.7^{b}	4.92±2.1^{b}	5.44±1.9^{a}	3.96±1.7^{b}	18.68
CSS	4.36±2.1^{b}	4.40±2.0^{b}	5.24±2.0^{a}	4.60±2.3^{b}	18.60

Standard deviation of the samples
Mean scores on the same colums with different superscripts are significantly different ($p<0.05$) while those with the same superscripts are statistically the same or similar even though there may be variations in the numbers
CAA: Breakfast porridge based on corn and *Afzelia africana* flours
CDM: Breakfast porridge based on Corn and *Detarium microcarpium* flours
CSS: Breakfast porridge based on Corn and *Sphenostylis stenocarpa* flours

followed by CAA which had lesser zinc 18.13 mg/100 g. The beta-carotene content of the breakfast porridges ranged from 1.42-5.68RE). CSS contained higher (5.68 RE) beta-carotene than (2.13 RE) and (1.42 RE) for CAA and CDM, respectively. The breakfast porridges had different values of vitamin B2 that ranged from 1.00 to 4.00 mg/100 g. CAA contained more vitamin B2 (4.00 mg) followed by CDM and CSS that had equal values (1.00 mg) each.

Table 5 shows the mineral and vitamin composition of the breakfast porridges/100 g dry weight. The result showed that calcium content of the breakfast porridge based on CAA had statistically ($p<0.05$) higher level of calcium (7.22mg), while CDM and CSS had 5.23mg and 5.40, respectively. CAA was significantly ($p<0.05$) different from CDM and CSS. The iron content of CSS (2.94 mg) and CDM (2.84 mg) was significantly ($p<0.05$) higher compared to CAA (2.11 mg). The zinc content of the breakfast porridges ranged from 54.54 to 63.28 mg. The breakfast porridge from CSS contained the highest level of zinc (63.28 mg), followed by CDM (61.31 mg) and CAA (54.54 mg). CSS was also significantly ($p<0.05$) different from CDM and CAA in term of the zinc levels. The breakfast porridges contained varied amounts of beta-carotene that ranged from 9.28 RE to 38.30 RE. CSS had significant ($p<0.05$) higher beta-carotene (19.17 RE) than CAA (6.41 RE) and CDM (4.64 RE). The vitamin B2 content of the breakfast porridges differed. CAA had the highest level of vitamin B2 (12.03 mg) while CDM and CSS contained 3.27 mg and 3.38, respectively. CAA was significantly ($p<0.05$) different from CDM and CSS.

Sensory evaluation: The sensory evaluation showed that the colour of CAA (7.44) was significantly ($p>0.05$) different from CDM (4.36) and CSS (4.36). The breakfast porridges produced from *Afzelia africana* had higher taste value (5.20) which was significantly ($p<0.05$) different from *Detarium microcarpium* (4.92) and *Sphenostylis stenocarpa* (4.40). There was no significant difference in the texture of the three breakfast porridges. The general acceptability of CAA was (5.80) which was significantly ($p<0.05$) different from CDM (3.96) and CSS (4.60).

DISCUSSION

This study examined the nutrient composition of breakfast porridges made with three indigenous Nigeria legumes, *Afzelia africana*, *Detarium microcarpium* and *Sphenostylis stenocarpa* in combination with corn flour. The formulated breakfast porridges were based on 50 g available carbohydrate/meal. The nutrient analysis was on wet and dry weight basis/100 g. The breakfast porridges/100 g dried weight contained more protein, fat, ash, crude fibre and carbohydrate than the wet weight.

The result of the nutrient analysis showed that drying increased the protein, fat, ash, fibre and carbohydrate content of the breakfast porridges. Okeke and Obizoba (1986) indicated that loss of moisture in any given food increases nutrient density, shelf life and weight. However, the loss of weight is sometimes accompanied with loss of some volatile complex compounds such as some phytochemicals and fat soluble vitamins. Low moisture content as observed in the dry weight confers good stability or keeping quality (Edem *et al*., 2009; Ijeh *et al*., 2004). The higher protein value of the breakfast porridge from corn and *Sphenostylis stenocarpa* flours (CSS) could be attributed to the high protein content of *Sphenostylis stenocarpa*. This is in line with work done by Ene-Obong and Carnovale (1992); Marshall *et al*. (2005) and Ojiako *et al*. (2010), which showed that *Sphenostylis stenocarpa* had higher protein (21.6%) than *Afzelia africana* (20.9%) and *Detarim microcarpium* (13.9%) per 100 g. Sample of *Sphenostylis stenocarpa* porridge (CSS) also had the highest fat value when compared to the other breakfast porridge. This agrees with the result of Ejikeme *et al*. (2009). However, it does not agree with the study by Ene-Obong and Carnovale (1992), which showed that *Afzelia africana* contained higher fat than *Detarium microcarpium* and *Sphenostylis stenocarpa*/100 g. The low fat content of the products was expected because cereal and legumes store energy in form of starch rather than lipids. CDM had the highest percentage of ash compared to CAA and CSS. The porridge based on corn and *Detarium microcarpium* flours (CDM) contained higher crude fibre than corn and *Afzelia africana* (CAA) and corn and *Sphenostylis stenocarpa* (CSS). Studies have shown that *Detarium microcarpium* had higher dietary and soluble fibres than *Afzelia africana* and *Sphenostylis stenocarpa* (Ene-Obong and Carnovale, 1992; Onyechi *et al*., 1998; Akpata and Miacho, 2010).

