African Multidisciplinary
Journal of Sciences and Artificial Intelligence

ISSN : 3434-9871

Index: Harvard, Boston, Sydney University, Dimensions, Lens, ResearchGet Scilit, Semantic, Google Scholar, Base etc

https://doi.org/10.58578/AMJSAI.v1i2.4165

Antinutritional Factors of Seed, Seed Hull, and Pod, of African Locust Bean (*Parkia Biglobosa*)

Mathew Jacob[1], A. J. Amuda[2], Isaac John Umaru[3]
Federal University Wukari, Nigeria
umaruisaac@gmail.com

Article Info:

Submitted:	Revised:	Accepted:	Published:
Oct 20, 2024	Nov 5, 2024	Nov 17, 2024	Nov 22, 2024

Abstract

Parkia biglobosa (African locust bean), is a genus of flowering plants of the Fabaceae family and is one of the many species of trees which serve as sources of food and medicinal purposes to the indigenous people of Africa. It is a perennial deciduous tree and provides shade for man. The research work was carried out in the Department of Animal Production and Health, Faculty of Agriculture and Life Sciences Federal University Wukari laboratory. The samples of different part of African locust bean (*Parkia biglobosa*) tree were collected within the University environment. The different part collected were as follows: Seed, Seed Hull, and Pod and each one serve as a treatment (T_1...T_3). Samples collected were oven dried and milled for laboratory analysis to determine the anti-nutritional factors (ANFs) using standard techniques. The following anti-nutritional factors were determined: Saponin, Tannin, Phytate, Alkaloids, Oxalate, Phenol, Lectin, Flavonoids and Cyanin. Data obtained were subjected to analysis of variance (ANOVA) using SPSS version 23.0.2018. The results of analysis showed that all the ANFs (Saponin (0.21-0.24%), Tannin (0.02-0.07%), Phytate (0.31-0.32%), Alkaloids (0.24-0.29%), Oxalate (0.20-0.24%), Phenol (0.15-0.29%), Lectin (51.94-78.28 Lu/mg), Flavonoids (0.004-0.007%) and Cyanin (5.28-11.40 mg/kg) observed varied significantly ($p<0.05$) across the treatments, such that T_3 (pod) had the highest

values in all the ANFs while the T_1 (Seed) had the lowest value except for saponin and Lectin. However, T_1 in oxalate and flavonoids and T_3 in alkaloids respectively. In conclusion the anti-nutritional factors of the African locust bean (*Parkia biglobosa)* tree parts, were lower than the tolerance level. Consequently, ruminant farmers can include pod in formulating ration for their livestock.

Keywords: Antinutritional, Seed, Seed Hull, Pod, African, Locust Bean, *Parkia Biglobosa*

INTRODUCTION

The African locust bean tree, *Parkia biglobosa* is a perennial tree legume which belongs to the sub-family Mimosoideae and family Leguminosae (now family Fabaceae). The savannah region of West Africa up to the southern edge of the Sahel area (13^0) constitutes its habitat (Abdulhamid *et al*., 2017.) *Parkia biglobosa* popularly called the African locust bean tree are known to occur in a diversity of agro ecological zones from tropical rainforest where the rain is high to the arid zone where it is low. The height ranges from 7-30 m. The tree is large crown and wide spreads with low branches; and the leaves of *Parkia biglobosa* are dark green, bipinnate, alternate and about 1.5-8 mm x 8-30 mm in size with about 13-60 pairs of leaflets of distinct venation on a long rachis. The colors of African locust bean pods when matured are dark brown to pink brown; they are up to 2 cm wide and 45 cm long. It can be found up to 30 seeds in one pod embedded in a yellow pericarp. The seeds have a hard test with an average weight of 0.26 g and relatively large (Cheeke, 1989).

Parkia biglobosa has a wide distribution ranging across the Sudan and Guinea savanna ecological zones. *Parkia biglobosa* tree has the capacity to withstand drought conditions because of its deep tap root system and an ability to restrict transpiration. *Parkia biglobosa* tree is an important food tree and plays a very vital role in the rural economics of West African countries: Senegal, the Gambia, Guinea Bissau, Guinea, Sierra Leone, Mali, Côte d Ivoire, Burkina Faso, Ghana, Togo, Benin, Niger, Nigeria; West-Central Tropical Africa: Cameroon; Central African Republic and Northeast Tropical Africa: Chad; Sudan (Hall, 1997; Sabiiti 1992).

