

NISEB 2010176/11209

Evaluation of the nutritional and anti-nutritional constituents of some selected browse plants in Kwara State, Nigeria

K. M. Okukpe* and A. A. Adeloye

Department of Animal Production, University of Ilorin, Nigeria

(Received October 28, 2010; Accepted December 12, 2010)

ABSTRACT: Fresh leaves and apical parts of the selected browse plants: *Chromolaena odorata*, *Mangifera indica*, *Anacardium occidentale*, *Synedrella nodiflora*, *Azadirachta indica*, *Tridax procumbens*, *Ficus congensis*, *Amaranthus spinosus*, *Hyptis suaveolens*, *Carica papaya* were collected in Ilorin, Kwara State, Nigeria and analyzed for proximate composition and some anti-nutritive component of their leaves.

A high variability was recorded in values of percentage crude protein (C.P.), the range in CP, Ash, CF, Ee, NFE and DM were 5.40 – 33.10g/kg DM, 3.00 – 34.57g/kg DM, 6.13 – 30.50g/kg DM, 1.50–13.30g/kg DM, 10.03 – 61.97g/kg DM and 54.92 – 96.54g/kg DM respectively.

The concentration of antinutritional factors were generally low, tannin content was 0.55% in *Chromolaena odorata* and 5.90% in *Synedrella nodiflora*, phytin content was 0.083 mol kg⁻¹ in *Hyptis suaveolens* and 1.99 mol kg⁻¹ in *Synedrella nodiflora*. Oxalate content was 13.93mg/100g in *Tridax procumbens* and 121.67mg/100g in *Chromolaena odorata* while hydrocyanic acid, HCN content were 49.95 mg/kg in *Amaranthus spinosus* and 201.83 mg/kg in *Mangifera indica*.

The result showed that the browse plants studies had good levels of nutrient, low and safe level of antinutritional factors, and may therefore form good feed resource for modern intensive animal production.

Keywords: Browse plants; Anti-nutritional factors; Kwara State; Nigeria.

Introduction

Browse plants are multipurpose trees and shrubs which constitute one of the cheapest sources of feed for ruminants in many parts of developing countries where animal production is limited by protein/energy deficiencies in diets. They have high potentials as feed resources for ruminants during the dry season since they are less susceptible to climate fluctuation (Dzowela *et al.*, 1995) the diversity and distribution of some browse plants have received early attention in studies carried out for the north (Saleem *et al.*, 1979), Middle belt (Ibeawuchi *et al.*, 2002) and Northeast (Njidda *et al.*, 2008) Nigeria, being perennial shrubs or trees, they are evergreen all the year round, thereby serving as a ready source of feed during off season feeding (Oji *et al.*, 2002, Wahua & Oji, 1987).

*To whom correspondence should be addressed.
E-mail: okukpek@yahoo.com.

Tropical browse have been shown to contain varying quantities of condensed tannin and other antinutritional components that limits their utilization by animal (Njidda *et al.*, 2008). The tree and shrubs are rich in most essential nutrients such as protein and mineral and tend to be more digestible than the grasses and crop residues. Overcoming the constraints of inadequate knowledge of most browse plants nutrient composition and ant nutritional constituents would ensure their development in ruminant nutrition. The evaluation of the nutritional value of common browse plants will form the basis for their use in subsequent nutritional studies. The present study examines the nutritional composition of the browse plant in Ilorin, Kwara State, Nigeria in order to know their usefulness as a dry season feed for ruminant animal.

Materials and Methods

Fresh leaves from the apical portion of the branches of the selected browse plants were used in this study. The plants used include *Anacardium occidentale*, *Hpytis suaveolens*, *Chromolaena odorata*, *Carica papaya*, *Azadirachta indica*, *Amaranthus spinosus*, *Triadax procumbens*, *Mangifera indica*, *Synedrella nodiflora*, and *Azadirachta indica*. All forages were harvested from Take, Ilorin-south metropolians council area of Kwara State. The browse forages were collected by observation and identified in the herbarium of the department of plant biology of the University of Ilorin. The harvested samples were then pooled for each individual tree species and then oven dried of 105°C for 24h to constant weight and ground to pass through a 2mm sieve. The samples were then sub-sampled to obtain three samples for each tree species and used for the laboratory analysis.

