South African Journal of Animal Science 2004, 34 (Supplement 1)


*Peer-reviewed paper: 8th International Conference on Goats*

# Nutritive value of goat diets in Okondjatu communal area of east-central Namibia

**G.T. Kamupingene and A.L. Abate#**
Department of Animal Science, University of Namibia, Private Bag 13301, Windhoek, Namibia

## Abstract

A study was conducted to quantify the nutritive value of most preferred and less preferred browse species by goats in Okondjatu Communal Area of east-central Namibia. The most preferred forages had a crude protein (CP) (mean 175.2 ± 5.2 g/kg DM) content ranging from 142.1 to 248.3 g/kg DM. Neutral and acid detergent fibres ranged from 309.0 to 530.3 g/kg DM and 225.1 to 366.0 g/kg DM, respectively. Total condensed tannins, with a mean value of 20.6 ± 1.0 g/kg DM ranged from 7.1 to 32.8 g/kg DM, while DMI (% of BW) ranged from 2.3 to 3.9. Low and high total digestible nutrients (TDN) values of 549.0 and 673.3 g/kg DM, respectively, were recorded for the preferred browse. Relative forage quality, which was 146.0 ± 22.4 units on average ranged from 101.1 to 207.3 units. The average CP, TDN and RFQ values of 152.0 ± 1.6 and 593.3 ± 8.6 g/kg DM and 140.8 ± 20.1 units respectively, for less preferred browse were lower than those of the most preferred species, while NDF and ADF values were within similar ranges. The mean TCTs value of 55.3 ± 1.5 g/kg DM in the less preferred browse is high compared to that of the preferred species. Generally, however, the TCT levels are within acceptable limits in ruminant nutrition. It was, therefore, concluded that the browse species are of a high feeding value and when used in, particularly, less extensive feeding systems in which forage plays a leading role in feeding ruminants, production impediments due to tannins would not be encountered.

**Keywords:** Nutritive value, browse, goat
#Corresponding author. E-mail: alabate@unam.na

## Introduction

The contribution of goats to the daily livelihood of rural people cannot be overemphasized. Also, it is documented (MacKenzie & Goodwin, 1996) that goats are browsers. Thus, in the Namibian rangelands where bushes and shrubs predominate (Bester, 2002) and hence offer a significant amount of browsable material, goats would continue to dominate the livestock production system and the general household economy. Whereas they have high crude protein (CP) content, browse, due mainly to lignification, tends to be slowly digested along the gastro-intestinal tract (Getachew *et al*., 2000). This results in low feed intake and consequently low animal performance. The high tannin contents in most browse species (Reed *et al*., 2000) further lead to reduced animal performance. However, given their high relative abundance and potential feeding value, browse would inevitably contribute to goat diets in most feeding systems. This is more-so in the communal areas of Namibia where alternative forms of supplementary feeds are irregular in supply. This study aimed at quantifying the nutritive value of browse known to contribute significantly to goat diets in Okondjatu Communal Area of east-central Namibia.

## Materials and Methods

The study was conducted at Okondjatu Communal Area (OCA) in east-central Namibia. The area, which is situated in the western part of the Kalahari Sand Plateau, receives approximately 350 mm of rainfall annually and has a flat terrain dominated by bushes and shrubs. Agriculture is livestock-based, with goats serving most of the household's socio-economic needs.

Through administration of a structured questionnaire to, and holding interviews with 55 farmers, the most preferred and less preferred forages to goats in the study area were determined. Based on ranking, six most preferred browse species comprising *Acacia erioloba, A. mellifera, Commiphora glandulosa, Grewia flavescens, Rhigozum brevispinosum* and a parasitic plant *Tapinanthus oleifolius* were identified. The less preferred browse species included, amongst others, *Balanites welwitschii, Bauhinia pettersiana, Combretum wattii* and *Croton gratissimus*. Predominantly, young leaves and tender twigs of the aforementioned forages

*Peer-reviewed paper: 8th International Conference on Goats*

were collected in the wet season, which is the season of their abundance, from eight villages in OCA. Following collection, samples were oven-dried to constant weight at 60º C, then ground through a 2 mm screen, thoroughly mixed and bottled in air-tight sample bottles ready for analysis. For tannin analysis, forage samples were further ground through a 1 mm screen and pulverized to their finest form using a mortar and pestle.

Crude protein content of the dried samples was determined according AOAC (1995) methods, while neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined according to the procedure as outlined by Van Soest *et al*. (1991). The Butanol–HCL assay with ferric ($Fe^{3+}$) reagent (Porter *et al*., 1986) was used when determining total condensed tannins (TCTs). Dry matter intake (DMI) and total digestible nutrients (TDN) were calculated using standard prediction equations developed by Holland & Wes (1990), while relative forage quality (RFQ) was calculated according to the equation of Moore & Undersander (2002), as shown below.

