

The Effect of Detannification Methods on *Acacia nilotica* and Hay Intake, Digestibility and Nitrogen Retention in Matebele Goats

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Villagers in the south-western parts of Zimbabwe collect pods of *Acacia nilotica* and feed them to goats as a protein supplement during the dry season (Sikosana et al 2002). *A. nilotica* is the most widespread woody plant in Zimbabwe (Timberlake et al. 1999). *A. nilotica* contain tannins, which are water-soluble polymeric phenolics that precipitate proteins (Mlambo et al 2005). Tannins impose limitations to the utilisation of the *A. nilotica* fruits by binding to protein and render it unavailable to the ruminant (Woodward and Reed 1989).

The objectives of the study were to determine the tannin content of *Acacia nilotica* fruits and the effectiveness of wood ash (WA), boiling, Polyethylene glycol (PEG) and Browse Plus™ (BP) as different detannification agents of tannins found in *A. nilotica* pods.

Materials and Methods

Study Site

The research was carried at Matopos Research Station, situated approximately 30 km south of Bulawayo, Zimbabwe. The station is situated at 28° 30' E; 20° 23' S at an altitude of 1340m above sea level. The area has wet summers (Nov-Mar) and dry winters (May-Sept) with a mean annual rainfall of about 600 mm.

Mean maximum temperature ranges from 29 °C in October to 21 °C in June. The vegetation is characterised by thorny acacia species mostly *Acacia karroo* and *A. nilotica* with a field layer dominated perennial grasses with occasional annuals (Ward et al 1979).

Fruit Treatment & Diet Formulation

The amounts of PEG, BP and WA used to treat the *A. nilotica* fruits was 2.7 kg per 40 kg of the fruits. A PEG solution was made through dissolving 2.7 kg of PEG in 20 litres of distilled water, which was sufficient to wet 40 kg of the fruits. 40 kg of the fruits were then soaked in the solution for 15 min and subsequently sun dried. The BP treating of the fruits was prepared the same way as PEG treatment. Ash powder was made through burning an *A. nilotica* tree. An ash solution was made through dissolving 2.7 kg of WA in 20 litres of water. 40 kg of the fruits were then soaked in the solution 15 min, before they were sun dried. 100 litres of water was boiled and then 40 kg of *A. nilotica* fruits were cooked for 15 min, before they were sun dried. The control treatment composed of untreated *A. nilotica* fruits. After sun drying, all the fruits were milled through a 14 mm sieve plate while hay was milled to pass a 25 mm sieve plate.

The five experimental diets consisted of the variously treated acacia fruits fed as supplements at the rate of 200g animal⁻¹ day⁻¹. The treatments were Untreated, WA, Hot water, BP and PEG treated fruits. Hay, which was fed *ad libitum*, constituted the basal diet.

Animals and Their Management

Twenty - four castrated Matebele goats aged between 30 - 35 months and weighed an average initial weight of 38.7 kg (± 3.12) were used in the trial. The goats were penned individually in metabolism crates. The goats were allowed to adapt to the different diets and metabolism crates for 21 days. During this period, feed intake and the health of the animals were closely monitored. Goats were fed supplements at 0700h. At 1000h, hay was fed *ad libitum* and water was offered at 1400h. The animals had access to water for 20mins.

Data Collection

Faecal samples and urine from each animal were collected at 0700hrs from the metabolism crates every morning for seven days. Faeces were then weighed and 10% of the total faecal matter from each goat were bulked and thoroughly mixed for the entire collection period and stored in a freezer (-20°C). Urine was collected in plastic containers containing 20ml of 25% (v/v) sulphuric acid. Sulphuric acid preserved the urine through prevention volatilization of nitrogen (Dube 2003). The volume of the urine was measured using a measuring cylinder and 10% of the total urine was bulked over the collection period and stored in a freezer awaiting analysis (-20°C).

Proximate and Fibre Analysis

Organic matter, nitrogen, nitrogen detergent fibre and acid detergent fibre were analysed in feed, faeces and refusals to calculate intake and digestibility. The difference between N intake and N output in faeces and urine was a measure of N retention. Dry matter (DM), and Organic Matter (OM) were analysed (AOAC 1999). Urine was analyzed for N only. Wet dung instead of dry dung was analysed for N to avoid loss of N through volatilisation of ammonia when faecal matter is dried. Neutral detergent fibre (NDF) and acid detergent fibre (ADF) was analysed as outlined by Van Soest et al (1991).