Chemical Analysis

The forage samples were analyzed for dry matter (DM), crude protein (CP), ether Extract (EE) and ash according to AOAC (2002) methods, tannin content was determined by the methods of Joslyn (1970). The presence of phytate was determined according to the methods of Wheeler and Ferrel (1971). The oxalate content was determined using the method employed by Ibeawuchi *et al.* (1995) while hydrocyanic acid (HCN) was determined by the method of AOAC (2002). neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined according to the methods of Van Soest *et al.* (1991).

Results and Discussion

The chemical composition of the browse forage species are shown in Table 1, the dry matter (DM) ranged from 54.92% (*Chromolaena odorata*) to 96.54% (*Synedrella nodiflora*). The crude protein (CP) content range was 5.40% (*Carica papaya*) to 33.10% (*Amaranthus spinosus*), while the crude fibre (CF) ranged from 6.13% (*Triadax procumbens*) to 30.50% (*Mangifera indica*) the lowest EE, NFE, and Ash were observed in *Anacardium occidentale* (1.50%), *Chromolaena odorata* (10.03%) and *Anacardium occidentale* (3.00%) respectively.

Variations were observed between the crude protein value obtained in the present study and other reported values. *Triadax procumbens* leaves contain 6.60% CP value. *Azadirachta indica* in the present study has 21% CP which was higher than that of Esonu *et al.* (2006) with CP value of 20.68%. *Synedrella nodiflora* with a crude protein value of 20.60% was lower than that reported by Mecha and Adegbola (1980) with CP value of 21.67%. *Anacardium occidentale* with a CP of 16.30% was higher than that reported by Mecha and Adegbola (1980) with 15.54% CP. *Carica papaya* had a CP value of 5.60%. *Mangifera indica* in the present study compare 10.07% lower than that reported by Ikhimiya *et al.* (2007). *Chromolaena odorata* with 24.31% CP corroborate the report of Ikhimiya *et al.* (2007). *Amaranthus spinosus* with 33.1% CP and 10.30% in the present study compared well with Oyenua (1968) and Ken Fern (1998) report of 31.9% CP and 9.8% CF. Although virtually unknown as animal fodder, with a 15.72% CP, *Ficus congesta* showed promise of being a useful ruminant forage feed.

The result of the anti-nutritional compounds (oxalate, hydrocyanic acid, phytin, tannin and lignin) of the browse forages are shown in Table 2. The forages varied widely in oxalate composition, it ranged from 13.93 (*Triadax procumbens*) to 121.67mg/100gDM (*Chromolaena odorata*) the highest HCN content was found in *Mangifera indica* (201.83mg/kgDM) while the lowest was in *Amaranthus spinosus* (49.95mg/kgDM). *Synedrella nodiflora* had the highest phytin (1.99mol/kgDM) while the lowest phytin (0.008mol/kgDM) were observed in

three brow
found in
and Ficus

Table 1

SAMPLE

Chromolaena odorata

Carica papaya

Triadax procumbens

Anacardium occidentale

Synedrella nodiflora

Azadirachta indica

Hyptis suaveolens

Mangifera indica

Ficus congesta

Amaranthus spinosus

± Standard

The tannin
Ikhimiya
higher than
higher than
level reported
(1994) but
consequently
phytase na

Although
reported na
less than 5
results in
(Chang and

The HCN
of these spe
that produce

Conclusion

The br
levels of to
other anti
ruminants
browse plant

three browse plants, *Anacardium occidentale*, *Azadirachta indica* and *Hyptis suaveolens*. The highest tannin was found in *Synedrella nodiflora* (5.90%) while the lowest was in *Chromolaena odorata* (0.55%). *Hyptis suaveolens* and *Ficus congensis* had the highest lignin value (2.24) while *Anacardium occidentale* had the lowest (0.55).

Table 1 Proximate Composition of selected Browse Plants in Kwara State, Nigeria.

