

RUN -18

Chemical Composition of Neem (*Azadirachta indica*) Plant Parts as Feed Resources for Ruminants

O.A. Fasae and T.O. Aganto

Department of Animal Production and Health, Federal University of Agriculture, P.M.B.2240,
Abeokuta, Nigeria.

Corresponding author: O.A. Fasae; E-mail: animalex@yahoo.co.uk

Abstract

An experiment was conducted to determine the proximate and phytochemical compositions of Neem (*Azadirachta indica*) plant leaves, seeds and stem bark. Fresh matured neem leaves, seeds and bark were harvested, air dried and ground into meal. The meals were analyzed for their proximate and phytochemical compositions. The stem bark and leaves had significantly ($p < 0.05$) higher dry matter values than the seeds. The leaf had significantly ($p < 0.05$) higher crude protein and ash values than the bark and seed. Values for acid and neutral detergent fibres, and acid detergent lignin were significantly ($p < 0.05$) different among the samples with the bark recording the highest followed by the leaves. The alkaloid, flavonoid, tannin and saponin values were significantly ($p < 0.05$) different from each plant part with the bark having the highest value followed by the leaf. It is concluded that the high crude protein content of Neem leaf and the low phytochemical values of the seed and leaf relative to the bark should be exploited as feed resources for ruminants.

Keywords: *Azadirachta indica*, leaf, bark, seeds, chemical compositions

Introduction

Dry season nutritional stress is a major constraint and threat to sustainable production of ruminant animal in Nigeria. This is because during this period most grasses and legumes dry up, hence the need to exploit drought resistance forages to counter this incessant problem which has been recognized as a limiting factor to a successful ruminant production enterprise. Neem is a common tropical multipurpose evergreen tree which is extremely resilient to challenging environment and grows very rapidly with broad-spreading leaves. The different parts of neem e.g. Leaf, seed, bark, flower, fruit and root are traditionally well known for their medicinal values.

Various biological activities and therapeutic potential (Brahmachari, 2004) of neem parts and are utilized for a variety of purposes in industry, health and animal agriculture. Neem is regarded as a promising tree species that can be utilized in various ways to benefit agricultural communities throughout the world (Tinghui *et al.*, 2001). It has been described as a promising potential feed ingredient with considerable attempts made at rendering it suitable for livestock. This therefore can help in bridging the gap between supply and demands of the feeding stuff during periods of scarcity.

Based on this traditional and other uses of Neem, this study was aimed at evaluating the chemical and phytochemical constituents of Neem plant parts as feedstuff in ruminant production system.

Materials and Methods

Neem (*Azadirachta indica*) plant leaves, seeds and stem barks were harvested fresh from matured neem trees at the Federal University of Agriculture, Abeokuta and its environs. The harvested plant parts were washed, chopped into small pieces and air dried for 15 days in shades. The air dried plant parts were ground into meal using a hammer mill. The meals were then sieved using 2mm sieve, bottled, labeled and stored for proximate and phytochemical analysis. Six samples per plant part were analyzed for their proximate compositions according to AOAC, (2000) and detergent fibre, acid detergent fibre and acid detergent lignin using the methods of Van Soest *et al.* (1991). Quantitative phytochemical compositions including percentage composition of saponins, alkaloids, flavonoids, and tannins were determined as described by Harbone (1973) and Sofowora (2008).

Data collected was subjected to one-way analysis of variance using SAS (1999) package and treatment means was separated using Duncan multiple range test (Duncan, 1955).

Results and Discussion

The proximate composition and fibre fractions of parts of *Azadirachta indica* are presented in Table 1. The bark and leaf had significantly ($p < 0.05$) higher DM values than the seed. There were significantly ($p < 0.05$)

differences in the crude protein contents of the samples with the leaf having the highest value followed by the seed. The seed had significantly ($p < 0.05$) higher ether extract than the leaf and bark, while the value for the leaf was higher ($p < 0.05$) than that of the bark. The leaf had a significantly ($p < 0.05$) higher ash content than the seed and bark. There were significant ($p < 0.05$) differences in the fibre contents with the bark having the highest values followed by the leaf and seed, respectively. Values for alkaloid, flavonoid, tannin and saponin were significantly ($p < 0.05$) different among the samples with the bark having the highest value followed by the leaf and seed, respectively.

