

Proximate and Phytochemical Compositions of Four Indigenous Seeds Used As Soup Thickeners in Ebonyi State Nigeria

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Abstract: Proximate and phytochemical compositions were carried on four indigenous seeds, *Azalia africana* (African oak tree), *Detarium microcarpum*, *Brachystegia nigerica* (African mahogany) and *Mucuna sloanei* (Velvet beans) used as soup thickeners. The concentration of carbohydrate were *Mucuna sloanei* 70.71%, *Detarium microcarpum* 70.38%, *Brachystegia nigerica* 65.97% and *Azalia africana* 53.65% showing that they were predominantly composed of carbohydrates. *Azalia africana* contained 18.50% crude lipid while other seeds contained *Brachystegia nigerica* 7.91%, *Mucuna sloanei* 6.25%, and *Detarium microcarpum* 7.41%. The protein contents of the seeds were *Azalia africana* 13.29%, *Brachystegia nigerica* 14.45%, *Mucuna sloanei* 12.52% and *Detarium microcarpum* 12.19%. The percentage crude fiber was highest in *Azalia africana* 8.25%, while in *Brachystegia nigerica*, it was 3.30%, *Mucuna sloanei* 2.99% and *Detarium microcarpum* 2.63%. The ash contents were very low with *Brachystegia nigerica* having a value of 4.07% while *Azalia africana*, *Mucuna sloanei* and *Detarium microcarpum* contained 3.51%, 3.46%, and 3.09% respectively. The percentage moisture contents were *Mucuna sloanei* 4.07%, and *Brachystegia nigerica* 4.30%, *Azalia africana* 2.80% and *Detarium microcarpum* 4.30%. The phytochemical composition showed the concentration of alkaloids ranged from 59.62 in *Azalia africana* to 165.85mg/100g in *Mucuna sloanei*. They had high concentrations of soluble carbohydrates, tannins, steroids and terpenoids. They were relatively low in flavonoids, cyanogenic glycosides, beta carotene, cyanide and anthocyanine. The investigation showed they were rich sources of carbohydrate and proteins and contains active metabolites that have both medicinal and therapeutic values.

Keywords: Proximate composition, phytochemicals, seeds, soup, thickeners.

I. Introduction

Food use of plants and their products have increased as well as their industrial need which is also associated with increase in world population. This has created a big problem in feeding the ever increasing world population. The different varieties of soup prepared in Ebonyi State, south-eastern part of Nigeria are boiled in water. The advantage of boiling food in water as opposed to cooking it over an open flame is that it produces a denser food. Boiling several ingredients together causes the flavors to blend, thus creating a new taste. Thickening agents, or thickeners, are substances which, when added to an aqueous mixture, increase its viscosity without substantially modifying its other properties, such as taste. They provide body, increase stability, and improve suspension of added ingredients (Collins And Harry, 1994).

Thickening agents are often used as food additives and in cosmetics and personal hygiene products. Food thickening can be important for people facing medical issues with chewing or swallowing, as foods with a thicker consistency can reduce the chances of choking, or of inhalation of liquids or food particles, which can lead to aspiration pneumonia (Fernandez-Armesto, 2002).

The food use of these thickeners calls for more investigative data on the nature of their compositions and properties of their constituents so as to ascertain their actual nutritional essence. These soup thickeners include *Azalia africana*, *Mucuna sloanei*, *Brachystegia nigerica* and *Detarium microcarpum*. It was observed that most people in the rural areas, who diet primarily on these seeds, do not have records of all these nutritionally associated diseases and conditions such as obesity, cardiovascular diseases, diabetes, protein malnutrition (PEM), weakened or compromised immune system and so on.

Proximate analysis is used to chemically evaluate the major constituents of food and other plant materials. It is used to among other purposes to establish whether the sample contains in the correct proportion, some important food component such as protein, carbohydrate, fat, and so on (Hall *et al.*, 1978).

Phytochemical screening determines the presence of biologically active non-nutritive compounds that contribute to the flavor, colour and other characteristics of plant parts. These compounds such as alkaloids, tannins, cardiac glycosides, terpenoids, saponins, anthraquinones, flavonoids, saponins and so on, are the major basis of pharmacological activities of medicinal plants (Oloyede, 2005). Thus in recent years, the global demand for alkaloids and their derivatives as well as other bioactive compounds has grown substantially (Harish *et al.*, 2010). The presence of many secondary metabolites in plants and plant products have been shown to display potent antimicrobial activity against organisms and potency in treating diseases (Aiyelaagbe *et al.*, 2007).