Anti-nutritional factors are a chemical compound synthesized in natural food and / or feedstuffs by the normal metabolism of species and by different mechanisms (for example

inactivation of some nutrients, diminution of the digestive process or metabolic utilization of food/feed) which exerts effect contrary to optimum nutrition (Soetan, and Oyewol, 2009). Such chemical compounds, are frequently, but not exclusively associated with foods and feeding stuffs of plant origin. These anti-nutritional factors are also known as secondary metabolites in plants and they have been shown to be highly biologically active. These secondary metabolites are secondary compound produced as side products of processes leading to the synthesis of primary metabolites. One major factor limiting the wider food utilization of many tropical plants is the ubiquitous occurrence in them of a diverse range of natural compounds capable of precipitating deleterious effects in man, and animals' compound which act to reduce nutrient utilization and/or food intake are often referred to as anti-nutritional factors (Shanthakumari, Mohan, and Britto, 2008).

The aim of this work was to study Antinutritional Factors of Seed, pulp and stem-bark, of African Locust Bean (*Parkia Biglobosa*)

MATERIALS AND METHODS

Experimental site:

The study was carried out in Teaching and Research Farm of Federal University Wukari Taraba state. Wukari lies between latitude 7˚51'N to 7˚85'N and longitude 9˚46'E to 9˚78'E of the Greenwich meridian. The mean annual rainfall value range from 1000 - 1500 mm. The onset of the raining season is usually around April while the offset period is October. The mean maximum temperature is experienced around April at about 40˚C while the mean minimum temperature occurs between the period of December and February at about 20˚C (Oyatayo *et al.*, 2015).

Samples collection and processing

The samples of the different parts of *Parkia biglobosa* were collected from within the Federal University Wukari Environment. The collected samples were oven dried at 65^0C and mill before taken for further laboratory analysis.

Analysis Site

The analysis was carried out at the Department of Animal Science, Ruminant Laboratory, Faculty of Agriculture University of Ibadan, Ibadan,

Parameters

The anti-nutritional factors analyzed such as phenol, saponin, tannin, phytate, oxalate, alkaloids, lectins, flavonoids, cyanogenic glycoside and anthocyanin were determined according to Sofowora (1993) method.

Data analysis

Data collected were subjected to one-way analysis of variance (ANOVA) using SPSS (version 23.0.2018). The treatment means will be compared using the multiple Duncan Multiple range test (Duncan, 1951).

RESULTS AND DISCUSSION

The anti-nutritional factors of different parts of locust bean (*Parkia biglobosa)* tree.

Table 1 shows the anti-nutritional factors of different parts of African locust bean (*Parkia biglobosa)* tree. Phenol, tannins, phytate, saponin, lectin, oxalate, flavonoids, cyanin and alkaloids were ranged between 0.15 and 0.29%, 0.02 and 0.07%, 0.25 and 0.32%, 0.21 and 0.24%, 51.94 and 78.28 Lu/mg, 0.20 and 0.24%, 0.004 and 0.007%, 5.28 and 11.30% and 0.24 and 0.29% respectively. Significant differences ($P<0.05$) occurred among the three treatment in all the phytochemicals property which was expected, owning to the different parts of African locust bean (*Parkia biglobosa)* tree examined. Phenolic compounds help to prevent the death of crop as phenolic compounds from plant extracts act as antimicrobial agent (Ofokansi, *et al*., 2005). Phenolic content of the *Parkia biglobosa* parts ranged from 0.15 to 0.29 %. High phenols observed in treatment T_2 (seed hull) suggests that it can act as antioxidants, protecting cells from oxidative damage caused by free radicals. The values obtained from tannins for all the parts except Seed hull cannot have a negative impact on the ruminants regarding the digestion of protein, carbohydrates and minerals by forming complexes with them, thus reducing their availability in the rumen and post-rumen. Goel & Makkar, (2012) reported that low dietary tannin levels improve nitrogen utilization by ruminants. Tannins in *Parkia biglobosa* parts varied as it's shown in this work. High levels of tannin (5-10%) were reported to have toxic effects on ruminants, leading to negative impacts on their health and well-being (Amuda and Okunlola 2023). However, goats are known to have a threshold capacity of about 9% dietary tannins (Natis and Malachek, 1981). The values of tannins obtained in this study (0.02 to 0.07%) could be tolerated by sheep, goats and cattle without adverse effects on their health (Amuda and Okunlola 2023). The results in Table 1 showed that the phytate content of the *Parkia biglobosa parts* ranged