SAMPLE	CP	ASH	CF	EE	DM	NFE
<i>Chromolaena odorata</i>	20.30 ^a ±1.00	3.89 ^a ±0.13	8.37 ^a ±0.05	8.32 ^e ±0.05	54.92 ^a	10.03 ^a
<i>Carica papaya</i>	5.40 ^a ±0.22	24.90 ^d ±0.55	30.30 ^e ±0.38	13.30 ^f ±0.50	96.42 ^d	22.32 ^b
<i>Tridax procumbens</i>	6.60 ^a ±0.37	34.57 ^f ±1.36	6.13 ^a ±0.37	5.20 ^{cd} ±0.27	93.21 ^{cd}	41.28 ^d
<i>Anacardium occidentale</i>	16.30 ^d ±0.44	3.00 ^a ±0.23	24.50 ^d ±0.25	1.50 ^a ±0.22	73.46 ^b	28.93 ^{bc}
<i>Synedrella nodiflora</i>	20.60 ^e ±0.52	12.00 ^c ±0.16	8.54 ^{ab} ±0.25	1.50 ^e ±0.22	96.54 ^d	50.33 ^e
<i>Azadirachta indica</i>	21.00 ^e ±0.28	7.10 ^b ±0.25	16.60 ^a ±0.42	7.10 ^e ±0.23	94.42 ^{cd}	42.94 ^d
<i>Hyptis suaveolens</i>	13.44 ^c ±0.44	5.68 ^{ab} ±0.28	9.04 ^{ab} ±0.53	4.39 ^{cd} ±0.40	95.30 ^{cd}	61.97 ^f
<i>Mangifera indica</i>	10.34 ^b ±0.26	5.00 ^{ab} ±0.32	30.50 ^e ±0.60	5.00 ^{cd} ±0.44	80.83 ^{bc}	30.26 ^c
<i>Ficus congensis</i>	15.72 ^d ±0.39	17.28 ^d ±0.07	15.10 ^c ±0.39	5.46 ^e ±0.08	94.45 ^{cd}	58.48 ^f
<i>Amaranthus spinosus</i>	33.10 ^f ±0.50	16.60 ^d ±0.13	10.30 ^b ±0.35	3.70 ^b ±0.21	92.32 ^{cd}	27.52 ^{bc}

± Standard Deviation

The tannin content in *Chromolaena odorata* and *Mangifera indica* was similar to that previously observed by Ikimiya *et al.* (2007) while the phytin content in *Chromolaena odorata* (5.0%) and *Mangifera indica* (1.7%) were higher than that reported by Ikimiya *et al.* (2007) i.e 4.88% and 1.34% respectively, the oxalate content was also higher than that of Ikimiya *et al.* (2007) in *Mangifera indica* (0.77%) and *Chromolaena odorata* (1.89%). Phytin level reported in the present study (0.08 - 1.99mol/kg) were similar to those reported by Aletor and Omodara (1994) but higher than that observed by Oduguwa *et al.* (1999). This level was unlikely to have any adverse consequences in ruminants although they could be of dietary importance to monogastric animals since they lack the phytase needed to breakdown the phytin to release phosphorus (Okoli *et al.*, 2003).

Although the composition of oxalate in the tested leaves were comparatively high, they however were within reported range of Onwuka (1996). Phytic acid level in the plant were generally lower than the threshold levels of less than 5% prescribed by Laurena *et al.* (1994). Feeding of plant with low to moderate levels of tannin usually results in little or no nutritional problems with ruminants although concentration above 10% could be problematic (Chang and Fuller, 1964).

The HCN content of the browses were equally as low as that reported by Selger *et al.* (1989). The level in most of these species were too low to pose a major animal health risk (Kumar and D'mello, 1996). Generally only plants that produce more than 20mgHCN/100g fresh weight are considered deleterious (Everist, 1981).

Conclusion

The browse plants analyzed in this study have good levels of nutrients particularly protein and contained low levels of toxic constituent such as phytin, hydrocyanic acid, oxalate and tannin, there is need to expand the study to other antinutritional factors such as nitrite, saponins, hemagglutinins and the alkaloids. Feeding trials using ruminants and monogastric animals are recommended in order to fully ascertain the nutritional value of these browse plants.