MATERIALS AND METHODS: TEST SAMPLES: All the samples used were fresh seeds collected from Okposi, a community in Ebonyi State, Nigeria where they were locally grown by the rural dwellers, who use the seeds extensively in soup preparation due to their availability, affordability and addition of bulk to soup preparations. They were dried, roasted, soaked in warm water and the shells of the thickeners were removed manually and further dried in an oven at 60°C for 48 hours. They were then milled with blender and used for the analysis.

METHODS: PROXIMATE ANALYSIS: The samples were analyzed for proximate compositions using the Official methods of AOAC, (1980).

ANTINUTRIENTS (PHYTOCHEMISTRY): Generally, the spectrophotometric methods were used in the analysis of the phytochemical compositions. Methods of Harborne (Harborne, 1973) and Okwu and Ndu (2006) were used for the phytochemical analysis of unpopular seeds.

II. Results:

Table 1: PROXIMATE ANALYSIS OF SOUP THICKENERS IN %W/W.

PARAMETER	<i>Afzelia africana</i> (% w/w)	<i>Brachystegia nigerica</i> (% w/w)	<i>Mucuna sloanei</i> (% w/w)	<i>Detarium microcarpum</i> (% w/w)
Moisture	2.80±0.01	4.30±0.12	4.07±0.01	4.30±0.02
Protein	13.29±0.10	14.45±0.01	12.52±0.05	12.19±0.01
Crude fat	18.50±2.02	7.91±2.10	6.25±2.02	7.41±2.61
Crude fiber	8.25±0.30	3.30±0.20	2.99±0.60	2.63±0.32
Ash	3.51±0.10	4.07±0.80	3.46±0.43	3.09±0.11
Carbohydrate	53.66±0.80	65.97±0.70	70.71±0.90	70.38±0.6

Table 2: PHYTOCHEMICAL COMPOSITION OF SOUP THICKENERS (SEEDS) IN mg/100g.

PARAMETER	<i>Afzelia africana</i> (mg/100g)	<i>Detarium microcarpum</i> (mg/100g)	<i>Brachystegia nigerica</i> (mg/100g)	<i>Mucuna sloanei</i> (mg/100g)
Alkaloid	59.62±3.69	61.78±3.21	73.58±4.74	165.85±10.49
Flavonoid	9.75±1.02	41.89±3.45	6.17±1.08	165.93±9.01
Cyanide	0.41±0.01	0.45±0.00	0.46±0.01	0.72±0.03
Beta carotene	4.70±0.82	2.64±0.01	0.81±0.02	0.90±0.01
Glycosides	3.50±1.20	5.64±1.01	2.65±0.23	10.88±1.15
Soluble carbohydrates	12.84±2.74	24.81±4.25	23.36±1.07	42.59±4.86
Cyanogenic glycosides	0.33±0.01	0.68±0.10	1.61±0.06	1.03±0.01
Tannins	62.22±5.25	80.14±5.67	75.18±3.44	70.86±4.07
Terpenoids	201.16±12.83	109.32±9.82	240.18±11.12	74.13±5.64
Saponins	0.88±0.01	0.61±0.02	1.05±0.02	0.56±0.01
Steroid	12.63±1.04	52.01±2.25	71.27±4.76	13.80±2.11
Anthocyanine	6.55±0.92	2.62±0.81	0.66±0.01	0.55±0.02

III. Discussion:

The usual constituents of food determined by proximate analysis include protein, carbohydrate, crude fibre (roughage), lipid (fat and oil), ash and moisture (water) contents. The protein contents of the seeds as shown in table 1 were *Afzelia africana* 13.29%, *Brachystegia nigerica* 14.45%, *Mucuna sloanei* 12.52% and *Detarium microcarpum* 12.19%. There were significantly lower than the reports of Igwenyi and Akubugwo, (2010) on similar soup thickeners from the open market. Plant seeds have not been reported as good sources of protein. There were found to be comparable to 12.45% reported by Barminas *et al.*, (Barminas *et al.*, 2004) for *Xylopiya aethiopicum* seeds grown in Nigeria and 26.80 – 29.20% reported for *Canavalia glidiata*). These values give the seeds positive attributes as plant proteins are scarce and this protein content can furnish the essential amino acid needed for healthy growth and repair of tissues (Igwenyi, 2008).

