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Chemical and Fatty Acid Composition of *Afzelia africana* Seeds

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Abstract The proximate, nutritionally valuable minerals, fatty acid and sugar composition of *Afzelia africana* were studied. The results showed that the sample contained moisture (5.72%), crude protein (44.5%), fat (18.9%), crude fibre (5.44%), total ash (4.93%) and carbohydrate (20.5%). The *Afzelia africana* has a high proportion of maltose (62.35mg in 100g sample) but low in glucose (l5.68mg in 100g sample) and fructose (l6.72mg in 100g sample) suggesting that it would be useful where low glyceamic index (GI) food is needed. The predominant mineral was potassium with the value of 831mg/kg followed by magnesium (781mg/kg), sodium (558mg/kg) and calcium (208mg/kg) while the sample was significantly low in copper (0.70 mg/kg) and manganese (2.60mg/kg). Stearic acid was the predominant fatty acid (9.20%), myristic acid was very low with value of 0.04%. It was observed that the total unsaturated fatty acid was 4.64% while the total saturated fatty acid was 12.8%.

Keywords Chemical, Fatty acid, *Afzelia Africana,* seeds

1. Introduction

In most industrially developed and under developed tropical countries, the prices of food are sky rocketing on daily basis due to importation impasse and limited scientific knowledge of underutilized farm products. This has resulted in a high rate of food scarcity and malnutrition. Some of these countries have insufficient food supply especially that of protein and they mostly rely on carbohydrates for their daily requirements which have resulted to obesity, sugar related problems and hypertension. Legumes are increasingly being used as potential solution to problem of low protein diet in highly populated region of the world [1]. However, many of the edible legumes which could serve as sources of protein are under-utilized [2]. Global food need for future population require urgent and un-relented efforts in exploiting the under utilized agricultural products of high magnitude of protein by both food scientists and agriculturists. Ogungbenle and Omaejalie [3] studied the proximate, in-vitro protein digestibility, anti nutritional factors and amino acids of *Afzelia africana.* In order to further widen the frontiers of the nutritional status of *Afzelia africana,* this study was designed to determine the chemical and fatty acid composition of *Afzelia africana* seeds.

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2. Materials and Methods

The sample used for the present work was bought in Akure market, Ondo State Nigeria in Africa. The seeds were separated from the shells, dried and ground into flour, then packaged and stored in freezer at -4℃ until used for the analyses. The oil from the sample flour was extracted by using soxhlet apparatus [4].

2.1. Proximate Analysis

The moisture and ash contents were determined using the air oven and dry ashing method [4]. The sample was analyzed for crude fat and crude protein according to the method described [5]. Nitrogen was determined by micro-Kjedahl method described [5] and the percentage nitrogen was converted to crude protein by multiplying by a factor of 6.25. The crude fibre was determined by adding 2g (W_1) of the sample into 500ml conical flask; 200ml of boiling 1.25% of H_2SO_4 was added and boiled for 30minutes. The mixture was filtered through muslin cloth and rinsed with hot distilled water. The sample was scrapped back into the flask and 200ml of boiling 1.25% NaOH was added and allowed to boil again for another 30 minutes; filtered and then rinsed with 10% HCl twice with industrial methylated spirit and allowed to drain and dry. The residue was scrapped into a crucible, dried in the oven at 105℃, allowed to cool in a desicator and weighed (W_2); then placed in muffle furnace at 300℃ for 30 minutes and finally allowed to cool at room temperature and weighed again (W_3) [4].

$$\% \text{ crude fibre} = \frac{W_2 - W_3 \times 100}{W_1} \quad (1)$$

The carbohydrate content was calculated by method of difference.

% Carbohydrate = {100 – (% moisture + % ash + % crude fibre + % crude fat+ % crude protein)} (2)

2.2. Determination of Sugar

The sugars were determined by the method Shaffer-Somogyi sugar-thiosulfate equivalent which was described [5]. The sample flour (2.5g) was dissolved in 20ml distilled water and hydrolysed in the presence of 20ml of 0.1 M H_2S0_4. The resulting solution (5ml) was pipetted into 25 x 200mm test tube and then 5ml. of Shaffer-Somogyi carbonate 50 reagent was added and thoroughly mixed by swirling. The test tube was placed in boiling water bath and heated for required minutes, while the test tube was removed carefully and without agitation to a running water cooling bath and allowed to cool for 4 minutes. The cap on the test tube was removed and 2ml KI-$K_2C_20_4$ were also added gently into the test tube. The mixture was mixed thoroughly to ensure that Cu_20 is dissolved and allowed to stand in cold water bath for 5 minutes with mixing done twice during the period. The remaining mixture was later titrated with 0.005M $Na_2S_20_3$ using starch indicator. The blank was equally run as described above and then the test solution titre value subtracted from that of blank. The titration was repeated until two concordant results were obtained. The amount of sugar was calculated according to Shaffer-Somogyi's equation. For glucose, the heating time was 15 minutes;

