MEDWELL PUBLISHING
Journal of Animal and Veterinary Advances 8 (6): 1233-1236, 2009
ISSN: 1680-5593

Fodder Potential Ranking of Selected Multi-Purpose Trees and Shrubs Through Degradation Studies with Rumen Fistulated N'dama Steers

[1]E.M. Ngodigha and [2]N.J. Anyanwu
[1]Department of Fisheries/Livestock Production Technology, Niger Delta University, Wilberforce Island, P.M.B. 071, Yenagoa, Bayelsa State, Nigeria
[2]Department of Animal Science, Rivers State University of Science and Technology, P.M.B. 5080, Port Harcourt, Nigeria

Abstract: Twenty Multi-Purpose Trees and Shrubs (MPTS) were ranked for their fodder potential based on degradation studies with rumen fistulated N'dama steers. Samples of oven-dried, one year re-growth leaf fractions of the 20 MPTS were milled to pass through a 2.5 mm screen in a laboratory mill. The oven-dried samples (5 g each) were put into nylon bags measuring 180×90 mm with a pore size of 41 μm. The bags were incubated in duplicates for 6, 12, 24, 48, 72 and 96 h in 3 rumen fistulated N'dama steers. The steers, aged about 3 years and weighing approximately 250 kg were grazed on a pasture of *Panicum maximum* supplemented with wheat bran at the rate of 2 kg/animal/day. At the end of each incubation period, the residues were dried to a constant weight at 60°C for 48 h in a forced air oven to compute Dry Matter (DM) disappearance. Results showed that *E. cyclocarpum*, *S. spectabilis*, *B. monamdra* and *A. ferruginea* were ranked in the high quality group, with Effective Degradability (ED) values >450 g kg^{-1} DM; *T. superba*, *L. leucocephala* and *A. noipoides* were ranked in the medium quality group with ED range of 400-450 g kg^{-1} DM, while *P. bicolor*, *L. sericeus*, *P. santalinoides*, *X. xylocarpa* and *T. tetraptera* belonged to the low quality group with ED values <400 g kg^{-1} DM. The study showed that MPTS with high effective degradability qualitatively can be used to enhance better live weight gains in ruminant animals.

Key words: Dry matter, rumen fistulated, multi-purpose trees and shrubs, N'dama steers, DM, ED

INTRODUCTION

Livestock are important components in the crop-based farming systems of the humid lowlands of West and Central Africa. The major constraints to livestock productivity in these regions is inadequate nutrition because the primary feed resources; natural pastures and crop residues, are bulky, high in fibre, low in nitrogen and of poor quality. The identification therefore, of Multi Purpose Trees and Shrubs (MPTS) species with potential for providing high quality fodder for livestock and maintaining soil fertility is a major focus of agro-forestry research in these regions (Larbi *et al*., 1997, 1998, 2000). Fodder trees and shrubs (browse) form part of the natural vegetation and are accessible to the majority of small holder farmers (Tedonkeng *et al*., 2006b). Besides being used as feed, they have additional benefits when integrated into farming systems. These benefits include fuel wood and timber, increased soil fertility (leguminous species) control of wind erosion, shade for man and livestock, folk medicine, etc. (Le Houerou, 1980). Tedonkeng *et al*. (2006a) observed that deficiencies in feed quality could be corrected by the addition of herbaceous legumes or multi-purpose trees to the basal diet.

The humid forest zone is endowed with a large variety of MPTS. Not all of these trees have potentials as forage for livestock, particularly small ruminants. Farmers in this region have long realized the utility of some particular species of trees for their livestock, for example, *Microdesmis puberula*-highly relished by sheep and goats but is now in danger of extinction. Small holder farmers, who practice cut-and-carry system, obtain these trees from the wild since there is hardly any attempt to preserve these highly valued species through deliberate planting or incorporation in farming systems.