The crude protein is comparable also to the value of 12.87% among the silages in the study of chemical composition and quality characteristics of corn, sunflower and corn-sunflower mixture silage (Mafakher *et al.*, 2010)

The soup thickeners in table 1 showed that *Mucuna sloanei* had percentage composition of 70.71% carbohydrate, *Detarium microcarpum* 70.38%, *Brachystegia nigerica* 65.97% and *Afzelia africana* 53.65%.

These values were lower than the report of Igwenyi and Akubugwo (2010) on similar seeds. The decrease could be as a result of the processing method in the preparation of the seed samples and other environmental factors. Food thickeners frequently used are based on polysaccharides (starch) content, vegetable gums, proteins, cornstarch, potato, or tapioca (Morton, 2004). These results are comparable to 72.52% in *Mangifera indica*, 60.17% in *Brachystegia eurycoma* (Achi) and 51.03% in *Dracaena fragranca* (Ukpo/Ibaba) (Eddy and Udoh, 2005). The carbohydrate contents were comparable to 57 – 59% reported for *Brachystegia eurycoma* and *Detarium microcarpum* (Uhegbu *et al.*, 2009). The values were also similar to 63.65g/100g in *Xylopiya aethiopyca* grown in Nigeria (Barminas *et al.*, 2004), and 69.70% for in *Irvingia gabonensis* (Eddy and Udoh, 2005) all used as soup thickeners. This property of carbohydrates is in line with the work of Ejiofor who explained that defatted flour of some of these seeds like *Irvingia gabonensis* are still acceptable in terms of its colour, taste, texture and drawability after a period of time in ambient conditions, and is more viscous, with greater emulsifying properties than undefatted flour (Ejiofor, 1994).

The percentage compositions of lipids in the samples were low (table 1). *Azalia africana* contained 18.50% crude lipid which was the highest while the analysis of other seeds revealed 7.91% in *Brachystegia nigerica*, 6.25% in *Mucuna sloanei*, and 7.41% in *Detarium microcarpum*. These values were higher than the result of Igwenyi and Akubugwo (2010) but lower than 14.0 – 18.5% reported by Uhegbu *et al.*, (2009). This variations in the oil contents may be attributed to differences in climatic conditions, soil properties, average rainfall, freshness and storage conditions/time of the seeds. The oil content was however lower than 59.46% as reported for *Cucumis melo* var. *agretis* scrub seeds in Nigeria (Adekunle and Olumo, 2008). The analysis of lipid contents however showed that the seeds were not oil seeds or oil crops and cannot serve as commercial sources of vegetable oils. However, lipids are the principal form of stored energy (fat and oils) in most organisms and major constituents of cellular membranes. Specialized lipids serve as pigments (retinal, carotene), cofactors (vitamin K), detergents (bile salts), transporters (dolichoils in bacteria cell wall synthesis), hormones (vitamin D derivatives, sex hormones), extracellular and intracellular messengers (eicosanoids), and anchors for membrane proteins (covalently attached fatty acids, phosphatidyl inositol, etc) (Voet and Voet, 2004; Nelson and Cox, 2005). The values for the proximate lipid composition were lower than 15% reported in *Detarium microcarpum* by Akpata and Miachi (2001) except for *Azalia africana*. The values were however comparable to 8.30% in *Mangifera indica* (Eddy and Udoh, 2005), 2.80 and 3.1% fat content of *Canavalia gladiata* seeds (whole and cotyledon respectively) (Sagariga *et al.*, 1999).

The percentage crude fiber was highest in *Azalia africana* with 8.25%, while in *Brachystegia nigerica*, it was 3.30%, *Mucuna sloanei* 2.99% and *Detarium microcarpum* 2.63%. These values are comparable to the values for *Detarium macrocarpum* (2.90%) and *Xylopiya aethiopyca* 8.66g/100g reported by Akpata and Miachi (2001) and Barminas *et al.*, (2004) respectively. Fiber regulates bowel actions and may help to guard against colon and rectal cancer as well as in diabetes. Crude fiber is the inorganic residue left after the defatted food materials have been treated with boiling dilute hydrochloric acid, diluted sulphuric acid, boiling dilute sodium hydroxide, alcohol and ether. It is that portion of food that is not used up by the body. Fibre shortens the transit time of food through the gastrointestinal tracts, reduces low density lipoprotein and hence keeps the gut healthy. Fiber supplements or fiber-rich foods may function as normal dietary agents by modulating the digestive and absorptive process (Okaka *et al.*, 2006). They are very important in promoting a range of physiological effects, including increased fecal bulk, water-holding capacity, absorption of organic molecules such as bile acids, cholesterol and toxic components (reduced bile acid and plasma-cholesterol levels), reduction of minerals and electrolytes (Igwenyi, 2008).

