

PROXIMATE AND ANTI-NUTRIENT COMPOSITION OF *AFZELIA AFRICANA* AND *CRESCENTIA CUJETE* SEEDS

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ABSTRACT

Afzelia africana and *Crescentia cujete* are underutilized seeds that have been suggested to have good nutritional content. Their utilization for food and other purposes can however be limited by the presence of some anti-nutritional, anti-physiological and toxic substances. Hence, proximate (moisture, protein, lipid, fibre, ash and NFE) and some anti-nutritional contents (alkaloids, phytate, tannins, saponins and flavonoids) of *Afzelia africana* and *Crescentia cujete* seeds were investigated. Collected seeds were milled and air dried before analyses. Milled seeds were analysed for proximate composition and anti-nutrients using standard procedures. All proximate contents varied significantly ($P < 0.05$) except for lipid content. Results showed that *A. africana* seed had the highest ash (4.13%), protein (13.89%) and nitrogen free extract (59.20%) contents, while *C. cujete* had the highest moisture, lipid and fibre content. The proximate composition of both seeds varied significantly ($P < 0.05$) except for lipid. Alkaloids, tannins, saponins and flavonoids contents were also considerably high for both seeds investigated. The contents of phytates, tannins and flavonoids varied significantly ($P < 0.05$) between both seeds. *Crescentia cujete* had the highest phytate, tannin and saponin contents while *A. africana* had the highest alkaloid and flavonoid contents. Since *Afzelia africana* and *Crescentia cujete* seeds had relatively high percentage contents of carbohydrate (59.20 and 49.86, respectively) and lipids (16.10 and 17.00, respectively), the seeds could be said to have potentials to serve as good sources of energy for livestock and animal production. The high composition of phytochemicals in the two seeds studied also implies the seeds could be useful for medicinal purposes.

Keywords: *Afzelia africana*, Anti-nutrients, *Crescentia cujete*, Flavonoids.

INTRODUCTION

Plants have been used for centuries for different purposes and their use for consumption as food, spices, for healing/ medicinal purposes, for purification of water, to ward off pest and disease carrying insects and for ornamental purposes. There is a wide distribution of biologically active

constituents in nature, particularly in plants used as feedstuff and human nutrition (Shimelis *et al.*, 2013). Knowledge of these compounds has given rise to several investigations on their possible physiological implications in various biological systems (Shimelis *et al.*, 2013) as some plants are toxic and yet may contain medicinal properties which may be utilized

for therapeutic purposes (Sofowora *et al.*, 2013). Anti-nutritional factors are compounds which reduces the nutrient utilization and food intake of plant or plant products used as human food or animal feed. They are otherwise known as secondary metabolites in plants.

A large segment of human population and animals in developing countries suffer from protein malnutrition (Semba, 2016). Legumes such as soybean contain high concentration of proteins, carbohydrates and dietary fiber and make important contribution to human diet in many countries (Bashir *et al.*, 2016). In addition to legumes, some nuts and seeds which are used as food in several parts of the world also have considerable potentials as alternative protein sources.

Afzelia africana Sm. (African mahogany) is a tree species of the Fabaceae family and subfamily Caesalpiniaceae which can be found in tropical regions of the world especially Africa; Nigeria, Benin, Cameroon, Guinea, Senegal, Sierra Leone, Sudan, and Uganda (Jackson, 2012). The seeds have waxy orange cup-like structure at their base and are generally used in Nigeria as soup thickener the same way melon and ogbono (*Irvingia gabonensis*) seeds are used (Ejikeme *et al.*, 2010). *Crescentia cujete* L. (Calabash tree) is an evergreen flowering plant belonging to the family Bignoniaceae (Olaniyi *et al.*, 2018). Virtually, all parts of the tree have been found to be useful. The wood is used for tool handles, ribs in boat building and cattle yokes; and the gourd for cups, containers and musical instruments (Ejelonu *et al.*, 2011). The pulp inside the

fruit have been used in folk medicine to treat cough, cold and bronchitis (Theis *et al.*, 2017).