$$Y = 0.1099x + 0.048 \quad (3)$$

Where Y = mg sugar in 5ml and x = Titre value (ml) of 0.005M $Na_2S_2O_3$

2.3. Mineral Analysis

The minerals were analyzed by dry ashing the sample at 550ºC to constant weight and dissolving the ash in 100 ml standard flask using distilled deionized water with 3ml of 3M HCl. Sodium and potassium were determined by using a flame photometer (model 405, corning, U.K). All other minerals were determined by Atomic Absorption Spectrophotometer (Perkin & Elmer model 403, USA) [4, 5].

2.4. Fatty Acid Profile

The fatty acid profile was determined using a method described [6]. The fatty esters analyzed using a PYE Unicam 304 gas chromatography fitted with a flame ionization detector and PYE Unicam computing integrator. Helium was used as carrier gas. The column initial temperature was 150℃ rising at 5℃ min^{-1} to a final temperature of 200℃ respectively. The peaks were identified by comparison with the standard spectral libraries.

3. Results and Discussion

Table 1 shows the proximate composition of *Afzelia africana.* The protein content was very high with the value of 44.5%. Protein is the major source of building block for the body. Excess protein that is not used by the body can be converted by the liver and stored as fat in the body tissues. Thus, *Afzelia africana* can contribute significantly to human daily requirement of 23-56g of protein [7]. *Afzelia africana is* a better source of protein and the value was higher than those of water melon (24.30%) [8], defatted cashew nut (31.5%) [9], lima bean flour (22.7%) reported [10] and pigeon pea (22.4%) reported [11]. The fat value was 18.9%. This value was lower than those of periwinkle (74.74%) [12], gourd seed (50.5%) and yellow melon (51.9%) reported by [13] but higher than those of cereal crops (quinoa, 6.3%, [14]; pearl millet, 7.6%, [15]). This indicates that *Afzelia africana* may not be grouped as oil-rich crop. Fat is essential in the diet as it increases the palatability of food. The ash content was 4.93%. Ash is an indicator of the quality of inorganic compounds (minerals) in the sample. The value of ash for the sample was greater than those of the Nigerian legumes like African yam bean (3.24%), pigeon pea (3.70%), cowpea (2.98%), [16]. It shows that *Afzelia africana* is a better source of minerals and protein. The % carbohydrate was 20.49%. This value was lower than those of cooked walnut (58.42%) [17] and African nut meg (44.85%) [18]. Carbohydrate helps to regulate protein and fat metabolism, fat requires carbohydrate for their breakdown within the liver. The crude fibre (5.44%) was higher than those of pigeon pea (3.8%) reported [11], cowpea (2.6%) reported [16] and pearl millet (3.1%) reported [15] but comparably lower than that of benniseed (7.9%) reported [15]. It has been discovered that dietary fibre has a number of beneficial effects related to its indigestibility in the small intestine [19]. Therefore, the high fibre content in *Afzelia africana* can improve its digestibility and absorption processes in the large intestine.

Table 1. Proximate composition of *Afzelia africana* seeds

Component	(%)
Moisture content	5.72
Crude Protein	44.5
Ash content	4.93
Fat content	18.9
Crude fibre	5.44
Carbohydrate	20.5

Table 2 presents the result of sugars in *Afzelia africana* flour. Maltose was found to be the richest sugar in *Afzelia africana* with the value of 62.35mg/100g sample while glucose (15.68mg/100g sample) was the lowest. Maltose is a disaccharide that is contained in malted drinks and loaves. It indicates that the sample may be used as weaning foods. The value of D-ribose was 25.02mg/l00g. This indicates that Af*zelia africana seed* is a good source of constituent of nuclei. The value of maltose (62.35 mg/l00g) was higher than that of date palm fruit (33.7 mg/l00g) [20] but lower than that of quinoa (101mg/100g) [14]. It is worth noting that the high value of maltose reported for *Afzelia africana* corroborates the observations made for quinoa [14] and date palm fruit [20]. *Afzelia africana* is low in glucose (15.65mg/l00g) and fructose (16.72mg/l00g) which are mono-saccharides that can provide a variable glycaemic response mainly related to the very low glycaemic index [15]. The importance of the blood glucose response after a meal is often expressed as the glycaemic index (GI) [19]. In maturity onset diabetes, low GI foods improve the metabolic control [21] and a number of potential advantages of low GI foods in general are being explored [22]. Such advantages include longer satiety, low blood pressure and lower plasma low-density lipoprotein (LDL) cholesterol levels related to the less pronounced insulin response to low GI foods [19]. This suggests that diet containing *Afzelia africana* may probably be recommended for maturity onset diabetic patients due to its low amount of fructose and glucose.