The ash contents were also investigated and it showed that the values were very low with *Brachystegia nigerica* (achi) having a value of 4.07% while *Azalia africana*, *Mucuna sloanei* and *Detarium microcarpum* were found to be 3.51%, 3.46%, and 3.09% respectively. The ash contents were also comparable to values reported by Barminas *et al.*, (2004) for *Xylopiya aethiopyca* also used as a thickener. Measure of ash content could be a measure of the food quality. The level of ash is an indication of adulteration. Adulteration is the contamination of food product due to inorganic substances present in the food being analyzed (Pearson, 1976; Schroeder, 1986).

The moisture contents were low. The percentage moisture contents were *Mucuna sloanei* 4.07%, and *Brachystegia nigerica* 4.30%, while values for *Azalia africana* and *Detarium microcarpum* were 2.80% and 4.30% respectively. These values were low and will discourage deterioration due to microbial attack. This was also anticipated given the hard and dry nature of the seeds and seed coats. Although the water content of a food is expressed as a percent, this number does not reflect how the water exists in the food. Water in food is classified according to its availability or biological activity and is either "free" or "bound." Free water is not bound to any components in a food; it can be used for microbial growth and is also available for chemical reactions. Bound water is physically bound to large (molecules) components in the food. It is not available to microorganisms for their growth and it cannot participate in chemical reactions (Hall *et al.*, 1978).

These values were slightly different from results of analysis on fresh samples brought from other countries in sub-Saharan West Africa and sold in the open market in Igwenyi and Akubugwo (2010). The slight variations in proximate contents could be attributed to climatic conditions, soil fertility and soil type. The results of the proximate compositions were similarly comparable to protein 19.69 – 39.08%, carbohydrate 32.78 – 67.26%, lipid 2.70 – 21.08%, and fiber 1.78 – 4.68% reported by Okwu and Orji (2007). The results were generally comparable to values obtained in the biochemical analysis of Black and White sesame seeds from China (Kanu, 2011).

Phytochemistry in the strict sense of the word is the study of phyto-chemicals (Trease and Evans, 1989). In a narrow sense, the term is used to describe the large number of secondary metabolic compounds from plants (Adodo, 2002). Many of these are known to provide protection against insect attacks and plant diseases as seen in B₇ toxin (*Bacillus thuringiensis*) that paralyze insects that feed on the plant. They also exhibit a number of protective functions in human existence (Iwu, 1993).

The concentration of alkaloids in table 2 was 73.58mg/100g for *Brachystegia nigerica* seed sample while the rest were *Detarium microcarpum* 61.78mg/100g and *Afzelia africana* 59.62mg/100g but significantly higher ($p < 0.05$) in *Mucuna sloanei* 165.85mg/100g when compared with the rest. These values were higher than 1.28 – 1.64mg/100g reported in the phytochemical composition and nutritional quality of *Glycine max* and *Vigna unguiculata* (L) Walp (Okwu and Orji, 2007) and 4.32% by Abukakar *et al.*, (2008). Alkaloids are famous analgesics (Mothes, 1996) and have been utilized in a variety of ways in the treatment of diseases and during surgery due to their medicinal and pharmacological efficacy.

The concentration of flavonoids was significantly higher ($p < 0.05$) in *Mucuna sloanei* 165.93mg/100g compared with the rest that yielded 6.17, 9.75 and 41.89mg/100g in *Brachystegia nigerica*, *Afzelia africana* and *Detarium microcarpum* respectively. The values of the phytochemical contents were comparable to alkaloid 66.70%, flavonoids 55.60% and tannins 57.10% in the ethnomedicinal and phytochemical profile of some savannah plant species in Nigeria (Bako *et al.*, 2005). Flavonoids are most commonly known for their antioxidant activity. However, it is now known that the health benefits they provide against cancer and heart disease are the result of other mechanisms (Ververidis *et al.*, 2007). Flavonoids have been referred to as "nature's biological response modifiers" because of strong experimental evidence of their inherent ability to modify the body's reaction to allergens, viruses, and carcinogens. They show anti-allergic, anti-inflammatory (Yamamoto and Gaynor, 2006), anti-microbial (Cushine and Lamb, 2005) and anti-cancer activity.