Table 1: Proximate and fibre fraction composition (%) of *Azadiractha indica* plant parts

Parameters	Bark	Leaves	Seeds	SEM
Dry matter	96.67 ^a	98.00 ^a	88.20 ^b	1.83
Crude protein	7.20 ^c	19.76 ^a	13.32 ^b	1.21
Ether extract	4.00 ^c	7.33 ^b	9.97 ^a	1.19
Ash	9.67 ^b	11.67 ^a	9.33 ^b	0.52
Neutral detergent fibre	59.33 ^a	56.67 ^b	51.33 ^c	1.62
Acid detergent fibre	40.63 ^a	37.33 ^b	30.00 ^c	1.43
Acid detergent lignin	11.33 ^a	7.67 ^b	6.33 ^b	0.44

abc Means in the same row with the same superscripts are significantly different ($P < 0.05$)

The CP content of the leaf is in line with values of 17.5 and 20.9% reported by Bais *et al.* (2002) and Ogbuewu *et al.*, (2011). Ramana *et al.* (2000) reported lower CP content of 9.7%. Variations observed across literature could be due the concentration of plant constituents which could vary from one geographical location to another depending on the age of the plant, differences in topographical factors, varietal differences, and the nutrient concentrations of the soil as well as processing methods. Norton (1994) reported that feeds with less than 6% CP levels are unlikely to provide the minimum ammonia levels required for maximum microbial growth in the rumen. The relatively high crude protein contents of the plant parts in this study is an indication that they could supply the critical nutrients needed to enhance ruminal microbial growth and fermentation of feed (Raghuvansi *et al.*, 2007). The significantly higher ether extract and ash contents of the seed and leaf respectively is expected and in line with reports in literature.

The bark had the highest neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin contents, followed by the leaf and the seed. Similar values for NDF and ADF have been reported for tropical fodder trees (Ramana *et al.*, 2000). The NDF concentration of the plant parts were below 60% which has been reported as the threshold level of NDF in tropical plants beyond which feed intake of ruminants is affected (Meissner *et al.*, 1991). The low fibre content of the neem plant parts, tend to suggests it as a potential and important source of readily fermentable carbohydrates in ruminant feed.

The phytochemical compositions (%) of different parts of neem plant are presented in Table 2. The plant parts had significantly ($p < 0.05$) different phyto-chemical values. The bark had the highest alkaloids, flavonoids, saponin, and tannin contents followed by the leaf and seed. The high saponin content of the bark compared to the other plant parts strongly highlights its use in agriculture, industrial and various anti-microbial activities. The flavonoids observed across the plant parts are noted to have antioxidant activity and protect cells against oxidative damage (Willis *et al.*, 1996). Flavonoids are one of the most popular secondary metabolites possessing a variety of biological activities at nontoxic concentrations (Irshad *et al.*, 2010).

Table 2: Phytochemical composition (%) of *Azadiractha indica* plant parts

Parameters	Bark	Leaves	Seeds	SEM
Alkaloid	2.58 ^a	1.24 ^b	0.88 ^c	0.26
Flavonoid	2.23 ^a	0.86 ^b	0.22 ^c	0.29
Tannin	2.43 ^a	1.97 ^b	1.74 ^c	0.10
Saponin	2.99 ^a	2.15 ^b	1.99 ^c	0.16

abc Means in the same row with the same superscripts are significantly different ($P < 0.05$)

The phytochemical properties identified in Neem have been severally reported in other plants to play important role in arresting disease pathogenesis and used traditionally as analgesic, antimicrobial and soothing herbs (Olafimihan, 2004; Ganesh and Vennila, 2011). The concentrations of these compounds in neem plant

parts as observed in this study are similar to what have been reported for other ligneous fodder species and below the level that will depress feed intake in ruminants (Niranjan *et al.*, 2008). Various neem components have shown every indication of being safe to mammals in normal use (Manikandan *et al.*, 2009).

Conclusion

The study reveals that neem plant parts vary in their chemical and phytochemical compositions. The seeds had lower phytochemical values than leaves and bark. The leaf is high in crude protein seed and could be a good source of nutritional supplement in the diet of ruminants. The presence of phytochemical constituents in neem plant parts also confirms and supports the traditional use of neem plant in the management of various diseases.

