Nutritional composition of *Afzelia africana*

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ABSTRACT

The proximate, mineral and amino acid composition of Afzelia were determined. The sample results of proximate analysis (g/100g) showed that it contains crude fat (30.20%), crude protein (15.02%), moisture (4.38%), ash (5.31%), crude fibre (3.91%) and carbohydrate (41.17%). The most abundant element in the seed was magnesium (624.31); others include potassium (624.31ppm), phosphorus (570.92ppm), calcium (380.62ppm), sodium (269.43ppm). The amino acid profile of the seed showed that the total essential amino acid (TEAA) was 365.7mg/g crude protein out of a total amino acids of 765.3mg/g. The most concentrated amino acid was glutamic acid (146.1mg/g). Lysine has the lowest essential amino acid score of 0.64 whence the limiting amino acid. The calculated isoelectric point ($_pI$) was 4.31. The implications of these results are discussed.

Key words: Nutritional composition and *Afzelia africana.*

INTRODUCTION

The continuous increase in population growth and the inadequate supply of protein are thought to be responsible for under-nourishment and malnutrition among people living in the developing countries. The limited supply animal protein due to high cost have the led to exploring new protein sources from underutilized legumes to help the low-income groups.

Afzelia africana is found growing in a humid and dry forest and also in the savannah. It is a large tree with a spreading crown with heights varying between 10 and 20 metres. The glamorous leaves of *Afzelia africana* are up to 30cm long with 7-17 pair of leaflets elliptic with an obtuse tip. (Ene-Obong and Carnovade, 1992).

It has flattened pods which open up at maturity to spread the seeds. The seed is often used as soup thickener like melon seeds in the South-western part of Nigeria. Even though seeds are considered to be potential protein and carbohydrates sources for humans and animals, the biologically available minerals and carbohydrates are relatively poor because of the presence of anti-metabolic substances and deficiency of sulphur containing amino acids. (Adebona *et al.,* 1988). The aim of this study to evaluate the nutritional potentials of *Afzelia africana* seed.

MATERIAL AND METHODS

Matured seeds of *Afzelia africa*na were obtained from the Oja-Oba market, Ikere-Ekiti. The seeds were shelled to remove the hulk and then dried in the oven at 45^{0}C for 48 hours. The seeds were then ground to fine powder stored in polythene bags and kept at 4^{0}C.

Analysis of Sample

Proximate analysis of *Afzelia africana* for moisture, total ash, crude fibre and ash were carried out in triplicates using the methods described by Pearson (1976) and the nitrogen content was converted to protein by multiplying by 6.25. Carbohydrate was determined by difference. All the proximate volumes were reported in percentage.

The minerals were analyzed by dry ashing the sample at 550^{0}C to constant weight and dissolving the ash in 100ml volumetric flasks using distilled, deionised water with a few drops of concentrated hydrochloric acid. Sodium and Potassium were determined by using a flame photometer (model 405, Coring UK) NaCl and KCl were used to prepare standards.

All other metals were determined by atomic absorption spectrophotometer.

Amino acid analysis

Defatted sample was weighed, hydrolysed and filtered. It was then evaporated to dryness at 40°C under vacuum in a rotary evaporator. Each residue was dissolved with 5ml of acetate buffer (pH-2.0) and stored in a plastic specimen bottle and kept inside the deep freezer pending subsequent analysis. The Technicon sequential multisample (TSM) Amino acid analyzer (Technicon Instrument Corporation, New York) was used for the analyses. The principle is based on ion exchange chromatography (IEC) (FAO/WHO, 1991). The equipment is designed to separate free acidic, neutral, and basic acids of the hydrolysate. The amount loaded for each sample was 5-10µl and about 76min elapsed for each analysis. The Column flow rate was 0.50ml/min at 60°C with reproducibility consistent within ±3%. The net height of each peak produced by the chart record of the TSM was measured and calculated for the amino acid it was representing. The average of 2determinations were reported. All chemicals were of analytical grade.

RESULTS AND DISCUSSION

The results of the proximate composition of *Afzelia africana* seed flour is shown Table 1. Moisture content of the seed is low (4.38 ± 0.06%) but compares favourably well with that observed for gourd seed (3.60%) by Amoo *et al.,* (2004) and the fruit of *Nauclea latifolia* (2.10%). The low moisture content is advantageous in that it would make the seed less vulnerable to microorganisms attack. This will mean a long shelf-life for the dehulled seed.

This crude protein in the seed is 15.02±1.01% and this value compares well with crude protein content of protein rich foods such as soybean, cowpea, pigeon pea and gourd seed. Ref.

