The role of condensed tannins in browse species preference by goats

Mengistu[a], G., M. Derseh[b] ,W.H. Hendriks[a], W.F. Pellikaan[a]

[a]Animal Nutrition Group, Department of Animal Sciences, Wageningen University 6708 WD, Wageningen, the Netherlands
[b]International Livestock Research Institute, P.O. Box, 30709 Addis Ababa, Ethiopia

Introduction

Browse species sustain grazing and browsing animals during the driest period in arid and semi-arid areas. Browse possesses plant secondary metabolites (PSM) such as condensed tannins which can have beneficial roles for ruminants (Aerts et al., 1999) at optimal intake. In free ranging systems, goats select a variety of browse species for nutritive and non-nutritive characteristics (e.g. PSM). There is thus a trade-off between ingesting nutritious feed and increasing the potential risk from PSM ingestion. It is thus important to understand the relationship between browse tannin composition and its nutritive value to develop a strategy for efficient utilization. The present study examined the role of condensed tannins in browse preference (measured in terms of dry matter intake) by local goats in Ethiopia.

Material and methods

Leaves of browse species, *Acacia etbaica, Cadaba farinosa, Capparis tomentosa, Dichrostchys cinerea, Dodonea angustifolia, Euclea racemosa, Maerua angolensis, Maytenus senegalensis, Rhus natalensis and Senna singueana* were collected from the Tigray region of Ethiopia and air dried. Samples were analysed for dry matter, ash and crude protein (CP, N×6.25) (AOAC, 1990) as well as, neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) (Van Soest and Robertson, 1985). The NDF, ADF and ADL fractions were also used to calculate cellulose (CELL) and hemicellulose (HEMI) contents. Total tannins (TT) and total phenol (TP) analyses were conducted according to Makkar (2003) and condensed tannins by the method of Grabber et al. (2013) (Table 1).

Four mature male goats were used in two subsequent preference trials each lasting 10 d measurement after 10d adaptation. In the two trials, goats received grass hay (4% body weight) and wheat bran (200g) daily. In both trials goats were provided with each browse (25g) simultaneously for 10 min. In trial 2 polyethylene glycol (PEG, 25g) was added to the wheat bran to counteract potential effects of tannins.

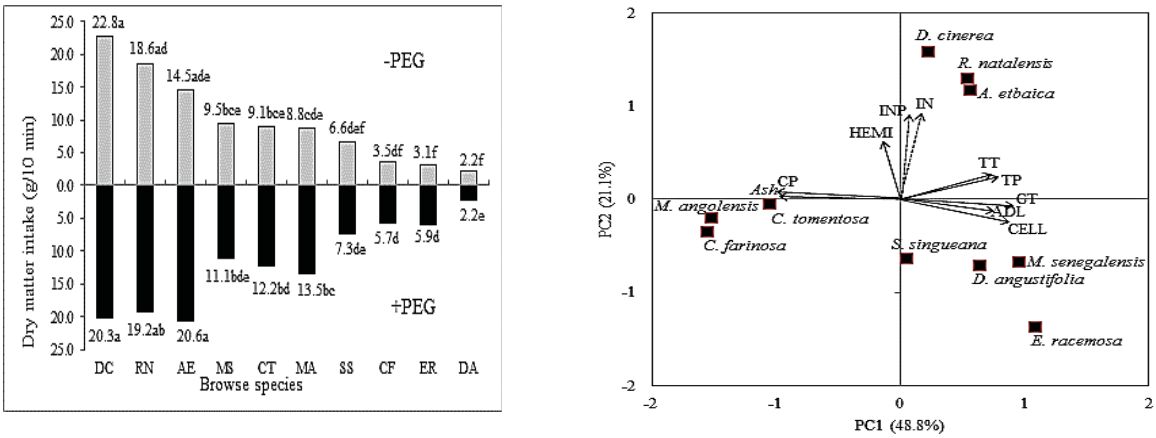
Data were analysed with the PROC MIXED procedure of SAS (version 9.3, SAS Institute Inc., Cary, NC, USA) with browse, PEG and day as fixed factors and goat as random factor. Principal component analysis was used to explore browse species clustering and relationships between browse chemical components and intake.

