Asian Journal of Advances in Research

4(1): 1011-1017, 2021

PROXIMATE, MINERALS, VITAMINS AND AMINO ACID COMPOSITION OF PROSOPIS AFRICANA (*African mesquite*) SEED OIL

R. A. OLUWAFEMI[1], O. C. P. AGUBOSI[1] AND J. O. ALAGBE[1*]

[1]Department of Animal Science, University of Abuja, Gwagwalada, Nigeria.

AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Received: 15 July 2021
Accepted: 20 September 2021
Published: 23 September 2021

Original Research Article

ABSTRACT

The aim of this experiment was to evaluate the proximate, mineral, vitamin and amino acid composition of *Prosopis africana* seed oil (PASO). The proximate revealed the presence of moisture (5.62%), crude protein (30.71 %), crude fibre (6.47%), ash (5.08%) and energy (383.26 Kcal/g). Mineral analysis of PASO showed that it contains calcium, potassium, potassium, magnesium, sodium, manganese, zinc, copper and iron at 403.8 mg/100g, 606.1 mg/100g, 142.8 mg/100g, 281.3 mg/100g, 101.7 mg/100g, 38.56 mg/100g, 19.10 mg/100g, 42.28 mg/100g and 14.93 mg/100g respectively. Amino acid such as lysine (4.18 g/100g), histidine (2.31 g/100g), arginine (4.85 g/100g), aspartic acid (8.61 g/100g), threonine (2.80 g/100g), serine (3.11 g/100g), glutamic acid (11.44 g/100g), proline (3.29 g/100g), glycine (3.47 g/100g), alanine (5.22 g/100g), cystine (1.08 g/100g), valine (4.72 g/100g), methionine (1.40 g/100g), isoleucine (3.22 g/100g), leucine (8.31 g/100g), tyrosine (2.40 g/100g), tryptophan (0.90 g/100g) and phenyl alanine (3.85 g/100g) were found to be abundant in PASO. Vitamin analysis of the test material shows that vitamin E had the highest concentration of 11.67 mg/100g followed by vitamin C (8.56 mg/100g), vitamin A (0.55 mg/100g), vitamin D (0.33 mg/100g), vitamin B_3 (0.25 mg/100g), vitamin B_1 (0.21 mg/100g), vitamin B_{12} (0.20 mg/100g), vitamin B_6 (0.18 mg/100g), vitamin B_5 (0.10 mg/100g), vitamin B_2 (0.08 mg/100g), vitamin K (0.08 mg/100g) and vitamin B_9 (0.06 mg/100g) respectively. It was concluded that PASO is rich in several nutrients that have numerous health benefits including tissue maintenance, coordination of body functions and other biochemical and physiological functions in the body.

Keywords: Amino acid; *Prosopis africana* oil; mineral; vitamins; phytochemicals; nutrients; plant.

1. INTRODUCTION

Prosopis africana (*African mesquite*) is an evergreen leguminous and uncultivated copiously available tree belonging to the family Fabaceae and subfamily Mimosoidae [1]. The genera *Prosopis* consists of about 45 species and it grows in subtropical and tropical regions of the world and abundantly in Northern parts of Nigeria [2]. According to Alagbe [3] *Prosopis africana* plant is one of the numerous underexplored medicinal plants due to its abundant potentials. The leaves stem bark and roots are rich sources of phytonutrients such as: alkaloids, flavonoids, terpenoids, tannins, saponins and steroids which have been reported to increase growth performance, reduce the retention time of feed,

**Corresponding author: Email: dralagbe@finmail.com;*

improves palatability and pathogenic microorganism in animals [4, 5]. However, the concentrations of these phyto-nutrients depends on age of the plant, geographical locations, processing methods as well as species [6].

Prosopis africana seeds have been reported to contain appreciable quantity of proteins, minerals, crude fibre and lipids [7]. According to Odunfa and Oyewole [8]; Tajudeen et al. [9] fermented seeds of the plant can be used as spices to enhance the palatability and flavor of foods, its pods can be used as fodder for cattle, sheep and goat [10]. The active compound in stems, roots and leaves of *Prosopis africana* performs anti-inflammatory, antiviral, antibacterial, antioxidant and hepato-protective activities [11]. The stem bark and leaves are traditionally used for the treatment of malaria, tooth ache, paralysis, pile, sexually transmitted infections, pimples and general body weakness where as the roots are used in the treatment of diarrhea, headache, cough, cold and visceral obstructions (Ajiboye, 2013; Ayanwale *et al*., 2009).