DMI, as % of body weight (BW) = 120/ NDF, %

TDN, g/kg DM = 82.38 – (0.7515 * ADF, g/kg)

RFQ, units = (DMI, as % of BW * TDN, g/kg DM)/ 1.23

The variation between forage samples with respect to the studied parameters was analysed statistically following the general linear model procedure of SAS (2000). A completely randomised design, with provision for replication was adopted and means of the studied parameters were separated by Duncan's multiple range test.

## Results and Discussion

The chemical composition of most preferred and less preferred browse species by goats in OCA is presented in Table 1. Crude protein, TDN and RFQ were slightly higher in the preferred browse, while ADF and TCTs were relatively higher in the less preferred species.

**Table 1** Chemical composition (g/kg DM), dry matter intake (DMI, % of BW), total digestible nutrients (TDN, g/kg DM) and relative forage quality (RFQ, units) of browse consumed by goats in OCA

| Browse species | CP | NDF | ADF | TCTs | DMI | TDN | RFQ |
|---|---|---|---|---|---|---|---|
| Most preferred | | | | | | | |
| *Acacia erioloba* | 142.1$^{c}$ | 452.3$^{b}$ | 337.2$^{b}$ | 18.3$^{cd}$ | 2.7$^{bc}$ | 571.1$^{de}$ | 123.2$^{d}$ |
| *A. mellifera* | 248.3$^{a}$ | 352.1$^{d}$ | 201.2$^{d}$ | 32.8$^{a}$ | 3.4$^{ab}$ | 673.3$^{a}$ | 187.4$^{b}$ |
| *Commiphora glandulosa* | 176.0$^{b}$ | 418.2$^{c}$ | 294.1$^{c}$ | 16.7$^{d}$ | 2.9$^{bc}$ | 603.2$^{cd}$ | 141.1$^{c}$ |
| *Grewia flavescens* | 177.1$^{b}$ | 512.1$^{a}$ | 277.4$^{c}$ | 21.1$^{c}$ | 2.3$^{c}$ | 616.4$^{bc}$ | 117.0$^{d}$ |
| *Rhigozum brevispinosum* | 144.2$^{c}$ | 530.3$^{a}$ | 366.0$^{a}$ | 7.1$^{e}$ | 2.3$^{c}$ | 549.0$^{e}$ | 101.1$^{e}$ |
| *Tapinanthus oleifolius*$^{\dagger}$ | 164.1$^{b}$ | 309.0$^{e}$ | 225.1$^{d}$ | 27.5$^{b}$ | 3.9$^{a}$ | 655.0$^{ab}$ | 207.3$^{a}$ |
| Mean ± s.e. | 175.2±5.2 | 428.8±9.3 | 283.3±7.5 | 20.6±1.0 | 2.9±0.26 | 611.2±11.6 | 146.0±22.4 |
| Less preferred | | | | | | | |
| *Balanites welwitschii* | 90.0$^{d}$ | 515.1$^{a}$ | 333.0$^{a}$ | Nd | 2.3$^{b}$ | 574.1$^{b}$ | 109.0$^{c}$ |
| *Bauhinia pettersiana* | 184.1$^{b}$ | 415.1$^{b}$ | 315.1$^{ab}$ | 72.6$^{a}$ | 2.9$^{ab}$ | 587.0$^{ab}$ | 138.0$^{b}$ |
| *Combretum wattii* | 128.0$^{c}$ | 344.0$^{c}$ | 277.2$^{b}$ | Nd | 3.5$^{a}$ | 616.0$^{a}$ | 175.2$^{a}$ |
| *Croton gratissimus* | 206.2$^{a}$ | 413.2$^{b}$ | 303.1$^{ab}$ | 38.1$^{b}$ | 2.9$^{ab}$ | 596.1$^{ab}$ | 141.3$^{b}$ |
| Mean ± s.e. | 152.0 ±1.6 | 421.8±7.6 | 307.1±9.7 | 55.3±1.5 | 2.9±0.16 | 593.3±8.6 | 140.8±20.1 |

CP – crude protein; NDF – neutral detergent fibre; ADF – acid detergent fibre; TCT - total condensed tannins
$^{a, b, c, d, e}$ Within category and within column, means with similar superscripts do not differ (P > 0.05)
$^{\dagger}$Parasitic plant growing on *A. mellifera*; nd = value not determined

Crude protein values are within the range reported by Aganga & Adogla-Bessa (1999) in Botswana and Kassily & Abate (2002) in Kenya. The average CP (165.9 ± 4.1 g/kg DM) concentration is more than twice the required minimum to effect cellulolysis in ruminants (Chenost & Kayouli, 1997). Thus, microbial