Nutritional deficiency especially protein has been one of the world's problem (Garman and Sherrington, 2008). Protein rich foods are generally more expensive than their carbohydrate counterparts. One of the ways of achieving good nutrition is by the exploitation of available local resources that are efficient/economical source of food for the growing population (Achu *et al.*, 2005). Unconventional legumes have good potential for commercial exploitation but remain ignored. They offer a good opportunity to meet the ever-increasing demands for vegetable protein. Although they have high protein content and possess good nutritional value, their utilization is limited by the presence of some anti-nutritional, anti-physiological and toxic substances (Shlini and Murthy, 2015). The objectives of this study are therefore to evaluate the proximate and anti-nutrients composition of *A. africana* and *C. cujete* seeds, with the following set hypotheses: *Afzelia africana* and *Crescentia cujete* seeds do not possess significantly high nutritional contents nor do they possess significantly low anti-nutritional content.

MATERIALS AND METHODS

Sample Preparation

The leaves and seeds of both *A. africana* and *C. cujete* were gotten from the wild and taken to the Herbarium, Department of Botany, Ahmadu Bello University Zaria for identification. The seeds of mahogany bean were collected



from its pod together with the arils while the seeds of calabash tree were extracted from pod containing pulp. Distilled water was used to wash seeds and the seeds were then air dried, placed in polyethene bag and taken to the Food Science Laboratory, Institute of Agricultural Research, Zaria for analysis. Prior to analysis the seeds were milled to powdered flour (together with the arils – for the Mahogany bean seeds).

Proximate analysis of seeds

Proximate analysis of both seeds was determined in triplicates using the recommended methods of the Association of Official Analytical Chemist (AOAC, 1990). Samples were analysed for crude protein by the micro-Kjeldahl method of determining nitrogen and calculated as $N \times 6.25$. Moisture content was determined by drying to a constant weight, crude lipid was determined as extracted ether using petroleum spirit within the soxhlet apparatus, crude fibre and ash contents were determined by incinerating dry samples in a muffle furnace set at 550°C . Carbohydrate was calculated as nitrogen free extracts by difference [$100 - (\% \text{ crude protein} + \% \text{ lipid} + \% \text{ moisture} + \% \text{ crude fibre} + \% \text{ ash content})$].

Determination of Anti-nutrients of the Seeds

Alkaloid, Saponin, Tannin, Flavonoid and Phytate contents were determined using recommended methods of Richard *et al.* (2016), AOAC (1990), Ejikeme *et al.* (2010), Ade-Ademilua and Umebese (2007) and Annor *et al.* (2016), respectively.

Determination of alkaloid

Two grams of the sample was weighed into a 250 ml beaker and 100ml of 10% acetic acid in ethanol was added, covered and allowed to stand for 4hrs. This was then filtered and filtrate was concentrated on a water bath to one quarter of the original volume. The entire/whole solution was allowed to settle. The precipitate was collected and washed with dilute ammonium hydroxide and then filtered. The residue was dried and weighed to show the alkaloid content as described by Richard *et al.* (2016).

Determination of tannin

Two grams of the sample was poured into a beaker containing 50 ml of distilled water and heated to 60°C . Then it was filtered and the residue was discarded. 10ml of 4% copper acetate solution was added to the hot filtrate and boiled for another 10min. The precipitate was filtered and the filtrate was discarded. The residue was dried using a filter paper and dried sample was then scraped from filter paper into a pre-weighed crucible. The weight was recorded as W. The crucible containing the sample was incinerated in a muffle furnace at 550°C , then cooled in a desiccator and then reweighed as W1. The difference between the weight of sample before ashing and the ash residue after incineration represents the tannin content as described by Ejikeme *et al.* (2010).

