

Minerals composition and amino acid profile of the different parts of African mesquite (*Prosopis africana*) pod

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Abstract

This study investigated the minerals composition and amino acid profile of the different parts of African mesquite (*Prosopis africana*) pod. Informations on the chemical composition of unconventional feeds are very vital in the choice of these feed resources but also helps in x-raying aspects that would require further processing to improve nutritive value of these materials before utilization as livestock feed. Whole mature dried pods of *P. africana* were picked at the vicinity of the trees between December and February in bushes within Makurdi, Benue State, Nigeria. The pods were cleaned, sundried and each pod separated into its various parts of epicarp, mesocarp and seeds. Separated pos parts were milled and taken to the laboratory for mineral composition and amino acid profile analyses. Results of nutritional analyses revealed that sulphur was the most abundant minerals in the epicarp, mesocarp and seeds with 1780, 1795 and 1810 mg/kg, respectively followed by phosphorus (1220, 1227 and 1440 mg/kg for epicarp, mesocarp and seeds, respectively), potassium (1210, 1220, 1290 mg/kg for epicarp, mesocarp and seeds respectively) and magnesium (890, 906, and 1200 mg/kg for epicarp, mesocarp and seeds respectively). Sodium composition of the epicarp was 770 mg/kg, while the mesocarp and seeds had 790 mg/kg and 101 mg/kg, respectively. The seeds had more calcium (750 mg/kg) than the epicarp (680 mg/kg) and mesocarp (691 mg/kg). Among the trace elements, Fe was the most abundant. The Fe values ranged from 178 mg/kg (seeds) - 159 mg/kg (epicarp), while lead (Pb) was the least abundant with the seeds containing 0.98 mg/kg, while the epicarp and mesocarp had 1.20 and 1.27 mg/kg respectively. The seeds had higher concentration of leucine (6.42g/100g protein), isoleucine (3.73 g/100g protein), phenyl alanine (4.08 g/100g protein), tryptophan (0.66 g/100g protein), valine (3.80 g/100g protein), methionine (1.10 g/100g protein), proline (3.35 g/100g protein), arginine (4.30 g/100g protein), tyrosine (2.06 g/100g protein), histidine (1.76 g/100 g/protein), cysteine (4.00 g/100g protein), g /100g glutamic acid (7.72 g/100g protein), threonine (3.50 g/100g protein), serine (4.00 g/100g protein) and aspartic acid (7.10 g/100g protein) than the epicarp and mesocarp. However, the concentration of lysine (4.46 g/100g protein) and glycine (3.23 g/100g protein) was higher in the mesocarp than the epicarp and seeds. The epicarp had the least concentration of leucine (3.21 g/100g protein), lysine (1.83 g/100g protein), phenyl alanine (2.14 g/100g protein), methionine (0.37 g/100g protein), tyrosine (1.38 g/100g protein), histidine (1.05 g/100g protein), cysteine (0.67 g/100g protein), alanine (2.35 g/100g protein) and aspartic acid (4.50 g/100g protein). It was inferred that the different parts of *P. africana* contained sufficient quantities of amino acids and minerals and therefore can be considered as a feed resource in livestock production. However, further studies on phytochemicals concentration in the pods is necessary.

Keywords: minerals, amino acids, African meaquite, *Prosopis africana*, pod

Composition minérale et profil des acides aminés des différentes parties du fruit de Mesquite africain (*Prosopis africana*)



Résumé

Les informations sur la composition chimique des ressources alimentaires non conventionnelles d'origine végétale sont essentielles si ces ressources alimentaires doivent être explorées comme

