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Contents of phenolics, biological effect of tannin in browse and ability to predict them in diets from faecal composition in sheep

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Abstract

Potential of faecal composition to predict contents and biological effects of tannin in Saligna *(Acacia saligna)*, Tagasaste *(Cytisus proliferus)* and Saltbush *(Atriplex amnicola)* diets were investigated in three feeding trials. Each browse and Oat *(Avena sativa)* experimental diet fed for 6 replicate sheep. Total phenolics (TPC) and tannin (TTC) contents, protein precipitation capacity of tannin (PPC), in-vitro gas production (ivGP), in-vitro organic matter digestibility (ivOMD) and in-vitro metabolizable energy contents (ivME) of experimental diets were determined. Respective faeces were analyzed for proximate composition. Data from the 3 trials were pooled to generate predictive models.
The TTC content of Saligna was greater as 36.2 gkg^{-1} while that of Tagasaste and Saltbush were lower as 6.4 g/kg DM and g/kg DM, respectively. Tannin of Saligna reported the highest PPC (27.3 g/kg DM) and reduced the ivGP, ivOMD and ivME, significantly *($P<0.001$)*. Biological effects of low tannin contents in Tagasaste and Saltbush were negligible. Strong leaner relationships *($P<0.0001$)* were found between faecal acid detergent fiber, acid detergent lignin and N contents with TPC and TTC and PPC of tannin in diets. Antinutrive effects and the ability of faecal composition to predict phenolic contents and their biological effects of browse diets were evident in sheep.

Key words: Browse, Tannin, Biological effect, Faecal, Prediction

Introduction

Phenolics and particularly the tannins occur in forage browse species form insoluble complexes with protein and fiber, thus remain undegraded by rumen flora limiting their availability to ruminants (1, 4, 24, 11). In tropical browse species, TPC, TTC and CTC ranged from 17-250, 7-214 and 0-260 g/kg DM, respectively, and PPC from 0-1066 µg BSA precipitated/g DM (20). Saligna *(Acacia saligna)* has high level of phenolics, TTC, CTC and PPC (1, 14, 18) while Tagasaste *(Cytisus proliferus)* contains tannins in low levels (9, 15, 19). River saltbush *(Atriplex amnicola)* has very low tannin content (16). Phenolics of these species increase towards summer and decrease towards winter (12, 3, 5). A significant proportion of condense tannin (CT) were present in bound form with fiber fractions both browse (10, 13) and in faeces when they fed to sheep (13). Free CT in saligna feed get bound to fiber and protein in the ruminants gastro intestinal tract (23). Tannins of tagasaste, schinopsis and leucaena enhance the excretion of faecal N in sheep (2, 9). The objective of this study was to test the hypothesis that faecal composition has the potential to predict contents and biological effect of tannin in browse diets of sheep. Such predictions will provide useful information in formulation supplementary feeding strategies for efficient utilization of browse diets particularly in grazing situations.

Materials and methods

Three pen feeding trails were conducted. Six dry matter (DM) levels of saligna (0, 250, 480, 690, 840, 1000 g/kg DM), 7 DM levels of tagasaste (0, 180, 350, 520, 720, 870, 1000 g/kg DM) and 6 DM levels of saltbush (0, 160, 360, 500, 650, 840 g/kg DM) were fed to sheep in trial 1, 2 and 3, respectively. Oat hay used to balance the DM contents of all experimental diets. Fresh, chopped (~2 cm), each diet was fed for 6 replicate sheep for 7 days for adaptation followed by 3 day collection period. Using freeze dried, composite feed samples TPC, TTC, PPC and biological effect of tannin (in vitro tannin bioassay) of diets were determined (24). Composite oven dried fecal samples were analyzed for proximate composition (25). Significance of tannin effect on biological activity of diets was tested by comparing data obtained in the presence and absence of polyethylene glycol of tannin bioassay, using *t* test. Data of the 3 trials were pooled to generate predictive regression models and ANOVA was performed. Best fit models were selected considering F statistics, R^2, standard deviation of error and *t* statistics of estimates.

Results and discussion

Table 1: Total phenolics, total tannin, protein precipitation capacity of tannin and results of in vitro gas fermentation of browse species and stem cut oat used in the experiment

Variable	*Acacia saligna*	*Cytisus proliferus*	*Atriples aminicola*	*Avena sativa*
Total phenolics (g/kg DM)	46.5	24.2	3.0	1.0
Total tannins (g/kg DM)	36.2	6.4	1.1	0.3
Protein precipitation capacity of tannins (g/kg DM)	27.3	0.1	1.0	0.0
In vitro gas production (mL/200mg DM)	17.7	43.2	24.3	44.9
In vitro ME (MJ/Kg DM)	5.3	8.8	6.3	8.6
In vitro OMD (g/kg DM)	361.2	594.9	437.1	573.6

Table 2: Predictive regression models of total phenolics (TPC) and tannin (TTC) contents and protein precipitation capacity of tannin (PPC) from faecal composition *(P<0.0001)*

Predictive model (Yi = a + b Xi)				*Standard deviation of error*	R^2
Yi	*Xi*	*a±SE*	*b±SE*		
TPC	fcADF	–57.25±6.39	0.15±0.01	6.87	*0.79*
TPC	fcADL	–2.48±2.53	0.12±0.01	7.23	*0.76*
TPC	fcN	–18.28±3.54	2.65±0.20	6.93	*0.78*
TTC	fcADF	–61.64±6.18	0.14±0.01	*6.64*	0.78
TTC	fcADL	–10.08±2.29	0.12±0.01	*6.54*	0.79
TTC	fcN	–24.66±3.40	2.53±0.20	*6.65*	0.78
PPC	fcADF	–51.59±5.85	0.11±0.01	*6.23*	0.71
PPC	fcADL	–11.78±2.08	0.09±0.01	*5.95*	0.74
PPC	fcN	–23.09±3.14	1.99±0.18	*6.15*	0.72