Determination of Phytate content

Phytic acid was determined using the method described by Annor *et al.* (2016). 4 g of the sample was soaked in 100 ml of 2%



HCl for 3 hrs and then filtered. 25 ml filtrate was dispensed into a conical flask and 5 ml of 0.3 ml ammonium thiocyanate solution was added as indicator. Thereafter, 53.5 ml distilled water was added to the mixture to give it a proper acidity and this was titrated with standard iron III chloride solution, which contains about 0.00195 g (1.95 g) of iron per millimeter until a brownish colour persisted for 5min.

Determination of saponin content

Saponin content was determined using the AOAC (1990). Saponin extract was done using acetone and methanol. Crude lipid content of samples was extracted with acetone while methanol was used to extract saponin. 2 g in triplicate were folded in filter paper and put in thimble and extracted by infusing in a Soxhlet extractor. Extraction was done with acetone in a 250 cm³ capacity round bottomed flask containing 100 cm³ methanol, fitted to the extractor and extraction sustained for another 3hr. The weight of flask was taken before and after extraction to note the change in weight. Methanol was recovered by distillation after the second extraction and the flasks oven-dried and allowed to cool at room temperature and weighed. The saponin content was calculated using the formula;

$$\text{Saponin (mg/100g)} = \frac{A-B}{S_m} \times 100$$

Where A= mass of flask and extract

B = mass of empty flask

S_m = Sample mass

Determination of flavonoids

Flavonoids level was determined by gravimetric method described by Ade-Ademilua and Umebese (2007). 10 g of sample was extracted with 100ml of 80% aqueous methanol at room temperature. It was filtered and the residue was transferred into a crucible for drying. This was dried at a constant eight in an oven. The percentage flavonoid was calculated as follows:

$$\% \text{ Flavanoids} = \frac{\text{wt of dried residue} \times 100}{\text{wt of original sample}}$$

Data Analyses

Data generated were statistically analyzed using mean and standard deviation. Student's T-test was adopted to test for significant difference ($P < 0.05$) in the means of the nutritional and anti-nutritional contents between the seeds of *Azelia africana* Sm. and *Crescentia cujete* L.

RESULTS

The proximate composition of *A. africana* seed showed higher level of ash (4.13%), protein (13.89%) and nitrogen free extract (59.20%) as shown in Table 1. All proximate contents varied significantly ($P < 0.05$) except for lipid content. Both seeds (*C. cujete* and *A. africana*) have a considerable high amount of carbohydrate, 49.86% and 59.20%, respectively, and low moisture content.

Table 1: Proximate Composition (%) of *Crescentia cujete* and *Azelia africana* seeds

	Parameters					
	Moisture	Ash	Protein	Lipid	Fibre	NFE
<i>C. cujete</i> seeds	19.16 ± 0.08*	3.59 ± 0.02*	10.42 ± 0.23*	17.00 ± 0.21	5.30 ± 0.03*	49.86 ± 0.42*
<i>A. Africana</i> seeds	6.68 ± 0.28*	4.13 ± 0.08*	13.89 ± 0.06*	16.10 ± 0.32	4.57 ± 0.02*	59.20 ± 0.42*
P Value	0.000	0.003	0.000	0.078	0.000	0.000

Means are presented. Means with (*) vary significantly (P<0.05)

Alkaloids, phytates and tannins were relatively low, while the saponins and flavonoids were considerably high as presented in Table 2. The contents of phytates, tannins and flavonoids varied significantly (P<0.05) between both seeds.

Crescentia cujete had the highest phytate, tannin and saponin contents, 0.28 mg/g⁻¹, 2.95 mg/g⁻¹ and 17.85 mg/g⁻¹, respectively. While, *A. africana* had the highest alkaloid and flavonoid contents, 2.09 mg/g⁻¹ and 80.67 mg/g⁻¹, respectively.