Table 1: Proximate composition of *A. africana*

Composition	Percentage
Moisture	4.38±0.06
Ash	5.31±0.10
Crude Fibre	3.91±0.04
Crude Protein	15.02±1.01
Crude fat	30.20±0.49
Carbohydrates	41.17±0.61

Values are means ± S.D of three determinations

Table 2: Mineral composition of *Afzelia africana*

Minerals	Composition
Zinc	8.56±0.1
Pottassium	618.08±0.30
Sodium	269.43±0.57
Iron	89.16±1.55
Magnesium	624.31±1.90
Manganese	2.24±0.04
Calcium	380.02±0.64
Phosphorus	570.92±0.13

Values are mean± S.D of 3 determinations

Table 3: Amino acid profile of Afzelia Africana. (mg/g crude protein)

Amino Acids	Concentration
Lysine (Lys)*	35.1
Histidine(His)*	30.0
Arginine(Arg)*	59.0
Aspartic Acid(Asp)	97.0
Threonine (Thre)*	30.0
Serine(Ser)	26.6
Glutamic acid (Glu)	146.1
Proline (Pro)$^-$	33.6
Glysine (Gly)	36.0
Alanine(Ala)	14.0
Cysteine(CYs)	13.0
Valine(Val)*	41.3
Methionine(met)*	13.8
Isoleucine(Ile)*	40.5
Leucine(Leu)*	71.5
Tyrosine(Tyr)	33.3
Phenylalanine(Phe)*	44.5

* Essential amino acids (EAA)

The crude fat content (30.20±0.49%) is much higher than that reported for soybean and lower than that reported for pumpkin seed, (49,2%) (Asiegbu 1987), C. vuglaris 47.9-51.1% (Ige *et al.,* 1984). The high fat content qualifies *Afzelia africana* as an oil rich seed.

The seed has moderate ash and crude fibre. (The ash content of any sample is a measure of the likely mineral content of the sample). The ash content (5.31±0.1%) is higher than that reported for gourd seed 3.60%. (Amoo *et al.,* 2004) and Hausa groundnut(*kerstingiella geocarpa*) 3.79%% (Oyetayo and Ajayi, 2005). The crude fibre content of the sample is 3.91±0.04. This is higher than that reported for soybeans (1.9%) and groundnut (2.9%) and lower than that reported for *kerstingiella geocarpa*, (6.5%).Fibre forms an important component of a healthy diet. It assists in reducing constipation and other attendant problems. The carbohydrate obtained is comparable with those reported in literature.

Table 2 shows the mineral content of the seed flour. The sample is very rich in potassium (618.08), magnesium (624.31), phosphorus (570.92), calcium (384.62) and sodium (269.43). Sodium and Potassium are required to maintain the osmotic balance of the body fluids; pH of the body and control of glucose absorption (Guthrie, 1989).

The high K/Na ratio observed in *Afzelia africana* is desirable because the average human diet is low in potassium but high in sodium due to addition of table salt. The seed could be beneficial in the diets of patients on diuretics for hypertension control who tend to lose excessive concentration of potassium in their body fluids. The potassium content in the seed is similar to that of cowpea varieties earlier reported and some selected agricultural grain products (Aletor and Aladetimi, 1989)

Magnesium is an activator of many enzyme systems and maintains the electrical potential in nerves(Ferres *et al.,* 1987). Calcium is important for blood clotting, muscle contraction and in certain metabolic proceses. (Adeyeye and Fagbohun, 2005). Both Calcium and Phosphorus are involved in bone metabolism, this has led to the concept of calcium: phosphorus (Ca/P) ratio. The Ca/P ratio of *A. Africana* is 0.67. Food is considered poor if the ratio is less than 0.5, and good if its above 1.0. Zinc concentration was found to be lower than that reported for *Kerstingiella geocarpa* seed and lima-beans. (Oshodi and Adeladun, 1993.,

Table 4: Essential non-essential neutral and bask amiino-acids mg/g crude protein of the sample

Amino-Acids	Level
Total Amino acids (TAA)	765.3
Total Non-essential amino acids (TNEAA)	396.6
Total Essential aminoacid (TEAA) with Histidine	365.7
No Histidine	335.7
Percent total non essential amino ac id (%TNEAA)	52.21
Percent Total essential amino acid	47.79
Total neutral amino acid (TNAA)	382.0
%TNAA	49.92
Total acidic Amino aacids (TAAA)	43.10
% TAAA	31.77
Total Basic amino acid (TBAA)	124.1
%TBAA	16.22
Total Sulphur Amino Acids (TSAA)	2.68
% cysteine in (TSAA)	48.5

Oyetayo and Ajayi, 2005). Zinc, manganese and iron content in this sample were lower than that reported for fluted pumpkin(Akintayo, 1997).