Table 1. Browse species phenol and tannin composition.

Browse species	Total Phenol[a]	Tannins	
		Total[a]	Condensed[b]
E. racemosa	29.7	28.6	18.4
R. natalensis	44.9	34.5	17.7
M. senegalensis	46.5	32.7	16.9
D. angustifolia	66.2	61.1	16.8
A. etbaica	70.6	68.1	11.2
D. cinerea	41.3	38.9	9.3
S. singueana	41.6	38.5	6.9
C. tomentosa	10.2	8.1	6.8
M. angolensis	7.2	4.6	3.3
C. farinosa	3.7	2.5	1.7

[a]Calculated as mg tannin acid equivalent/g DM.
[b]Expressed as Abs $_{550nm}$/g DM.

Results and discussion



(A) (B)

Figure 1. Browse intake in the absence (-) and presence (+) of polyethylene glycol (PEG) (**A**); Principal component analysis displaying browse species position in relation to tannins, phenols and other chemical components (**B**). AE: *A. etbaica,* CF:*C. farinosa,* CT:*C. tomentosa*, DC:*D. cinerea,* DA: *D. angustifolia,* ER:*E. racemosa,* MA:*M. angolensis,* MS:*M. senegalensis,* RN:*R. natalensis and* SS:*S. singueana*, IN: intake in the absence of PEG, INP: Intake in the presence of PEG

There was a significant difference among browse species in intake ($P<0.0001$), PEG inclusion ($P<0.0001$) and interaction between browse and PEG ($P=0008$). Goats visited all the 10 browse species during the 10 min time and predominantly preferred *D. cinerea*, *R. natalensis* and *A. etbaica* Fig. 1 (A). In short-term tests, diet discrimination by goats is likely related to diet chemical composition (Morand-Fehr, 2003). However, the ability of herbivores to associate diet sensory property with post-ingestive consequences is limited when diets are offered simultaneously (Duncan and Young, 2002). In the present study, goats were obtained from the same habitat where the browse species grew naturally, and familiarity is likely to have influenced the preference by the goats. The most preferred species contained significant levels of tannins and phenols and this preference was contrary to expectations. It suggests that tannin concentrations at the observed level of intake were tolerated by goats. In Fig. 1 (B), the first two principal components explained 69.9% of the variation. The CP was negatively correlated with the fiber and phenolic components. However, the association of condensed tannins or phenols to intake/preference was not evident under the conditions of the present experiment. It appeared that intake was more associated with the hemicellulose fraction.

References

Aerts, R.J., Barry, T.N., McNabb, W.C. 1999. Polyphenols and agriculture: beneficial effects of proanthocyanidins in forages. Agric. Ecosyst. Environ. 75, 1–12.

AOAC (Association of Official Analytical Chemists). 1990. Official methods of analysis, 15th ed. Assoc. Off. Chem. Arlington, VA.

Duncan, A.J., Young, S.A. 2002. Can goats learn about food through conditioned food aversions and preferences when multiple food options are simultaneously available? J. Anim. Sci. 80, 2091– 2098.

Grabber, J.H., Zeller, W.E., Mueller-Harvey, I. 2013. Acetone enhances the direct analysis of procyanidin- and prodelphinidin-based condensed tannins in lotus species by the butanol-HCl-iron assay. J. Agric. Food Chem. 61, 2669–2678.

Makkar, H.P.S. 2003. Quantification of tannins in tree foliage. A laboratory manual. FAO/IAEA Working Document, Vienna, Austria.

Morand-Fehr, P. 2003. Dietary choices of goats at the trough. Small Rum. Res. 49, 231–239.

Van Soest, P.J., Robertson, J.B. 1985. Analysis of forages and fibrous foods. A laboratory manual for animal science. Cornell University. Ithaca, NY.