So far, several indigenous and exotic MPTS have been evaluated for the development of integrated crop-livestock agro-forestry technology such as alley farming in the humid lowlands of West and Central Africa

Corresponding Author: E.M. Ngodigha, Department of Fisheries/Livestock Production Technology, Niger Delta University, Wilberforce Island, P.M.B. 071, Yenagoa, Bayelsa State, Nigeria

(AFNETA, 1991; Duguma *et al*., 1994). A considerable number of these species have potentials as forage (Onwuka, 1992).

There is however, a paucity of information on the nutritive value attributes of MPTS based on data obtained from previous studies.

Since, ruminant animals are an integral part of the farming system in the humid lowlands of West and Central Africa, this study was conducted to rank the fodder potential of 20 MPTS through Dry Matter (DM) degradation studies, with rumen fistulated N'dama steers.

MATERIALS AND METHODS

Site: The *in sacco* rumen degradation studies were carried out at the International Livestock Research Institute (ILRI), Onne (4°52'N; 6°57'E).

***In sacco* DM degradation:** Leaf fraction samples of 20 species of MPTS were oven dried at 60°C and milled to pass through a 2.5 mm screen in a Christy Hunt laboratory mill. The oven-dried samples were weighed in an analytical balance and put into nylon bags measuring 180×90 mm with a pore size of 41 μm. The bags were incubated in duplicates for 6, 12, 24, 48, 72 and 96 h in three rumen fistulated N'dama steers. The steers, aged about 3 years with an average weight of 250 kg were grazed on a pasture of *Panicum maximum* supplemented with wheat bran at the rate of 2 kg/animal/day. At the end of each incubation period; bags were withdrawn from the rumen, put in a bucket of water at about 30°C and washed immediately under running tap water for about 25 min until the filtrate became clear. Residues were dried to a constant weight at 60°C for 48 h in a forced air oven to compute DM disappearance.

Statistical analysis: The degradation constants were estimated by fitting data to the exponential model of Orskov and McDonald (1979):

$$y = a + b\,(1\text{-}e^{-ct})$$

where,

- y = Dry matter disappearance at time t
- a = Zero time intercept or soluble water fraction
- b = Insoluble portion that will degrade in time t
- c = Rate of degradation (%h^{-1}) of the b fraction
- PD = Potential Degradability or extent of degradation (a + b) in time t

The effective degradability will be estimated from the model:

$$ED = a + b*c/(c + k)$$

Assuming an outflow rate k of 3% h^{-1}. The estimated parameters were subjected to analysis of variance procedures using the ANOVA command of the statistical analysis systems (SAS, 1999).

RESULTS AND DISCUSSION

There were significant variations in DM degradation characteristics as shown in Table 1. The soluble fraction a, ranged from 139 g kg^{-1} DM in *L. sericeus* to 333 g kg^{-1} DM in *A. ferruginea* while, the degradable fraction b, ranged from 329 g kg^{-1} in P. *santalinoides* to 680 g kg^{-1} DM in *L. sericeus*. The rate of degradation c was as low as 0.11 h^{-1} in *M. griffoniana* and *T. africana* to as high as 0.037 h^{-1} in *S. spectabilis*. Calculated values for PD showed a range of 545 g kg^{-1} DM for *P. santalinoides* to 883 g kg^{-1} DM in *M. griffoniana* while, the ED showed a range of 330 g kg^{-1} DM for *T. tetraptera* to 560 g kg^{-1} DM in *E. cyclocarpum*.