alternative aux aliments pour le bétail. Cette étude a examiné la composition minérale et le profil des acides aminés des différentes parties du fruit de Mesquite africain (*Prosopis africana*). Les gousses matures et séchées de *P. africana* ont été cueillies autour des arbres entre décembre et février dans les buissons de Makurdi, État de Benue, au Nigéria. Les gousses ont été nettoyées, séchées au soleil et chaque gousse a été séparée en ses différentes parties : épicarpe, mésocarpe et graines. Les parties séparées ont été broyées et envoyées au laboratoire pour des analyses de composition minérale et de profil des acides aminés. Les résultats des analyses nutritionnelles ont révélé que le soufre était le minéral le plus abondant dans l'épicarpe, le mésocarpe et les graines avec respectivement 1780, 1795 et 1810 mg/kg, suivi du phosphore (1220, 1227 et 1440 mg/kg pour l'épicarpe, le mésocarpe et les graines, respectivement), du potassium (1210, 1220, 1290 mg/kg pour l'épicarpe, le mésocarpe et les graines, respectivement) et du magnésium (890, 906 et 1200 mg/kg pour l'épicarpe, le mésocarpe et les graines, respectivement). La composition en sodium de l'épicarpe était de 770 mg/kg, tandis que le mésocarpe et les graines contenaient respectivement 790 mg/kg et 101 mg/kg. Les graines contenaient plus de calcium (750 mg/kg) que l'épicarpe (680 mg/kg) et le mésocarpe (691 mg/kg). Parmi les oligo-éléments, le fer était le plus abondant. Les valeurs de fer allaient de 178 mg/kg (graines) à 159 mg/kg (épicarpe), tandis que le plomb (Pb) était le moins abondant, les graines contenant 0,98 mg/kg, tandis que l'épicarpe et le mésocarpe avaient respectivement 1,20 et 1,27 mg/kg. Les graines avaient une concentration plus élevée de leucine (6,42 g/100 g de protéine), d'isoleucine (3,73 g/100 g de protéine), de phénylalanine (4,08 g/100 g de protéine), de tryptophane (0,66 g/100 g de protéine), de valine (3,80 g/100 g de protéine), de méthionine (1,10 g/100 g de protéine), de proline (3,35 g/100 g de protéine), d'arginine (4,30 g/100 g de protéine), de tyrosine (2,06 g/100 g de protéine), d'histidine (1,76 g/100 g de protéine), de cystéine (4,00 g/100 g de protéine), d'acide glutamique (7,72 g/100 g de protéine), de thréonine (3,50 g/100 g de protéine), de sérine (4,00 g/100 g de protéine) et d'acide aspartique (7,10 g/100 g de protéine) que l'épicarpe et le mésocarpe. Cependant, la concentration de lysine (4,46 g/100 g de protéine) et de glycine (3,23 g/100 g de protéine) était plus élevée dans le mésocarpe que dans l'épicarpe et les graines. L'épicarpe avait la concentration la plus faible de leucine (3,21 g/100 g de protéine), de lysine (1,83 g/100 g de protéine), de phénylalanine (2,14 g/100 g de protéine), de méthionine (0,37 g/100 g de protéine), de tyrosine (1,38 g/100 g de protéine), d'histidine (1,05 g/100 g de protéine), de cystéine (0,67 g/100 g de protéine), d'alanine (2,35 g/100 g de protéine) et d'acide aspartique (4,50 g/100 g de protéine). Il a été conclu que les différentes parties de *P. africana* contenaient des quantités suffisantes d'acides aminés et de minéraux et peuvent donc être considérées comme une ressource alimentaire pour la production animale. Cependant, des études supplémentaires sur la concentration des phytochemicals dans les gousses sont nécessaires.

Mots-clés : Minéraux, acides aminés, Mesquite africain, *Prosopis africana*, gousse

Introduction

There is a severe shortage of grains for human consumption, particularly in the under-developed and developing countries, which is further aggravated by their increasing population (Dhakad *et al.*, 2002), competition with livestock, and, farmers-herders crisis especially in Nigeria. Ajala *et al.* (2008) suggested that solution to the present grain shortage rests on the promotion and sustenance of efficient production of all classes of meat animals using unconventional feed resources. There are vast availability of plant resources which may be developed and used as alternative feed resources to animals. To achieve this,

information on the chemical/nutritional compositions of these resources is necessary. One of such materials is the African mesquite pod (*Prosopis africana*) commonly known as African mesquite, Iron tree, or locally as *Kiriya* (Hausa), *Ayan* (Yoruba), *Ubwa* (Igbo) (Ogunshe *et al.*, 2007) and *Gbaaye* (Tiv), is a member of the family *Fabaceae*. The genus *Prosopis* has 44 species of which 40 are native to the North and South Americas, to Asia and one originates from Africa (*Prosopis africana*). *P. africana* is a fast growing hardy and drought resistant tree of about 4-20 m in height, found mainly in the semi-arid and arid regions of tropical Africa. It is a multi-purpose tree known

for its hard and durable saplings, nitrogen-fixation ability and condiments, pharmaceutical and medicinal properties and feedstuff for animals. The pods, pulps and leaves are highly relished by ruminants.