The level of cyanide and cyanogenic glycosides were very low. The concentrations of glycosides were 10.00, 5.64, 3.50 and 2.65mg/100g in *Mucuna sloanei*, *Detarium microcarpum*, *Afzelia africana* and *Brachystegia nigerica* respectively. This is an advantage in the use of the material for food due to the effect of cyanide in oxidative phosphorylation (Rawn, 1983; Voet and Voet, 2004).

The concentrations of saponins were generally lower than 1.1mg/100g in all the seeds. These values were lower but comparable to 2.2% reported in the phytochemical screening and antibacterial activity of *Tamarindus indica* pulp extract (Abukakar *et al.*, 2008). Saponin is group of glycosides that is widely distributed in higher plants. They are characterized by forming colloidal solution in water, which froth upon shaking. They have bitter taste and drugs containing them are usually irritating to the mucous membranes. Thus, these compounds give a permanent froth when shaken with water. Saponins destroy the red blood cells by hemolysis and are toxic especially to cold blooded animals. Many have been used as fish poisons and are toxic to aquatic life (Baranov, 1996).

The concentrations of tannins were relatively high. *Detarium microcarpum* contained 80.14mg/100g tannins, *Brachystegia nigerica* 75.18mg/100g, *Mucuna sloanei* 70.86mg/100g and *Afzelia africana* 62.22mg/100g. These values were higher than 0.38 – 0.77mg/100g reported for *Glycine max* and *Vigna unguiculata* (Okwu and Orji, 2007). The values of the tannin contents were comparable to 57.10% in the ethnomedicinal and phytochemical profile of some savannah plant species in Nigeria (Bako *et al.*, 2005).

Tannins are astringent, bitter plant polyphenols that either bind and precipitate or shrink proteins. The astringency from the tannins is what causes the dry and puckery feeling in the mouth following the consumption of red wine or an unripened fruit. Their main function in nature seems to be one of protection; animals are deterred from eating plants high in tannins because of the bitter, astringent. Tannins have traditionally been considered antinutritional but it is now known that their beneficial or antinutritional properties depend upon their chemical structure and dosage (Muller-Harvey and McAllan, 1992). Recent studies have demonstrated that products containing chestnut tannins included at low dosages (0.15-0.2 %) in the diet can improve wellbeing (Schiavone *et al.*, 2007).

The levels of beta carotenes were low occurring at the concentration of *Afzelia africana*, *Detarium microcarpum*, *Brachystegia nigerica* and *Mucuna sloanei* were 4.70, 2.64, 0.81 and 0.90mg/100g respectively. In animals, one particular carotenoid, β -carotene is an essential dietary requirement, since it provides a precursor of vitamin A. Vitamin A is the precursor of rhodopsin (visual purple) and promotes growth and repair of body

tissues; reduces susceptibility to infections (immune function); regulate gene expression and cell differentiation; aids in bone and teeth formation; maintains smooth skin; and is an anti-oxidant (Kirk-Othmer, 1984).

The levels of steroids in mg/100g were *Azelia africana* 12.63, *Detarium microcarpum* 52.01, *Brachystegia nigerica* 71.27 and *Mucuna sloanei* 13.80. The concentration of anthocyanine were *Azelia africana*, *Detarium microcarpum*, *Brachystegia nigerica* and *Mucuna sloanei* were 6.55, 2.62, 0.66 and 0.55mg/100g respectively.

IV. Conclusion:

The seeds used as soup thickeners have high percentage yield of carbohydrate that serve both as thickener and fuel source for the generation of the energy currency of the cell. The protein contents showed that they can provide the amino acids needed to support the metabolic activities of the body. Despite the various levels of these plants secondary metabolites, there are not associated with any disease state or condition in the area as such diseases associated with malnutrition and malabsorption. This could be attributed to the presence of antioxidants (flavonoids and vitamin A). However, many traditional methods of food preparation such as fermentation, cooking, and malting increase the nutritive quality of plant foods through reducing certain anti-nutrients and such processing methods are widely used in societies where cereals and legumes form a major part of the diet.

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