References

- Aganga A.A. and Tshwenyane S.O. (2003). Feeding value and anti-nutritive factors of forage tree legumes. *Pakistan Journal of Nutrition*, 2: 170–177.
- Anyanwu, G. I. and Dawet, A. (2005). Pharmacological and phytochemical screening of *Hyptis suaveolens* Poit (Lamiaceae) for bioactivity in rodents. *Nigerian Journal of Botany*, 18: 190-196.
- AOAC, 2000. Association of Official Analytical Chemists Inc. Volume 2, Washington DC,
- Bais, B., Purohit G.R, Dhuria R.K. and Pannu U. (2002). Nutritive value of sares and neem leaves in Marwari goats. *Indian Journal of Animal Nutrition*, 19(3): 266-268.
- Bhowmik S., Chowdhury S.D, Kabir M.H and Ali M.A. 2008. Chemical composition of some medicinal plant products of indigenous origin. *The Bangladesh Veterinarian*, 25(1):32.
- Brahmachari G, 2004. Neem—An omnipotent plant: A retrospection. *Chem BioChem*, 5: 408.
- Duncan D.B. 1955. Multiple range and multiple F tests. *Biometrics*, 11:1-42.
- Fasae, O.A. and Omosun, J.E.O. (2013). Influence of tannin in selected forages on the growth performance and faecal egg count of semi-intensively managed sheep. *Bull. Anim. Hlth Prod. Afri.*, 61: 247-252.
- Ganesh, S. and Vennila, J.J. (2011). Phytochemical analysis of *Acanthus iliffolius* and *Avicennia officinalis*. *Res. J. Phytochem.*, 4: 109-111.
- Harbone J.B. (1973). Phytochemical methods: A guide to Modern technique of plant analysis. Chapman and Hall, London.
- Irshad, Ahmad, M.I., Goel, H.C. and Rizvi, M.M.A. (2010). Phytochemical screening and high performance TLC analysis of some cucurbits, *Res. J. Phytochem.*, 4: 242-247.
- Manikandan, P., Anandan, R. and Nagini, S. (2009). Evaluation of *Azadirachta indica* leaf fractions for *in vitro* antioxidant potential and protective effects against H₂O₂-induced oxidative damage to pBR322 DNA and red blood cells. *J. Agric Food Chem.*, 57: 69-90.
- McNabb, W.C., Waghorn, G.C., Peters, J.S. and Barry T.N. (1996). The effect of condensed tannins in *Lotus pedunculatus* on the stabilization and degradation of ribulose-1, 5-bisphosphate carboxylase (EC 4.1.1.39; Rubisco) protein in the rumen and the sites of Rubisco digestion. *British Journal of Nutrition*, 76: 535–549.
- Meissner, H.H., Viljoen, M.O. and Van Niekerk, W.A. (1991). Intake and digestibility by sheep of Antherphora, Panicum, Rhodes and Smooth finger grass. In: *Proc. 4th International Rangeland Congress*, September 17th–21st, Montpellier, France.
- Niranjan P.S., Udeybir, Singh, J. and Verma, D.N. (2008). Mineral and antinutritional factors of common tree leaves. *Indian Veterinary Journal*, 85: 1067-1069.
- Norton, B.W. (1994). Tree legumes as dietary supplements for ruminants. In: Gutteridge R.C., Shelton H.M. (eds): *Forage tree legumes in tropical agriculture*, 20th Ed. CABI International, Wallingford, UK.
- Ogbuewu, I.P., Odoemenam, V.U., Obikaonu, H.O., Opara, M.N., Emenalom, O.O, Uchegbu, M.C. Okoli I.C, Esonu, B.O and Iloeje, M.U. (2011). The growing importance of neem (*Azadirachta indica*) in agriculture, industry, medicine and environment: A review. *Research Journal of Medicinal Plant*, 5(3): 230-245.
- Olafimihan, C.A. (2004). Effects of seasonal variation on the antibacterial activity of aqueous extract of *Azadirachta indica* fresh stem bark, *Biosci. Res. Commun.*, 16: 13-16.
- Raghuvansi, S.K.S, Prasad, R., Mishra, A.S., Chaturvedi, O.H., Tripathi, M.K., Misra, A.K., Saraswat, B.L and Jakhmola, R.C. (2007). Effect of inclusion of tree leaves in feed on nutrient utilization and rumen fermentation in sheep. *Bioresource Technology*, 98: 511–517.
- Ramana, D.B.V., Singh, S., Solanki, K.R. and Negi, A.S. (2000). Nutritive evaluation of some nitrogen and non-nitrogen fixing multipurpose tree species. *Animal Feed Science and Technology*, 88: 103-111.

- SAS (1999). Statistical Analysis System user's guide (Version 8). SAS Institute Inc., Cary, NC., USA.
- Sofowora, A. (1993). Medical Plants and Traditional Medicine in Africa. (2nd ed.), Spectrum Books Ltd. Ibadan, Nigeria.
- Tinghui, Xin, Malcolm Wegener Michael O'Shea Ma Deling (2001). World distribution and trade in neem products with reference to their potential in China. *Conference of Australian Agricultural and Resource Economics Society, Adelaide, 22-25 January, 2001.*
- Willis J.A., Scott R.S. and Brown L.J. (1996). Islet cell antibodies and antibodies against glutamic acid decarboxylase in newly diagnosed adult-onset diabetes mellitus. *Diabetes Res Clin Pract.*, 33:89–97.
- Van Soest, P.J., Robertson, J.D. and Lewis, B.A. (1991). Methods for dietary fiber, neutral detergent fiber and non-starch polysaccharide in relation to animal nutrition. *J. Dairy Sci.*, 74: 3583-3597.