The difference among the MPTS in degradation characteristics may be partly related to variations in chemical composition (Nashlai *et al*., 1994) and configuration of cell wall polysaccharides and their effect on rumen microbial attachment and colonization of digesta particles (Cheng *et al*., 1984). This could result in differential intakes and rates of synthesis of microbial nitrogen per unit intake of the species, when given as sole diets. The high ED recorded for *E. cyclocarpum* may relate to complete absence of tannins and other phenolic compounds as reported by Norton (1994). This confirmed earlier reports that *in situ* nylon bag method could be used to rank MPTS for quality in initial screening studies. Based on ED values in this study, MPTS could be ranked as high (> 450 g kg^{-1} DM), medium (400-450 g kg^{-1} DM) and low (<400 g kg^{-1} DM) quality groups. *E. cyclocarpum*, *S. spectabilis*, *B. monandra* and *A. ferruginea* were among the high quality group; *T. superba*, *L. leucocephala* and *A. noipoides* were in the medium quality group, while *P. bicolor*, *L. sericeus*, *P. santalinoides*, *X. xylocarpa* and *T. tetraptera* belonged to the low quality group. Depending on the desired objectives, these groups could be targeted for further nutritional and soil improvement studies. It is important to point out that ranking of these species based on degradation data has to be interpreted with caution for the following reasons; firstly, the *in sacco* nylon bag method could over estimate *in vivo* digestibility (Larbi *et al*., 2000), secondly, there is not much documentation on the utilization by livestock of some species such as *S. spectabilis* and *I. edulis*, which are ranked high based on *sacco* studies and thirdly, some species could differ in animal preference and palatability. Since, animal output

Table 1: Dry matter degradation characteristics[1] of 1-year re-growth of 20 multi-purpose trees and shrubs

Species	a (g kg^{-1})	b (g kg^{-1})	c (% h^{-1})	PD (g kg^{-1})	ED (g kg^{-1})
A. ferruginea	333	344	0.021	678	472
A. gummifera	227	590	0.014	817	417
A. noipoides	232	530	0.016	763	417
B. grandiflora	181	520	0.013	701	338
B. monandra	316	375	0.027	691	485
D. guineensis	225	477	0.012	703	363
D. sisso	249	486	0.018	736	428
E. cyclocarpum	288	549	0.030	837	560
L. leucocephala	246	553	0.014	800	424
L. sericeus	139	680	0.013	820	342
M. griffoniana	238	645	0.011	883	367
M. thonningii	294	526	0.016	821	466
N. imperialis	191	449	0.017	641	353
P. bicolor	186	452	0.017	639	349
P. santalinoides	215	329	0.018	545	340
S. spectabilis	247	554	0.037	801	549
T. africana	224	633	0.011	858	384
T. superba	271	426	0.021	697	446
T. tetraptera	200	392	0.015	592	330
X. xylocarpa	179	451	0.016	631	334
SED (df = 38)	17.4	40.8	0.004	38.7	5.4

[1]Dry matter degradation constants from the non-linear model: PD = a + b (1-e^{-ct}) suggested by Orskov and McDonald (1979), where: a = Zero time intercept, b = Insoluble but degradable fraction in time t, c = Degradation rate constant of the b fraction PD = Potential Degradability (a + b) and ED = Effective Degradability (ED) = a + b*c/(c+0.03)

is a better determinant of forage quality (Moore *et al*., 1990), it remains to be seen whether these results could be transformed into better live weight gains in ruminants. Hence, further research is warranted to determine their performance in intake and digestibility studies.

CONCLUSION

Based on DM degradation values, *E. cyclocarpum*, *S. spectabilis*, *B. monandra* and *A. ferruginea* were ranked among the high quality group with ED values higher than 450 g kg^{-1} DM; *T. superba*, *L. leucocephala* and *Albizia noipoides* were in the medium quality group with ED range of 400-450 g kg^{-1} DM; while *P. bicolor*, *L. sericeus*, *P. santalinoides*, *X. xylocarpa* and *T. tetraptera* belonged to the low quality group with ED values <400 g kg^{-1} DM. The study showed that MPTS, with high effective degradability, qualitatively can be used to enhance better live weight gains in ruminant animals.

REFERENCES

AFNETA, 1991. Alley Farming Network for Tropical Africa. Annual Technical Report, International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, pp: 99. http://www.fao.org/Wairdoc/ILRI/x5545/x5545e09.htm.

Cheng, K.J., C.S. Stewart, D. Dinsdale and J.W. Costerlon, 1984. Electron bacteria involved in the digestion of plant cell walls. Anim. Feed Sci. Technol., 10: 93-120. http://www.sciencedirect.com/science?_ob=Publication.