The pulp of African mesquite has a pleasant aroma with a somewhat bitter-sweet taste. The dried pulp is obtained when the whole dried pod is crushed to separate the seeds. On weight basis, the pulp makes up 45-55 % of the whole pod (Pasicznik, 2018). Studies have shown that the pulp could contain between 13 – 15.23 % CP, 11 – 23.2 CF, 1 – 3.50 % EE and 3 – 6.59 % Ash (Annongu and Ter meulen, 2000; Akande and Alabi, 2021). Further knowledge on the composition of *P. africana* will provide information on its potential usefulness in the livestock industry. Therefore in this study, the proximate, fibre fractions and phytochemicals compositions of the different parts of *Prosopis africana* pod were investigated.

Materials and Methods

Study Location

The study was conducted at Joseph Sarwuan Tarka University, Makurdi. Makurdi is located between latitude 7°68'N and longitudes 8°62'E in the Guinea savannah Zone of West Africa. The area is warm with a minimum temperature range of 21.71±3.43°C and a maximum temperature range of 32.98±2.43°C and relative humidity ranges between 39.5±2.20 and 64.0±4.80% (TAC, 2011).

Source and Processing of African Mesquite (*P. africana*) Pod Parts.

Whole mature dried pods of *P. Africana* were picked between December and February at the vicinity of the trees in bushes within Makurdi, Benue State, Nigeria. Collected pods were cleaned, sundried and each pod separated into its various parts of epicarp, mesocarp and seeds. The parts were milled and packaged separately in polythene bags.

Chemical analysis

Inorganic minerals were determined by X-Ray fluorescence (XRF) spectrophotometer as described by Igile (2013), while the amino acids profile of the different parts of the pod

were determined using the procedure outlined by Anhwange *et al.* (2020).

Results and Discussion

Minerals Composition of the Different Parts of the African Mesquite (*P. Africana*) Pod

The macro and micro minerals composition of the various parts of the African mesquite pod is presented in Table 1. The various parts contained appreciable quantities of macro and micro minerals. The results showed that the most abundant minerals in the various pod parts were sulfur (1780, 1795 and 1810 mg/kg for epicarp, mesocarp and seeds), phosphorus (1220, 1227 and 1440 mg/kg for epicarp, mesocarp and seeds respectively), potassium (1210, 1220, 1290 mg/kg for epicarp, mesocarp and seeds respectively) and magnesium (890, 906, and 1200 mg/kg for epicarp, mesocarp and seeds respectively). Sodium composition of the epicarp (770 mg/kg) and mesocarp (790 mg/kg) differed slightly and much higher than the Na composition of the seeds (101 mg/kg). The seeds had more calcium (750 mg/kg) than the epicarp (680 mg/kg) and mesocarp (691 mg/kg). The most abundant trace element in the pod parts was iron (Fe). The Fe values ranged from 178 mg/kg (seeds) to 159 mg/kg (epicarp), while lead (Pb) was least abundant with the seeds containing 0.98 mg/kg, epicarp and mesocarp having 1.20 and 1.27 mg/kg respectively. Copper concentration was highest in the seeds (55 mg/kg) while the epicarp and mesocarp contained 43 and 48 mg/kg copper respectively. The concentration of zinc in the different parts of the pod ranged from 85 mg/kg (seeds) to 66 (mg/kg). Lead concentration was higher in the epicarp and mesocarp (1.20 and 1.27 mg/kg respectively) than the seeds (0.98 mg/kg). The seeds had 7.60 mg/kg of Iodine while the epicarp and mesocarp contained 6.90 and 7.20 mg/kg iodine respectively. The values obtained for the macro and micro minerals determined were comparable to those reported by Adbulrazak *et al.* (2008), but higher than the reports of Anhwange *et al.* (2020). These appreciable mineral concentrations warrants consideration of its use as a feed

resource when compounding supplemental diets for ruminants since minerals play a key role in several physiological processes like maintenance of osmotic pressure, transmission of nerve impulses, and as essential components of bones, teeth, co-enzymes and hormones (McDonalds *et al.*, 2022).