Prosopis africana seed contains some volatile essential oils and phenolic compounds which can be used for the treatment of poisonous bites from snakes, bronchitis, paralysis, aphrodisiac and leprosy (Ezeonu and Ejikeme, 2016).

In view of these abundant potential in *Prosopis africana* seeds, there is need to access the chemical composition of the seed in order to ascertain its nutritional significance and medicinal value.

2. MATERIALS AND METHODS

2.1 Experimental Site

This study was carried out at the department of Animal Science Research Laboratory, University of Abuja, along airport road, Gwagwalada, Abuja, Nigeria. Gwagwalada is located between latitudes $8^{o}57^{1}$ and $8^{o}55^{1}$N and longitude $7^{o}05^{1}$ and $7^{o}06^{1}$E.

2.2 Collection, Identification and processing of *Prosopis africana* Seed

Mature seeds from *Prosopis africana* were harvested from different trees at the University of Abuja, Teaching and Research Farm. It was identified and authenticated by a certified taxonomist at the Department of Biological Sciences, University of Abuja, Gwagwalada with a voucher specimen number ABJ/01C/2021. The seeds were sorted to remove the bad ones and washed with running water to remove dirt's and air dried for 18 days to maintain the bioactive chemicals in the seeds, mechanically separated from their pods with knife to obtain the seeds. Dried seeds was grinded using a laboratory grinder (Panasonic: model AS/309F) to obtain *Prosopis africana* seed meal and stored in a clean well labeled container for analysis. Prior to the commencement of the analysis, laboratory equipments were serviced and all the necessary reagents were purchased.

2.3 Identification and Extraction of *Prosopis africana* Oil (PASO)

Extraction of PASO was done using a cold press machine (Model: YZYX168, China). The grinded *Prosopis africana* (2000 g) was poured at into the feeder of the machine which works at a low temperature and PASO was collected via the squeeze cage

2.4 Laboratory Analysis

Proximate analysis (moisture, crude protein, crude fibre, ash, ether extract and energy) of *Prosopis africana* seed meal was carried out using NIRS^{TM} DS 2500 analyzer Denmark with 375 × 490 × 300 mm (width × depth × height), wave length range of 400 – 2500 nm, optical bandwidth of 8.75 nm with silicon and lead sulfide detector.

2.5 Mineral Analysis

The atomic absorption spectrophotometer (Shimadzu, Model P/N 202-5610, China) was used for the analysis of the following metals: magnesium, zinc, iron, copper, phosphorus and calcium while the flame photometer (Punjabi, Model AA2-01C, Punjab, India) was used in the analysis of potassium and sodium.

2.6 Amino Analysis of PASM

Amino acid analysis was carried out using Automated High Speed Amino Acid Analyzer (LA8080) Amino SAAYAA, Hitachi, China with a wave length of 570 nm and 440 nm with high speed technology.

2.7 Vitamin Analysis of PASM

Vitamins (A, D, E, K, B_1, B_2, B_3, B_6, B_9, B_{12} and C) in the seeds were determined using Zivak VD-200 automated vitamin ultra-high performance liquid chromatography (UHPLC) analyzer, Hamburg, Germany.

2.8 Statistical Analysis

The analyses were done in triplicates and the data obtained were expressed as mean ± standard error of

the means (mean ± S.E.M). The data was subjected to one way analysis of variance (ANOVA) using SPSS (18.0). Significant differences were separated using software of the same package.