Duguma, B., J. Tonye, J. Kanmengne, T. Manga and T. Enoch, 1994. Growth of 10 multi-purpose tree species on acid soils in Sangmelima, Cameroon. Agrofor. Syst., 27: 107-119. http://www.peroidicals.com/springer.html.

Larbi, A., J.W. Smith, A.M. Raji, I.O. Kurdi, I.O. Adekunle and D.O. Ladipo, 1997. Seasonal dynamics in dry matter degradation of browse in cattle, sheep and goats. Small Rum. Res., 25: 129-140. DOI: 10.1016/S0921-4488(96)0097-6. http://www.sciencedirect.com/science?_ob=ArticleURL&udi.

Larbi, A., J.W. Smith, I.O. Kurdi, I.O. Adekunle, A.M. Raji and D.O. Ladipo, 1998. Chemical composition, rumen degradation and gas production characteristics of some multi-purpose trees during wet and dry seasons in the humid tropics. Anim. Feed Sci. Technol., 72: 81-96. http://www.elsevier.com/inca/publications/misc/anifee.

Larbi, A., I.O. Adekunle, D.O. Ladipo and J.A. Akinlade, 2000. Fodder production responses to pruning height and fodder quality of some trees and shrubs in a forest savannah transition zone of south western Nigeria. Agrofor. Syst., 48: 157-168. http://www.springerlink.com/content/gbgdwfgwtnav/?p=a7c84036643b430f8.

Le Houerou, H.N., 1980. Chemical Composition and Nutritive Value of Browse in Tropical West Africa. In: Le Houerou, H.N. (Ed.). Browse in Africa: The current state of knowledge. International Livestock Centre for Africa (ILCA) Addis Ababa, Ethiopia, pp: 261-279.

Moore, J.E., W.E. Kunkle, S.C. Denham and R.D. Allhouse, 1990. Quality index expression of forage quality and prediction of animal performance. J. Anim. Sci., 68: 572-575. http://jas.fas.org/content/vol68.issue 2.

Norton, B.W., 1994. Nutritive Value of Tree Legumes. In: Gutteridge, R.C. and H.M. Shelton (Eds.). Forage Tree Legumes in Tropical Agriculture. CAB International, Oxon, pp: 389-392.

Nashlai, I.V., D.E.K. Siaw and O.P. Osuji, 1994. The relationships between gas production and chemical composition of 23 browses of the genus Sesbania. J. Sci. Food Agric., 65: 13-20. http://www.3.interscience.wiley.com/journal/113319714/issue.

Onwuka, C.F.I., 1992. Tannin and saponin contents of some tropical browse species fed to goats. Trop. Agric. (Trinidad), 69: 177-180. http://www.worldcat.org/oclc/1767777.

Orskov, E.R. and I. McDonald, 1979. The estimation of protein degradability in the rumen from incubation measurements weighted according to rates of passage. J. Agric. Sci., 92: 499-503. http://journals.cambridge.org/action/browse Journal.

SAS, 1999. Statistical Analysis Systems. User's Guide (Version 6), SAS Institute Inc., Cary, North Carolina, USA. http://www.sas.com/technologies/analytical/statistics.

Tedonkeng, E., F.A. Fonteh, F. Tendonkeng, J.R. Kana, B. Boukila, P.J. Djaga and G. Fomewang, 2006a. Influence of supplementary feeding with multi-purpose leguminous tree leaves on kid growth and milk production in the West African Dwarf goat. Small Rum. Res., 63 (1-2): 142-14. DOI: 10. 1016/jsmallrumres.2005.02.011 http://dx.doi.org/10.1016/j.smallrumres.2005.02.011.

Tedonkeng, E., F. Tendonkeng, J.R. Kana, B. Boukila and A.S. Nanda, 2006b. Effects of Calliandra *calothyrsus* and *Leucaena leucocephala* supplementary feeding on goat production in Cameroon. Small Rum. Res., 65 (1-2): 31-37. DOI: 10. 1016/j.smallrumres.2005.05.023. http://dx.doi.org/10.1016/j.smallrumres.2005.05.023.