Table 2. Estimate of the content of antinutritional compounds in the selected browse plants in Kwara State, Nigeria

SAMPLE	OXALATE (mg/100g)	HCN (mg/kg)	PHYTIN (mol/kg)	TANNIN (%)	LIGNIN (%)
<i>Chromolaena odorata</i>	121.67 ^f ±0.70	110.70 ^c ±1.60	0.50 ^b ± 0.16	0.55 ^a ±0.23	1.02 ^{ab} ±0.09
<i>Carica papaya</i>	67.80 ^d ±0.19	184.95 ^e ±1.16	0.75 ^c ± 0.19	3.52 ^b ±0.33	1.09 ^b ±0.23
<i>Tridax procumbens</i>	13.93 ^a ±0.68	111.38 ^c ±0.47	0.17 ^a ± 0.09	4.72 ^c ±0.26	0.88 ^{ab} ±0.71
<i>Anacardium occidentale</i>	104.48 ^e ±1.44	64.13 ^a ±0.98	0.08 ^a ± 0.13	5.20 ^a ±0.55	0.55 ^a ±0.22
<i>Synedrella nodiflora</i>	99.77 ^e ±0.37	111.38 ^c ±1.01	1.99 ^d ± 0.07	5.90 ^a ±0.63	0.81 ^{ab} ±0.07
<i>Azadirachta indica</i>	31.51 ^b ±0.66	89.78 ^b ±0.66	0.08 ^a ± 0.04	5.35 ^d ±0.34	1.16 ^b ±0.09
<i>Hyptis suaveolens</i>	68.85 ^d ±1.41	126.23 ^c ±0.10	0.08 ^a ± 0.04	5.50 ^d ±0.32	2.24 ^c ±0.24
<i>Mangifera indica</i>	106.51 ^e ±0.86	201.83 ^a ±1.27	0.17 ^a ± 0.09	3.12 ^b ±0.26	2.22 ^c ±0.22
<i>Ficus congensis</i>	51.20 ^c ±0.51	159.98 ^d ±0.07	0.16 ^a ± 0.07	3.23 ^b ±0.46	2.24 ^c ±0.13
<i>Amaranthus spinosus</i>	103.23 ^e ±0.75	49.95 ^a ±1.15	0.25 ^a ± 0.19	3.280 ^b ±0.27	0.86 ^{ab} ±0.13