3. RESULTS AND DISCUSSION

3.1 Proximate Composition of *Prosopis africana* Seed Oil

Proximate composition of *Prosopis africana* seed is presented in Table 1. The sample contains moisture (5.62 %), crude protein (30.71 %), crude fibre (6.47 %), ether extract (3.66 %), ash (5.08 %) and energy (383.26 Kcal/kg). The moisture content for *Prosopis africana* seed is very low (5.62 %). The value indicates less chance of microbial growth in the sample, thus improving the shelf life of the seed [12]. The moisture content recorded in the seed is lower than those reported for *Olax subscorpoidea* seed [13]. Proteins are important components of diet needed for growth and repair of worn out tissues and its basic function in nutrition is to supply adequate amount of amino acids [14]. *Prosopis africana* seed can be used as an alternative protein source with 30.71 % crude protein for poultry since protein supplement are ingredients than contain more than 20 % protein [15]. Crude fibre are important in the digestion of food in the intestine. They also prevent constipation, lowering the cholesterol level in the blood and reducing the risk of cardiovascular disease [16]. The crude fibre content of 6.47 % recorded for *Prosopis africana* seed is lower when compared with previous report for *Afzelia africana* (8.79 %) by Olorunmaiye et al. [17]. This difference could be attributed to processing methods as well as species. The ether extract value recorded in this study 3.66 % is lower than the values reported for non-roasted *Afzelia africana* seed (4.69 %), *Daniellia oliveri* seed (7.09 %) but much higher than that of roasted *Afzelia africana* seed (2.77 %) as reported by (FAO, 1998). Fats are important in diets for energy and also help in transport of fat soluble vitamins [18, 19]. They also increase the palatability of foods by absorbing and retaining their flavours [20]. Carbohydrates in *Prosopis africana* seed (56.87 %) is lower than values reported for *Albizia lebbeck* seed oil (43.21 %) reported by Alireza et al. [21]. Carbohydrates play a significant role in providing energy for metabolism for living organism [22]. The energy content contained in the sample 583.26 kcal/g is higher compared to previous reports by Aremu et al. [2] This result indicates that the dietary inclusion of *Prosopis africana* seed in the diet of animals is capable of supplying adequate energy needed for the body's metabolic and physical activities.

Table 1. Proximate composition of *Prosopis africana* seed meal oil

Parameters	% Composition
Moisture	5.62 ± 0.01
Crude protein	30.71 ± 1.00
Crude fibre	6.47 ± 0.02
Ether extract	3.66 ± 0.00
Ash	5.08 ±1.10
Energy (kcal/g)	383.26 ± 2.33

3.2 Mineral Composition of PASO

Mineral composition of *Prosopis africana* seed meal is presented in Table 2. The sample contains calcium, potassium, phosphorus, magnesium, sodium, manganese, zinc, copper and iron at 403.8 (mg/100g), 606.1 (mg/100g), 142.8 (mg/100g), 281.3 (mg/100g), 101.7 (mg/100g), 38.56 (mg/100g), 38.56 (mg/100g), 19.10 (mg/100g), 42.28 (mg/100g) and 14.93 (mg/100g) respectively.

Mineral analysis of *Prosopis africana* seed reveals the presence of potassium > calcium > magnesium > phosphorus > sodium > copper > manganese > zinc > iron in order of abundance. Phosphorus is essential for the maintenance of cells for the production of DNA and RNA [23]. Calcium aids bone and teeth formation [24]. Magnesium is an important mineral element which facilitates circulatory activities in the body of animals [25]. Iron is an important components of haemoglobin [26,27] while sodium plays a role in body fluid maintenance in the body tissues [26]. Zinc helps to maintain molecular structure of cellular membrane structures [28]. Copper is an essential element in human body and exists as an integral part of copper proteins ceruloplasmin which is concerned with the release of iron from the cells into the plasma and is involved in energy metabolism [24]. The presence of copper, manganese and zinc indicates that *Prosopis africana* seed is essential for immune functions [29,30].

Table 2. Mineral composition of PASO

Constituents	Composition (mg/100g)
Calcium	403.8 ± 0.45^{a}
Potassium	606.1 ± 1.67^{a}
Phosphorus	142.8 ± 1.06^{b}
Magnesium	281.3 ± 2.65^{b}
Sodium	101.7 ± 0.34
Manganese	38.56 ± 0.25^{c}
Zinc	19.10 ± 0.04
Copper	42.28 ± 0.01^{c}
Iron	14.93 ± 0.15

3.3 Amino Acid Composition of PASO

Amino acid composition of *Prosopis africana* seed is presented in Table 3. The sample contains lysine, histidine, arginine, aspartic acid, threonine, serine, glutamic acid, proline, glycine, alanine, cystine, valine, methionine, isoleucine, leucine, tyrosine, phenyl alanine and tryptophan at 4.18 g/100g, 2.31 g/100g, 4.85 g/100g, 8.61 g/100g, 2.80 g/100g, 3.11 g/100g, 11.44 g/100g, 3.29 g/100g, 3.47 g/100g, 5.22 g/100g, 1.08 g/100g, 4.72 g/100g, 1.40 g/100g, 3.22 g/100g, 8.31 g/100g, 2.40 g/100g, 3.85 g/100g and 0.90 g/100g respectively.