The increases in all the micronutrients could be attributed to the fact that drying increases nutrient density of foods. However, the breakfast porridges had low calcium, iron and vitamin B2. This could be due to the degree of milling, Ene-Obong (2001) reported that cereal grains are good sources of calcium, iron and B vitamins depending on the degree of milling. The low level of calcium, iron and vitamin B2 suggested that dietary advice to consume these foods with appropriate complimentary foods should be encouraged. All the breakfast porridges contained appreciable amount of zinc and beta-carotene, although the breakfast porridge made from corn and *Sphenostylis stenocarpa* blend had higher beta-carotene value compared to the other porridges. This is contrary to several research findings that have shown that *Detarium microcarpium* contained high levels of essential elements such as sodium, potassium, magnesium, calcium, sulphur, potassium and iron (Abreu *et al*., 1998; Abreu and Relva, 2002; Umar *et al*., 2007; Akpata and Miachi, 2010). This could be attributed to the anti-nutrients like saponins, phytates and cyanides (Anhwange *et al*., 2004). It is also reported that phytates up to 1% in foods interferes with mineral availability (Anigo and Ameh, 2009). However, various heat treatments applied during preparation could have inactivated these nutrient inhibitors (Enwere, 1998). This could also explain the appreciable amount of zinc and vitamin A found in legumes especially *Sphenostylis stenocarpa* (Marshall *et al*., 2005). The beneficial role of micronutrients such as zinc in diabetics has been well documented (Anderson, 2000). This author further showed that though these micronutrients are known to provide specific beneficial effect on the post-prandial blood glucose profiles of diabetic subjects, the judicious combination would possibly exert complementary, cumulative or synergistic benefits towards nutritional as well as blood sugar management of diabetics. Several researches have documented the importance of vitamin A in human body. Vitamin A, specifically retinoic acid, is necessary for cellular differentiation, the process by which general precursor cells develop into a specific cell type that produces characteristic protein (De Luca *et al*., 1995). The American Diabetic Association (2004) indicated the importance of appropriate levels of essential micronutrients and food ingredients with hypoglycaemic effect that regulate the blood glucose and insulin profile of target population. However, such foods will be useful to the healthy adults not only in maintaining normal health, but also in preventing other chronic diseases and their complications (Ene-Obong 2008; Onyechi *et al*., 1998). The level of beta-carotene in CSS accorded the breakfast porridge nutritional superiority over the rest of the experimental foods.

The sensory evaluation revealed that there were significant ($p<0.05$) difference in the colour, taste and general acceptability of these products. Conversely, there was no significant difference ($p>0.05$) in the texture of the test porridges. Porridges made from *Azelia africana* and corn seed flour was more preferred in terms of colour, taste and general acceptability than the other breakfast porridges. This could be as a result of the pale yellowish colour and the processing method (roasting and soaking) of *Azelia africana* seeds. Although there was no significant difference in the texture of the breakfast porridges, the *Afzelia Africana* porridge was rated higher than other products. This could be attributed to the soaking process in water for 48 h (Okeke *et al*., 2009; Okorie and Amaechi, 2003). The higher organoleptic attribute (of *Afzelia africana* porridge when all the attributes were added up and compared could be due the appearance of the porridge. All the other breakfast cereals compared favorably.

Conclusion: The result of the study showed that the breakfast porridges contained moderate amount of nutrients in addition to fibre, which could provide nutritionists, dietitians and clinicians a new means of modulating post-prandial blood glucose levels in diabetic patients. Incorporating these legumes into porridges will increase the consumption of these indigenous Nigerian foods among the urban dwellers as well as provide a variety in their diet.

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