± Standard Deviation

References

- AOAC 2002: Official Method of Analysis, Association of Official Analytical Chemists, 17th Edition, Washington Dc, USA.
- Makkar, H.P.S. (2000) Quantification of Tannins in Tree Foliage. A Laboratory Manual for the FAO/IAEA coordinated Research Project on "Use of Nuclear and Related Techniques to Develop Simple Tannin Assays for Predicting and Improving the Safety and Efficiency of Feeding Ruminants on Tanniniferous Tree foliage" FAO/IAEA Working Document IAEA, Vienna, Austria.
- Van Soest P.J.; Robertson, J.B. and Lewis B.A. 1991: Methods of Fibre, Neutral Detergent Fibre and non- starch carbohydrates in relation to animal nutrition *J. Dairy science*, 74: 358
- Saleem, M.A. Oyatogun, O.M. and Checa H.R. 1979. Nutritive value of Browse plants in the Sudan Savanna of North West Nigeria. *Nig. J. Anim. Prod.* 6:3:7
- Ibeawuchi, J.A., Ahamefule F.O. and Oche J.E., 2002: An Assessment of the Nutritive value of Browsed Plants in Makurdi, Nigeria, *Nig. Agric. J.* 33:128-135
- Njidda, A.A. and Ngoshe A.A. 2008: Chemical composition of Some Selected Browse Plants in North East of Nigeria, Proceedings 13th Ann Conf. ASAN Eds G.S. Bawa, G.N. Akpa, G.C. Jokthan, M. Kabir and S.S. Abdu. ABU, Zaria.
- Oji U.I, Larbi A and Akele, S.A., 2002: Nutritional potentials of Common shrubs of the Niger Delta as ruminants feed. Proceedings 27th Ann. Conf. NSAP. Eds: V.A. Aletor and G.E. Onibi. Pp69.
- Wahua T.A.T. & Oji U.I 1987: Survey of browse plants in uplands areas of Rivers State, Nigeria in browse and Small ruminant production in Southeastern Nig. Proc. of a Symposium, ILCA Humid Zone programme, Ibadan, Nig. Eds. Raynolds I.T. Attah- Krah
- Odenyo, A.A., Mc Sweeney, C.S., Plamer, B. Negassa and Osuyi, P.O (1999): In Vitro Screening of rumen fluids with superior capacities to Digest Tannin-rich fodders.
- Joslyn M. (1970): Method of sample preparation. In. Method in food analysis, 2nd edition
- Wheeler E.L. and Ferrel R.E 1971. A method of phytic acid determination in wheat and wheat flour. *Cereal Chemistry*, 48:312-316.
- Mecha I. and Adegbola T.A. 1980 : Chemical composition of some Southern Nigeria forage eaten by goats. Department of Animal Science, University of Nigeria, Nsukka, Nigeria.
- Oyenuga V.A. 1955: The Composition and Agricultural value of some grass species in Nigeria. *Empire Journal of Experimental Agriculture Vol. 23 No 81.*
- Norton B.W. 1994: Antinutritive and toxic factors in forage tree. In: Legumes in tropical Agriculture Pp202-215 (R.C Gutteridge and H. M. Shelton, eds) Wallingford, Oxford: CAB International.
- Ikimiya I, Bamikole M.A, Omoregie A.U. and Ikhatua U.J. (2007): Compositional Evaluation of some dry season shrub and tree foliages in a transitionally vegetated zone of Nigeria, *Livestock Research for rural Development* 19 (3)

Aletor V.A. and
mineral and
Odoguwa B.O.
leguminous
Okoli I.C, Ebe
ruminant f
Laurena A.C;
inhibitor a
Chang S.J an
Science 43
Selger D.S, M
in Legume
Kumar R. an
D'mello J
Everist, S.L. 1

- Aletor V.A. and Omodara O.A. 1994: Studies on some leguminous browse plants with particular references to their proximate, mineral and some endogenous anti nutrition constituents. *Animal feed science Technology*, Volume 46:343-348
- Oduguwa B.O., Oduguwa O.O and Amore E.A. (1999): Effect of Season on the anti nutritive factors of some foliage of some leguminous tress, in Proc. 26th Annual Conf. NSAP 21-25 March, 1999 Pp11-12.
- Okoli I.C, Ebere, C.S, Uchegbu, M.C. Udah, C.A. and Ibeawuchi, I.I 2003: A survey of the diversity of plants utilized for small ruminant feeding in South- eastern Nigeria, *Agriculture, Ecosystems and Environment* 96, 147-154
- Laurena A.C; Jamela M.A; Revilla r. and Mendoza E.M.T. 1994: Polyphenols, phytate, Cyanogenic glucosides and Trypsin inhibitor activity of Several Philippine indigenous food legumes. *Journal of Food composition and Analysis* 7:194-202
- Chang S.J and Fuller S.I: 1964: Effect of Tannin Content of grain sorghum on their feeding value of growing chicks. *Poultry Science* 43:30-37.
- Selger D.S; Maslin B.R. and conn E.E. (1989): Cyanogenesis in the Leguminosa. In Stirton H.O. and Sarchi J.L. (eds). *Advances in Legume Biology, Monograph systematic Botany*. Missouri Botanical Garden volume 29:645-672
- Kumar R. and D'mello J.P.F. 1996: Antinutritional factors in forage Legumes. In: *Tropical Legumes in animal Nutrition*. D'mello J.P.F. & D. Devendra (eds). CAB International , Wallingford UK.
- Everist, S.L. 1981: *Poisonous plants of Australia*. Revised Edition. Angus and Robertson, Sydney.