Experimental Design and Statistical Analysis

A completely randomised design was used. Animals were randomly allocated to the five treatments and all the treatments had five replications except BP treatment, **which** had four replications. Initial weight of the goats was used as covariate in affecting the digestibility of DM, OM, ADF and NDF and N-retention. The Least Significant Difference (LSD) method was used to separate means. A square root transformation was used to transform the N retention values. Data from the digestibility trial were analysed by analysis of variance using a Genstat 6.1. (2002).

Results Chemical Analysis

The nutritional composition of the untreated and different treated *A. nilotica* and hay are shown in Table 1. Mean values for supplement and hay intakes and apparent digestibility coefficients of DM, OM, ADF, NDF, and N retention, faecal and urinary N are shown in Table 2. In this study there were no differences ($P > 0.05$) between the grass hay intakes of goats offered treated and those offered untreated fruits (Table 2). The DM, OM, ADF, and NDF apparent digestibility coefficients were not significantly different ($P > 0.05$) among the treatments (Table 2). Both the faecal and urinary N output were not significantly different ($P > 0.05$) (Table 2). Animals on treatments T1, T2, T4 and T5 were not significantly different ($P < 0.05$) in N retention but they were significantly different ($P > 0.05$) from T3.



Table 1. Mean hay intake (g/day), supplement intake (g/day)

Treatment	Hay intake	Supplement
Untreated	426 ^a	75.8 ^a
Wood ash	421 ^a	96.8 ^a
Hot water	375 ^a	33.1 ^a
Browse plus	433	84.1 ^a
PEG	401 ^a	77.4 ^a
SE	6.38	37.65
LSD	123.2	50.52
P-value	0.87	0.141
CV%	22.4	51.6
SED	58.70	24.05

Means with different superscripts within a column differ (P<0.05)

Table 2. Apparent digestibility coefficients for DM, OM, NDF and ADF, nitrogen retention (g/day)

DMD	OMD	ADF	NDF	N-retention	Faecal nitrogen	Urinary nitrogen
0.59 ^a	0.61 ^a	0.55 ^a	0.61 ^a	0.48 ^a	1.73 ^a	1.20 ^a
0.61 ^a	0.63 ^a	0.58 ^a	0.63 ^a	0.50 ^a	1.99 ^a	0.90 ^a
0.58 ^a	0.60 ^a	0.60 ^a	0.64 ^a	-1.03 ^b	1.33 ^a	1.64 ^a
0.58 ^a	0.61 ^a	0.61 ^a	0.64 ^a	1.33 ^a	1.85 ^a	0.93 ^a
0.56 ^a	0.60 ^a	0.60 ^a	0.61 ^a	0.03 ^a	1.77 ^a	1.03 ^a
0.06	0.06	0.60	0.07	0.40	0.55	0.44
0.09	0.08	0.12	0.09	0.54	0.73	0.59
0.86	0.90	0.50	0.62	0.05	0.42	0.11
11.0	9.9	15.9	11.3	27.8	31.6	38.5
0.04	0.04	0.06	0.04	0.26	0.35	0.28

Means with different superscripts within a column differ (P<0.05)

Discussion

The high phenolic content, mostly catechin gallates of *A. nilotica* fruits were probably responsible for its low intake by goats (Mueller-Harvey 1999). In an experiment where PEG was used to bind condensed tannins in high tannin *Lotus pedunculatus*, there was an increase in the intake of *L. pedunculatus* by sheep (Barry and Duncan 1984). This was in contrast with the findings in this study where none of the treatments including PEG did not increase the intake of *A. nilotica* fruits (Table 2). Detanninification methods used in this study were not effective. Treating the fruits did not increase digestibility of the fruits (Table 2). This may imply that the catechin gallates were active, which, reduced the activity enzymes and microbes found in the rumen (Woodward 1988).

Conclusion

The study showed that use of WA, PEG and BP resulted in no change in the N retention and digestibility of the fruits by the goats. The detanninification methods were meant to inactivate the condensed tannins, but there was no response.

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