Table 2. Sugar contents (mg sugar in 100g sample) of the *Afzelia africana* seeds

Component	Value
Fructose	16.72
Glucose	15.68
L-Sorbose	18.89
D-Ribose	25.02
D-Galactose	37.55
Maltose	62.35
D-Xylose	32.18

Potassium (831mg/kg) was highly concentrated followed closely by magnesium (781mg/kg). Potassium has been found to be more concentrated in agricultural products [23] and it is highly needed for intra and inter-cellular activities in the body. The ratio of Na/K is highly significant. The Na/K value of 0.67 was less than 1 (Table 3). The health implication is that the sample would not promote hypertension in the human body when consumed. It helps also to regulate the acid-base balance and the osmotic pressure of the body fluid. The value of calcium (208mg/kg) was found to be higher than those of quinoa (86mg/kg) [14], African nutmeg (203.7mg/kg) reported by [20] but lower than those of *Lagarania vulgaris* (450mg/kg) and *Cucumeropsis edulis* reported by [24]. Calcium accounts for about 75% of the weight of the mineral element present in the body [25]. Also the deficiency of calcium can also affect the life of newly born baby where the body and the bone is very soft and this becomes hardened as the calcium intake increases, so the diet must supply a high amount of calcium for proper functions of the body. Calcium is the principal contributor to bone formation [26]. When there is lack of calcium in the body, it results to osteoporosis (bone thinning). The deficiency of calcium and magnesium may also lead to high blood pressure. This suggests that *Afzelia africana* is good for human food formation. Iron is nutritionally important. It is highly required for blood formation. The value of iron (10.8mg/kg) is adequate for blood formulation. This value of iron in the sample was lower than those of spannish green olives (14.8 mg/kg) [27], cat fish (15.5 mg/kg) [28] but comparable with that of snake fish (10.6 mg/kg) [28]. Iron also facilitates the oxidation of carbohydrates, protein and fats. Zinc plays very important role in the immunity and strength of the body.

Table 3. Mineral composition of *Afzelia africana* seeds

Mineral	Mg/kg
Potassium	831
Sodium	558
Magnesium	781
Iron	10.8
Manganese	2.60
Zinc	37.1
Copper	0.70
Lead	2.70
Cadmium	ND
Calcium	208
Na /K	0.67

Table 4. Fatty acid profile of *Afzelia africana* seed oil

Fatty acid	%
Lauric cid	0.72
Myristic	0.04
Linolenic	4.62
Oleic	N.D
Stearic	9.20
Palmitic	2.86
Linoleic	N.D

Table 4 shows the fatty acid composition of *Afzelia africana* oil. The predominant fatty acid was stearic acid with the value of 9.20%. This value was higher than that of (4.00%) reported for soy bean [29]. The quantity of myristic acid (0.04%) was lower than soy bean oil (0.2%) while the value for palmitic acid (2.86%) was comparatively lower than that of *Adenopus breviflorus* oil (15.8%) [30]. The value of linolenic acid (4.62%) was lower than those reported for African yam bean (AYB) varieties that ranged from 28.33 to 35.16% [31] and periwinkle (7.40%) [32], but higher than those of tilapia fish (1.46%) [28] and soy bean (0.52%) [33]. The total saturated fatty acid (TSFA) in the present sample was 12.8% and that of total unsaturated fatty acid (TUFA) was 4.64%. The low value of unsaturated fatty acid (TUFA) in *Afzelia africana* seed oil suggests that it is not desirable for cooking since high level of unsaturation is desirable for cooking. It is worth noting that relative to carbohydrate, the saturated fatty acids elevate serum cholesterol while the poly unsaturated fatty acids lower serum cholesterol [34, 35]. The saturated fatty acids, lauric acid ($C_{12:0}$), myristic acid ($C_{14:0}$) and palmitic acid ($C_{16:0}$) have been established as the dietary factors in CHD [36]. The amount of saturated fatty acids (caprylic, lauric, myristic, palmitic and stearic) that are present in *Afzelia africana* indicate that the oil is less liable to oxidative rancidity. Rancidity can be described as the spoilage that oils and fats undergo which results to unpleasant odours and flavours [14].

4. Conclusions

The results show that *Afzelia africana* is a good source of protein, essential minerals and contain appreciable quality and quantity oil for domestic and industrial uses.

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