from 0.31 to 0.32%. The parts with the highest phytate content was T_2 (Seed hull), while the parts with the lowest phytate content was T_3 (pod). Phytates and oxalate secondary metabolites hindered the absorption and utilisation of minerals such as Ca^{2+}, P^{2+}, Zn^{2+}, Mg^{2+}, Co^{2+}, Mn^{2+} and Fe^{2+}. The two phytochemicals exert adverse effects on animal performance mainly by binding Ca, P, Mg, Zn and some other trace minerals making them unavailable for absorption and utilisation (Diarra *et al.*, 2019, Amuda and Okunlola 2023). However, ruminants through the action of rumen microbes can secrete the digestive enzyme phytase to unlock the stored phosphorus as phytic acid and make it available to ruminants. Dietary oxalate plays an important role in the formation of Ca oxalate, and a high dietary intake of Ca may decrease oxalate absorption and its subsequent urinary excretion. Non-ruminants appear to be more sensitive to oxalate than ruminants because in the latter, rumen bacteria help to degrade oxalate. If ruminants are slowly exposed to a diet high in oxalate, the population of oxalate-degrading bacteria in the rumen increases sufficiently to prevent oxalate poisoning (Amuda and Alagbe 2023). The results in Table 2 showed that the oxalate content of the *Parkia biglobosa* parts ranged from 0.21 to 0.24% while the T_2 (Seed hull), had the highest value (0.24%) and the lowest value (0.21%) was T_1 (seed). Furthermore, oxalate affects Ca and Mg metabolism (Onwuka, 1983), however, ruminants can utilise considerable amounts of high oxalate without adverse effects owing mainly to microbial degradation in the rumen. Saponins are characterized by a bitter taste and foaming properties. Saponins are glycosides that form complexes with cholesterol and interfere with its absorption. The results in the Table showed that the saponin content of the *Parkia biglobosa* part ranged from 0.22 to 0.24%. The parts with the highest saponin content was T_2 (Seed hull), while the parts with the lowest saponin content was T_1 (seed). Saponins have been shown to have both beneficial and detrimental effects on ruminant nutrition. On the other hand, saponins have been found to improve rumen fermentation, increase microbial protein synthesis, and enhance nutrient utilization in ruminants. Saponins can also have negative effects such as reducing feed intake, altering rumen microbial populations, and causing hemolysis in ruminants due to their detergent-like properties (Min *et al.*, 2003). Moreover, saponins have been implicated in reducing the uptake of certain nutrients including glucose and cholesterol. Lectins are carbohydrate-binding proteins found in plants, animals and microorganisms. Table 2 shows that the lectin content of the *Parkia biglobosa* parts ranged from 52.77 to 78.28 Lu/mg. The part with the highest Lectin content was T_2 (Seed hull) and the lowest in T_1 (seed) across the

treatment. Various studies have revealed that lectins can impair nutrient absorption and impaired intestinal function in ruminants, resulting in decreased performance and even death. However, some studies reported that lectins have beneficial effects on ruminant health by improving immune function and reducing inflammation. Moraes *et al.* (2016) reported that supplementing the diet of dairy cows with lectins from soybeans improved the cow's immune response and reduced inflammation. Similarly, a study carried out by Haque *et al.* (2017) observed that feeding goats a diet containing lectins from jack beans had no adverse effects on nutrient utilisation and performance. The values (52.77-78.28 Lu/mg) obtained in this work may not have adverse effects on ruminants. Alkaloids are nitrogen-containing compounds that can have toxic effects on animals if consumed in high amounts. Ruminants animal have varying tolerance levels for alkaloids in the feed, as well as the age and physiological status of the animal. The results in the Table 1 show that the alkaloid content of the *Parkia biglobosa* parts ranged from 0.24 to 0.29%. The part with the highest alkaloid content was T_2 (Seed hull), while the part with the lowest alkaloid content was T_1, (Seed). Cyanins are major class of plant phenolic pigments, responsible for the red, purple or blue color of leaves, flowers, tubers, fruits and certain vegetables. The results in Table 1 show that the cyanin content of the *Parkia biglobosa* parts ranged from 8.30 to 11.40 mg/kg. The part with the highest Cyanin (11.40 mg/kg) was T_2 (Seed hull), while the part with the lowest (8.30 mg/kg) was T_1 (Seed) across the treatment. Flavonoids are widely spread in plants which play in many functions. Flavonoids may act as a chemical messenger or physiological regulator; it is also act as cell cycle inhibitor. Some flavonoids contain inhibitory activity against organisms that cause plant disease e.g. Fusarium oxysporum (Lanzotti *et al.*, 2008). Flavonoids have protective effects including anti-inflammatory, anti-oxidant, anti-viral, and anti-carcinogenic properties. The results in Table 2 show that the flavonoids content of the *Parkia biglobosa* parts ranged from 0.004 to 0.007%. The part with the highest flavonoids (0.007%) was T_2 (Seed hull), while the part with the lowest flavonoids (0.004%) was T_1, (Seed). The widespread distribution of flavonoids, their variety and their relatively low toxicity compared to other active plant compounds (for instance alkaloids) indicate that many animals, including humans, ingest significant quantities in their diet.