Table 3. Amino acid composition of PASO

Parameters	Concentrations (g/100g)
Lysine	4.18 ± 0.12^{b}
Histidine	2.31 ± 0.01
Arginine	4.85 ± 0.18^{b}
Aspartic acid	8.61 ± 0.28^{b}
Threonine	2.80 ± 0.01
Serine	3.11 ± 0.01
Glutamic acid	11.44 ± 0.38^{a}
Proline	3.29 ± 0.01
Glycine	3.47 ± 0.00
Alanine	5.22 ± 0.12^{b}
Cystine	1.08 ± 0.00
Valine	4.72 ± 0.17^{b}
Methionine	1.40 ± 0.00
Isoleucine	3.22 ± 0.00
Leucine	8.31 ± 0.17^{a}
Tyrosine	2.40 ± 0.01
Phenylalanine	3.85 ± 0.02
Tryptophan	0.90 ± 0.00

The result on the amino acid composition of *Prosopis africana* seed revealed that it is rich in both essential and non-essential amino acid. The levels of some of the essential amino acid are comparable to that of WHO [31]. The result therefore reveals that *Prosopis africana* seed would complement well with those protein sources that are low in lysine, methionine, threonine, tryptophan, leucine, isoleucine and histidine. These results are similar to those reported by Onwuka (2005). Comparatively, among the non-essential acids glutamic acid is high in the entire sample when compared with those of *Blighia sapida* (2.80 mg/100g) (Adeboye *et al*., 2004). The values obtained are similar to the amino acid content of *Lannea kerstingii* seed oil reported by Judicael et al. (2017). Amino acids are building blocks of proteins which are necessary for gene expression, metabolic pathways and function of cells [32] for instance, histidine promotes the function of the kidney and immune system [33]. Lysine function is directly linked to fat metabolism, cell division and growth where as methionine prevents reactive oxygen species or free radicals [34]. Phenylalanine is necessary for the signaling of available glucose and insulin secretion [35]. Alanine and glutamic acid are source of energy to cells while aspartate and glycine are involve in the balance of central nervous system and collagen formation [36]. Isoleucine promotes muscle formation and also provides fuel (glucose) for effective activity of the cells [37].

3.4 Vitamin Analysis of *Prosopis africana* Seed Oil

The seeds of *Prosopis africana* possess significant quantities of water soluble vitamins –ascorbic acid (vitamin C) and vitamin A precursor, folic acid, niacin, thiamine and riboflavin. According to Awuchi et al. (2020) vitamins are a diverse group of inorganic molecules required in small quantities in the diet for health, growth and survival. Vitamin A is a component of the visual pigments in the retina which regulates gene expression and cell regulators [38]. Vitamin C maintains blood vessels flexibility, improves arteries circulation in the arteries and also act as an antioxidants thereby scavenging free radicals [39]. Riboflavin (vitamin B_2) is synthesized by all green plants, most bacteria, yeast and moulds. Animals have so far not been shown to synthesize riboflavin. Persons deficient in vitamin B_2 show keratitis, coerneal vascularization, glossitis, cheilosis and seborrheic dermatitis [40, 41]. Vitamin D is responsible for regulating mineral metabolism for bones and other organs in the body [42, 43]. Vitamin K plays an integral role in blood clotting [44]. Since the *Prosopis africana* seed contains reasonable amounts of vitamins, it could a good source of vitamins in animal nutrition.

Table 4. Vitamin Analysis of *Prosopis africana* Seed Oil

Parameters	Scientific name	Composition (mg/100g)
Vitamin A	Retinol	0.55 ± 0.01
Vitamin B_1	Thiamin	0.21 ± 0.00
Vitamin B_2	Riboflavin	0.08 ± 0.00
Vitamin B_3	Niacin	0.25 ± 0.01
Vitamin B_5	Pantothenic acid	0.10 ± 0.00
Vitamin B_6	Pyridoxine	0.18 ± 0.02
Vitamin B_9	Folic acid	0.06 ± 0.01
Vitamin B_{12}	Cyanocobalamin	0.20 ± 0.00
Vitamin C	Ascorbic acid	8.56 ± 0.18^{a}
Vitamin D	Cholecalciferol	0.33 ± 0.01
Vitamin E	Tocopherol	11.67 ± 0.21^{b}
Vitamin K	Phytomenadione	0.08 ± 0.01

4. CONCLUSION

It was concluded *Prosopis africana* (*African mesquite*) is rich in several nutrients that have numerous health benefits including tissue maintenance, coordination of body functions and other biochemical and physiological functions in the body.

FUNDING

This study has not received any external funding.

COMPETING INTEREST

The authors declare that there are no conflicts of interests.

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