Amino Acids Concentration of the Different Parts of the African Mesquite (P. Africana) Pod

The analysis of amino acid profile of the different parts of *P. Africana* pod is shown in Table 2. The result showed the presence of several essential and non-essential amino acids. Values obtained for the essential amino acids such as leucine, lysine, methionine and tryptophan in the epicarp and mesocarp were comparable to 4.55g/100g (leucine), 3.1g/100 g (lysine), 163 g/100g (methionine), reported for *P. Africana* pulp (Adamu *et al.*, 2010).

The amino acids profile of the *P. Africana* seeds obtained from this study were comparable to the reports of Anhwange *et al.* (2020), however the values for lysine (3.63 g/100g) and methionine (1.10 g/100g) in the seeds were

higher than 0.28 and 0.191 g/100g reported by Anhwange *et al.* (2020).

More so, the amino acid profile of the mesocarp and epicarp were higher than those in some agro-industrial by-products such as maize offal (0.40 % lysine, 0.15 % methionine, 0.15 % lysine and 0.12 % tryptophan) (Ogunsipe *et al.* (2022), but comparable to that in brewer’s dried grain. This has made the epicarp and mesocarp of *P. Africana* a rich fibre source for ruminants and perhaps monogastrics if further processed.. The results of the amino acid profile also shows that the seeds of *P. Africana* contains good amino acid mix. Although, the concentrations of the various amino acids in the seeds were lower than those in soyabean, a major conventional protein source, values were higher than those in soup condiments such as the African Locust bean (1.58 % lysine, 0.19 % methionine, 0.17 % cysteine and 0.28 % tryptophan), and velvet bean (1.18 % lysine, 0.30 % methionine, 0.37 % cysteine, and 0.28 % tryptophan) (Ogunsipe *et al.*, 2022). *P. Africana* seeds can therefore be harnessed and used in improving the amino acid status of livestock feed.

Table 1: Minerals Composition of the Different Parts of the African Mesquite (P. Africana) Pod.

Mineral	African Mesquite pod parts		
	Epicarp	Mesocarp	Seeds
Macro Minerals (mg/kg)			
Sodium	770	790	101
Magnesium	890	906	1200
Phosphorus	1220	1227	1400
Sulphur	1780	1795	1810
Chloride	79	85	88
Potassium	1210	1220	1290
Calcium	680	691	750
Micro Minerals(mg/kg)			
Manganese	56	67	83
Iron	159	164	178
Copper	43	48	55
Zinc	66	71	85
Lead	1.20	1.27	0.98
Iodine	6.90	7.20	7.60

Table 2: Amino Acids Concentration of the Different Parts of the African Mesquite (*P. Africana*) Pod

Amino acid (g/100g protein)	African Mesquite pod parts		
	Epicarp	Mesocarp	Seeds
Leucine	3.21	5.32	6.42
Lysine	1.83	4.46	3.63
Isoleucine	3.34	3.21	3.73
Phenylalanine	2.04	2.75	4.08
Tryptophan	0.50	0.37	0.66
Valine	3.01	2.81	3.80
Methionine	0.37	0.56	1.10
Proline	2.94	2.64	3.35
Arginine	3.35	3.10	4.30
Tyrosine	1.38	1.89	2.06
Histidine	1.05	1.57	1.76
Cystine	0.67	0.85	1.09
Alanine	2.35	3.00	2.96
Glutamic acid	1.21	6.21	7.72
Glycine	1.76	3.23	2.90
Threonine	3.02	3.11	3.50
Serine	3.19	2.62	4.00
Aspartic acid	4.50	5.52	7.10

Conclusion

Based on the results obtained from this studies, it can be inferred that the different parts of African mesquite (*Prosopis Africana*) pod contains minerals and amino acids in quantities that may warrant their trial either singly or in combination as ingredient in the diet of livestock especially ruminants.

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- Date received: 1st October, 2024**
- Date accepted: 13th January, 2025**