Table 1: Anti-nutritional factors of different parts of African locust bean (*Parkia biglobosa*)

PRMTS	TREATMENTS			SEM
	T_1	T_2	T_3	
Phenol (%)	0.25^{b}	0.29^{a}	0.22^{e}	0.00
Tannin (%)	0.05^{b}	0.07^{a}	0.04^{c}	0.00
Phytate (%)	0.31^{b}	0.32^{a}	0.31^{b}	0.00
Saponin (%)	0.22^{c}	0.24^{a}	0.23^{b}	0.00
Lectin (lu/mg)	52.77^{e}	78.28^{a}	61.41^{c}	0.00
Oxalate (%)	0.21^{c}	0.24^{a}	0.22^{b}	0.00
Flavonoids(%)	0.004^{c}	0.007^{a}	0.005^{b}	0.00
Cyanin (mg/kg)	8.30^{d}	11.40^{a}	9.78^{c}	0.00
Alkaloids (%)	0.24^{c}	0.29^{a}	0.27^{b}	0.00

a, b, c, e, f = means on the same row with different superscripts are significantly ($P<0.05$) different. T_1= *Parkia biglobosa* seed, T_2= *Parkia biglobosa* seed hull, T_3= *Parkia biglobosa* pod,

CONCLUSION

Anti-nutritional factors in foods are responsible for the deleterious effects that are related to the absorption of nutrients and micronutrients which may interfere with the function of certain organs. Most of these anti-nutritional factors are present in foods of plant origin. Thus, the presence of cyanin, Flavonoids, oxalate, Phenol, lectins, phytate, tannins, alkaloids, and saponins in foods may induce undesirable effects in humans and animals if their consumption exceeds an upper limit. Certain harmful effects might also be due to the breakdown products of these compounds. However, some anti-nutritional factors as well as their breakdown products may possess beneficial health effects if present in small amounts. The results of the Anti-nutritional factor of different parts of African locust bean (*Parkia biglobosa)* tree samples collected from Federal University Wukari Environment indicated that these Anti-nutritional constituents are present on the *Parkia biglobosa* samples. However, these constituents are more concentrated in seed hull than the others. Some of the benefits derivable from this research as regards these showed that the presence of Alkaloids signified the possession of antimicrobial properties within the *Parkia biglobosa* while the presence of flavonoid shows possession of antioxidant, anti-inflammatory and antiviral infection activities. Flavonoids was said to have the ability to lower the cholesterol level. Saponins are found to have numerous health benefits. Recent studies have illustrated

saponin effects which have been beneficial on the control of blood cholesterol levels, bone health, cancer, and building up of the immune system. This work therefore elucidates the presence of these Anti-nutritional content in these *Parkia biglobosa* tree parts.

Recommendation

The results of Anti-nutritional factors composition indicate that Anti-nutritional reside mostly in seed hull. However, since seed is utilised by man the seed hull, pulp and pod can be incorporated into ruminants feed, if processed to improve the quality by reducing ANFs levels to enhance the digestibility and utilisation by ruminants.

Acknowledgements

I wish to express my profound gratitude to Dr. J.K. Onaleye. Prof. S.I Daikwo for their advice and Mr. Jacob Buggi Zira, Mrs Ruth Jacob for their contributions toward the completion of this research financially.