efficiency would not be limited by dietary protein level if these forages were to be fed solo to animals. Fibre contents, the values of which are comparable to those of Kassily & Abate (2002) and Rubanza *et al*. (2003) are within the limits required for a normal rumen environment (Van Soest, 1994). The concentration of TCTs is below the level at which they could lower forage quality (Reed *et al*., 2000). Further, TCT levels compare well to those reported by Aganga & Adogla-Bessa (1999) and Rubanza *et al*. (2003). Considering the DMI of about 3% of BW, TDN of more than 600 g/kg and a RFQ value of over 140 units on average (see Table 1), forages in OCA are of a high nutritive value. The average predicted DMI is above the requirements for 50 g/d growth in goats (McDonald *et al*., 2002). When compared to the daily allowances proposed by AFRC (1993) for a goat gaining 100 g/d and fed on a diet whose metabolizability is approximately 0.59, the reported average DMI values are lower by only 0.2%. This indicates that DMI *per se* would not limit goat performance if these forages were to be used in a less extensive production system. Given that TDN estimates the available energy from a feedstuff, the reported TDN values show that over 60% of the energy in these browse forages is available for use by the animal's body. Moore & Undersander (2002) reported 100 RFQ units as the maintenance requirements for livestock. Based on these findings, the average 143 RFQ units observed in the current study would, therefore, be enough to support a production level above maintenance.

## Conclusion

The CP and RFQ values were high, while the fibre and total condensed tannin levels were low across sample categories. Therefore, the studied browse species are of a high feeding value and when fed to, particularly, growing goats, whose DMI requirements are generally low, productivity would be increased.

## Acknowledgement

The authors thank the African Smallholder Livestock Production (ASLIP) Project for funding the study.

## References

AFRC, 1993. Energy and protein requirements of ruminants: An advisory manual prepared by the AFRC Technical Committee on responses to nutrients. CAB International, Wallingford, UK. 159 pp.

Aganga, A.A. & Adogla-Bessa, T., 1999. Dry matter, tannins and crude protein contents of some indigenous browse plants of Botswana. Arch. de Zootec. 48, 79–83.

AOAC, 1995. Official methods of analysis (16th ed.). Association of Official Analytical Chemists. Maryland, USA. Vol. I. 593 pp.

Bester, F.V., 2002. Bush densities in Namibia. Agro-ecological zoning programme, Directorate of Research and Training, Sub-Division Pasture Science. Ministry of Agriculture, Water and Rural Development. ArcView/2002/139.

Chenost, M. & Kayouli, C., 1997. Roughage utilization in warm climates. FAO Animal Production and Health Paper 135. FAO, Rome. 226 pp.

Getachew, G., Makkar, H.P.S. & Becker, K., 2000. Effect of polyethylene glycol on *in vitro* degradability of nitrogen and microbial protein synthesis from tannin-rich browse and herbaceous legumes. Br. J. Nutr. 84, 73–83.

Holland, C. & Wes, K., 1990. Pioneer Forage Manual. A nutritional guide. Pioneer Hi-Bred International, Inc, Iowa, USA. 165 pp.

Kassily, F.N. & Abate, A.L., 2002. Composition and quality of camel diets in central Baringo, Kenya. Bull. Anim. Hlth. Prod. Afri. 48, 139–147.

MacKenzie, D. & Goodwin, R., 1996. Goat husbandry. 5th ed. Faber & Faber Publ. 334 pp.

Madibela, O.R., Letso, M., Boitumelo, W.S., Masedi, M. & Alton, K. 2002. Chemical composition of four parasitic plants harvested over a period six months from two sites in Botswana. Anim. Feed Sci. Technol. 95, 159–167.

McDonald, P., Edwards, R.A., Greenhalgh, J.F.D. & Morgan, C.A., 2002. Animal nutrition. 6th ed. Prentice Hall Publ. Harlow, England. 672 pp.

*Peer-reviewed paper: 8th International Conference on Goats*

Moore, J.E. & Undersander, D.J., 2002. Relative Forage Quality: An alternative to Relative Forage Value and Quality Index. Proc. Florida Ruminant Symposium, University of Florida, Gainesville, January 10–11th, 2002. pp. 16–31.

Porter, L.J., Histich, L.N. & Chan, B.G., 1986. The conversion of procyanidins and prodelphinidins to cyanidin and delphinidin. Phytochemistry 25, 233–230.

Reed, J.D., Krueger, C., Rodriguez, D. & Hanson, J., 2000. Secondary plant compounds and forage evaluation. In: Forage Evaluation in Ruminant Nutrition. Eds. Givens, D.I., Owen, E., Axford, R.F.E. & Omed, H.M., CAB International, Wallingford. pp. 433–448.

Rubanza, C.D.K., Shem, M.N., Otsyina, R., Ichinohe, T. & Fujihara, T., 2003. Nutritive evaluation of some browse tree legume foliages native to semi-arid areas in Western Tanzania. Asian-Aust. J. Anim. Sc. 16, 1429–1437.

SAS, 2000. Statistical Analysis Systems user's guide (Proprietary software release 8.1). SAS Institute Inc., Cary, North Carolina, USA.

Van Soest, P.J., 1994. Nutritional ecology of the ruminant. 2nd ed. Cornell University Press, Ithaca, USA. 476 pp.

Van Soest, P.J., Robertson, J.B. & Lewis, B.A., 1991. Methods for dietary fiber, neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. J. Dairy Sci. 74, 3583–3597.