Table 2: Antinutrients (mg/g⁻¹) of *Crescentia cujete* and *Azelia africana* seeds

	Parameters				
	Alkaloid	Phytate	Tannin	Saponins	Flavonoids
<i>C. cujete</i> seeds	2.04 ± 0.01	0.28 ± 0.02*	2.95 ± 0.03*	17.85 ± 0.35	45.68 ± 0.34*
<i>A. Africana</i> seeds	2.09 ± 0.04	0.06 ± 0.01*	0.25 ± 0.01*	15.00 ± 0.72	80.67 ± 0.39*
P Value	0.349	0.010	0.000	0.071	0.000

Means are presented. Means with (*) vary significantly (P<0.05)

DISCUSSION

The lipid contents of both seeds are greater than the protein contents thus they could be regarded as primarily oil-rich seeds. Seeds with lipid content values greater than 10% of the dry matter are considered to be oil rich (FAO, 1994). This is contrary to the report of Ogungbenle

(2014), who opined that *A. africana* seed cannot be grouped under oil-rich crops. The protein content of both seeds is lower than that reported by Bashir *et al.* (2016) for *Tamarindus indica* (19.46%). Lipids are however known to increase the palatability of foods.



The moisture and carbohydrate contents of *A. africana* from this study were 19.16 and 49.86%, respectively, which are higher than the values of 5.72% and 20.50% obtained by Ogungbenle (2014). The lower moisture content of *A. africana* seeds (6.68%) however suggests that it will have a better shelf life compared to *C. cujete* seeds (19.16%). The lower moisture content of *A. africana* seeds could be because *C. cujete* seeds were contained in a watery pulp while *A. africana* seeds were in dry pod, and the two seeds were air dried for the same period of time.

Most legumes contain large amounts of non-digestible carbohydrates, which may include arabinogalactan, stachyose, sucrose and raffinose (Achi, 2005). These carbohydrates are associated with abdominal distention and flatulence in animals (Naczek *et al.*, 1997).

The tannin content of *C. cujete* proves that the seeds can be used to hasten the healing of wound, prevent decay and have antimicrobial activity (Chukwuma *et al.*, 2010), and also to treat urinary tract infections and other bacterial infections (Michael, 2004). Flavonoids have anti-oxidant properties and also protects body cells from damage by free radical cells. Alkaloids have analgesic, anti-spasmodic and bactericidal effects (Roy, 2017) and can be used to treat coughs and as anti-inflammatory agent (Michael, 2004). The presence of saponins in both seeds implies they can serve as anti-inflammatory agents and as antibiotics in treating diseases and ailments (Ejelonu *et al.*, 2011).

The proximate composition of the seed flours of *A. africana* and *C. cujete* were comparable with reported values for edible legumes, oil seeds and grains like *Tamarindus indica*, 46.49-58.62% NFE (Bashir *et al.*, 2016) and wheat, 11.0-14.0% protein content (FAO, 2004). The values of lipid (16.10-17.00%), protein (10.42-13.89%), crude fibre (4.57-5.30%), moisture (6.68-19.16%), and NFE (49.86-59.20%) content in the seeds were high enough, which suggests that the seeds can make valuable contribution to global nutritional needs. *Afzelia africana* and *Crescentia cujete* seeds had high contents of carbohydrate and lipids which also implies that they can serve as a good source of energy for livestock and animal production. Since *Afzelia africana* and *Crescentia cujete* seeds have low tannin, alkaloid and phytate contents, they could be said to be relatively safe for consumption. The flavonoids and saponins found in *Afzelia africana* and *Crescentia cujete* can act as anti-oxidants, protect the cells of the body from free radical damage which would have led to health-related problems and can serve as natural antibiotics and also boost energy while reducing inflammation of the upper respiratory passage.

CONCLUSIONS

Afzelia africana and *Crescentia cujete* seeds had relatively high percentage contents of carbohydrate, the seeds could be said to have potentials to serve as good sources of energy for livestock and animal production. The high composition of phytochemicals in the two seeds studied also



implies the seeds could be useful for medicinal purposes.

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