REFERENCES

Abdulhamid, B., Dawaki, S.A., & Dau, H.J. (2017). Diameter at breast height-crown width prediction models for Parkia biglobosa (Jacq) R. Br. ex G. Don. *Curr Life* Sci, 3(2): 15-21.

Cheeke, P.R. (1989). Toxicants of plant origin: Glycosides (CRC Press: United States).

Sen, S., Makkar, H.P., & Becker, K. (1998). Alfafa saponins and their implication in animal nutrition. *Journal of Agricultural and Food Chemistry,* (46): 131-140.

Hall, J.B., Tomlinson, H.F., Oni, P.I., Buchy, M., & Aebischer, P.D. (1997). *Parkia biglobosa*: A Monograph. School of Agricultural and Forest Sciences, University of Wales, Bangor, UK.

Sabiiti, E.N., & Cobbina J. (1992). *Parkia biglobosa*: a potential multipurpose fodder tree legume in West Africa. *Int Tree Crops J*; 7(3): 113-139.

Soetan, K.O., & Oyewole, O.E. (2009). The need for adequate processing to reduce the anti-nutritional factors in animal feeds: A review. *Afr J Food Sci* 3(9): 223-232

Shanthakumari, S., Mohan, V., & Britto, J. (2008). Nutritional evaluation and elimination of toxic principles in wild yam (*Dioscorea spp*.). Tropical and Subtropical

Oyatayo T.K., Songu A.G., Amos A.G., & Ndabula, C. (2015). Assessment of heavy metal concentration in hand dug well water from selected land uses in Wukari Town, Wukari, Taraba state Nigeria. *Journal of Geoscience and Environmental protection* (3) 1-10

Sofowora, A.D. (1993). Phytochemical screening of medicinal plants and traditional medicine in African edition. spectrum Book. Ltd., Nigeria 150-156

Duncan, D.B. (1951). Multiple range and multiple F-tests. Biometrics, 11(1).1-42.

Ofokansi, K.C., Esimone, C.O. & Anele, C.K. (2005). Evaluation of the in vitro combined antibacterial effects of the leaf extracts of Bryophyllum pinnatum (Farm Crassulaceae) and Ocimum gratissimum (Farm Labiate). *Plant Prod. Res. J.* 9: 23-27.

Goel, G., & Makkar, H.P.S., (2012). Methane mitigation from ruminants using tannins and saponins. *Trop. Anim. Health Prod.* 44, 729-739.

Amuda, A.J., & Okunlola, D.O. (2023). Nutrient Composition, Phytochemical Properties and *In Vitro* Gas Fermentation Assessment of Some Selected Legume Forage Seeds that can be utilized by Ruminants. *Nigerian Agricultural Journal*, 54: 512-521

Natis, A.S., & Malachek, J.C. (1981). Digestion and utilization of nutrients oak browse by goats. *Journal of Animal Science.* 52: 283-288.

Diarra, S.S., Sylla, M., & Diallo, M.M. (2019). Evaluation of the nutritional value and in vitro ruminal fermentation of Senna hirsuta seed meal. *International Journal of Livestock Research,* 9 (7): 106-115. doi:10.5455/ijlr.20180619022552.

Onwuka, C.F. (1983). Nutritional evaluation of some Nigeria browse plants in the humid tropics. Ph.D. Thesis University of Ibadan, Ibadan, Nigeria.

Min, B.R., Barry, T.N., Attwood, G.T., & Mc-Nabb, W.C. (2003). The effect of condensed tannins on the nutrition and health of ruminants fed fresh temperate forages: a review. *Animal Feed Science and Technology*, 106(1-4): 3-19.

Morales, A., Pérez, M., Castro, P., Ibarra, N., Bernal, H., Baumgard, L.H., & Cervantes, M. (2016). Heat stress affects the apparent and standardized ileal digestibility of amino acids in growing pigs. *Journal of Animal Science,* 94(8): 3362-3369

Haque, A., Engel, J., Teichmann, S.A., & Lönnberg, T. (2017). A practical guide to single-cell RNAsequencing for biomedical research and clinical applications. *Genome medicine,* 9 (1): 1-12.

Lanzotti, V., Galeotti, F., Barile, E., Curir, P., & Dolci, M. (2008). "Flavonoids from carnation (*Dianthus caryophyllus*) and their antifungal activity". Phytochemistry Letters 1: 44. doi:10.1016/j.phytol.2007.10.001.