Amino acids profile of A. africana

Table IV shows the amino acid profile of *Afzelia africana* seed flour.

The present result indicates that the major abundant amino acid in A. Africana is glutamic acid followed by aspartic acid. This is similar to the result obtained for *T. conophorum* (Asaolu, 2009) and some oilseeds (Adeyemi and Adediran 1994, Olaofe *et al.,* ,1994).

This observation could be because these two amino acids are the precursors from which the backbones of amino acids are formed and they are storage forms of nitrogen (Onwuliri and Anekwe, 1993). The nutritive value of a protein depends on the capacity to satisfy the needs for nitrogen and essential amino acids (Oshodi *et al.,* 1998). The total essential amino acids in *A. africana* is 47.8%. this suggests that these seed flour will contribute significantly to the supply of essential amino acids in the diet. However, this value is higher than that of cowpea (42.6%) soybean (44.4%) and *T. conophorum* (27.4%) (Kuri *et al.,* 1994;Olaofe *et al.,* 1993 and Asaolu, 2009). This implies that the protein in *A.africana* is of higher quality compared with those in cowpea, pigeon pea and soy beans and that its a good source of essential amino acids, hence this seed can be used as food supplements.

Table 5: Provisional acid scoring pattern and amino acids scores of the sample

Amino acids	Suggested level mg/g protein	Score
Isoleucine	40	1.01
Leucine	70	1.02
Mel+Cys	35	0.77
Lysine	55	0.64
Phe+Tyr	60	1.30
Threonine	40	0.75
Tryptophan	10	N.D
Valine	50	0.83
Leu/ile	1.78	
Total	360	0.90

Table 5 depicts that the total amino acids (TAA) was 765.3 mg/g crude protein. This value compares with those reported for African yam bean (AYB) (702.9-917.5 mp/gcp). The total non essential amino acids (TNEAA) 395.6 mg/ gcp was comparable to that of (AYB) 327.2-453.8mg/gcp, which shows that TNEAA formed the bulk of the amino acids. The total essential amino acids of this sample was lower compared to melon seed (534.4 mg/gcp) pumpkin seed 338mg/gcp and gourd seed 536mg/gcp and higher than *Blighia sapida(* 226.86)mg/gcp)(with His). The total neutral amino acids (TNAA) was 382mg/g crude protein (i.e 49.92%)

The most concentrated essential amino acids is Leucine (7.15g/100g crude protein). The essential aliphatic amino acids (Ile, Val, Leu) which constitute the hydrophobic regions of proteins were lower (15.33%) than that reported for scarlet runner beans (25.69%) and cowpea (22.48%) varieties.

Also the total acidic amino acids (TAAA) which is 31.77% was found to be greater than the total basic amino acid TBAA (16.22%) suggesting that the protein is probably acidic in nature. The calculated isoelectric point (pI) is 4.31 which also support the acidic nature of the protein in the sample. A knowledge of the pI of proteins will enhance the precipitation of protein isolate from a biological sample.

Results in Table 6 shows the value of essential amino acids scores in *A. africana*. The limiting essential amino acid is lysine (0.640) and this is similar to what obtains in most vegetable proteins (Oei, 1991). However lysine was reported to have a good distribution in different mushroom parts(Akindahunsi and Oyetayo, 2006). It then means this will be the first amino acid to be corrected for in *A. Africana*. The best amino acids in quality is Phe + Tyr. with a score of 1.30 (130%) followed by Leu and Ile with a score of 1.02 and 1.01 respectively. Tryptophan was not determined. Both His and Arg are particularly essential for children (FAO/WHO/UNU, 1985) and *Afzelia africana* would be a good source of the two amino acids. Like most legumes, this sample is deficient in sulphur containing amino acids. Environmental factors under which legumes are grown can affect their amino acid composition. The application of phosphorus molybdenum and nitrogen has been shown to increase the level of methionine while application of sulphur-containing fertilizers increase the cysteine content of Bengal grain protein (Arora and Luthra, 1970, Gupta, 1982 and Dhage *et al.,* 1984).

The predicted protein efficiency ratio (P-PER) is 6.24 which shows that the protein in this sample would be better utilized in the body than those of the unfermented (3.55) and fermented (2.55) cocoa nibs(Adeyeye *et al.,* 2010.

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