

Nutritive value of red vine husks and pips for sheep

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Abstract

The potential of red vine husks and pips as a component of animal feed was investigated. Twenty-five Dohne Merino ram lambs (mean live weight \pm s.d. = 41.4 \pm 2.3 kg) were used. A completely randomised design was used and the animals were assigned to five diets including 0, 12.5, 25.0, 37.5 and 50% vine husks and pips together with pelleted lucerne hay, respectively. The voluntary intake of feed and water were not negatively influenced by the percentage vine husks and pips included in the diet. The digestibility of the crude protein, neutral detergent fibre and acid detergent fibre decreased significantly, while the dry matter digestibility showed a strong tendency towards a lower digestibility as the percentage vine husks and pips increased in the diet. According to the plasma metabolites, no toxic effects were evident in this study.

Keywords: Intake, tannins, digestibility, toxic effects

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Introduction

Grapes are widely grown in the Mediterranean area of South Africa, producing considerable quantities of by-products. Traditionally the vine husks is dumped or used as compost after the production of wine. Tannins, a naturally-occurring polyphenolic in vine by-products, form complexes with proteins, polysaccharides, amino acids, fatty acids and nucleic acids (Flores *et al.*, 1994). Both the composition and the extent of polymerisation of tannins are important in determining their ability to form such complexes. In addition, a high tannin level in forage impairs palatability, digestibility and voluntary intake (Silanikove *et al.*, 2001). There is a lack of information regarding the nutritive value of vine husks and pips for sheep. This shortcoming complicates recommendations for the use of vine husks and pips as supplementary feeding. In order to determine the potential of vine husks and pips as a component of feeds for ruminants, a trial was conducted to determine the intake, digestibility and toxic effects of vine husks and pips when fed at increasing levels in a mixed diet with lucerne hay.

Materials and Methods

Vine husks and pips, after pressing four red wine cultivars (Merlot, Shiraz, Carignan and Cabernet Sauvignon), were dried, pooled in equal amounts, mixed and pelleted. The basal diet, pelleted lucerne hay, was then supplemented with the vine husks and pips in such a way that it contributed 0, 12.5, 25.0, 37.5 and 50.0% of total dry matter (DM) intake, respectively. Twenty-five Dohne merino ram lambs (mean live weight \pm s.d. = 41.4 \pm 2.3 kg) were used in the trials. A completely randomised design was used and the animals were assigned to five diets consisting of 0, 12.5, 25.0, 37.5 and 50% vine husks, respectively. Animals were kept in individual pens and fed on an *ad libitum* basis. During the voluntary intake trial, which lasted 35 days (14 days for adaptation and 21 days for the recording of voluntary intake), daily water and DM intake were measured. Sheep were fed once daily and had free access to water. The digestibility trial lasted 21 days (14 days for adaptation and seven days for the experiment). Feed was offered at an intake level close to maintenance (40-45 g DM/kg LW^{0.75} per day) as recommended by Van Es & Van der Meer (1980). Faeces were collected daily from each animal and dried in a drying oven for 96 h at 50 °C and ground through a 1 mm screen. Daily faecal and feed samples were analysed for DM, ash, CP and ether extract (EE) according to AOAC (1984) methods. To determine NDF and ADF the methods proposed by Van Soest *et al.* (1991) were followed. Acid-detergent insoluble nitrogen (ADIN) was measured (Licitra *et al.*, 1996), and the value was given in terms of crude protein (ADF-CP). Blood samples (10 mL) were taken from each sheep at the end of the digestibility trial. Blood was taken from the jugular vein into heparinized tubes and centrifuged for 20 minutes at 3000 revolutions per minute to separate the plasma, which was stored at -20 °C. The plasma was analyzed according to procedures conventionally used for diagnosing domestic animal hepatic and kidney damage and general disorders (Kaneko, 1989). Components measured were total protein, plasma urea nitrogen and creatinine. In addition, the plasma enzymes aspartate aminotransferase

(EC: 2.6.1.1) (AST) and gamma glutamyltranspeptidase (EC: 2.3.2.2) (GGT) were measured. The sorghum tannin equivalents method was used for determination of condensed tannins (Hagerman, 1995). Analyses of variance were performed on all the variables measured using the General Linear Models (GLM) procedure of SAS (1990).

Results and Discussion

The chemical composition of the five diets, as well as the vine husks and pips, is shown in Table 1. The protein content decreased as the percentage vine husks and pips increased in the diet, while the CP-ADF (protein attached to cell walls, and therefore indigestible) increased. There was also a marked increase in the condensed tannin content as the percentage vine husks and pips increased in the diets. The condensed tannins bind to proteins and sometimes may reduce protein digestibility (Silanikove *et al.*, 2001).

Table 1 Physical (on an air dry basis) composition and chemical (on a dry matter basis) composition of the experimental diets

Experimental diet	1	2	3	4	5	Vine husks and pips
Ingredients (kg/1000 kg)						
Lucerne hay	1000	875	750	625	500	
Vine husks and pips	0	125	250	375	500	
Chemical composition (g/kg)						
Dry matter	925	921	920	920	924	923
Organic matter	889	894	891	907	920	929
Ash	111	106	109	93	80	71
Crude protein	182	179	172	162	151	137
Neutral detergent fibre	440	434	438	439	436	433
Acid detergent fibre	334	345	363	370	385	434
CP-ADF (g/100 g CP ¹)	3.2	4.3	4.8	5.7	5.5	9.8
Ether extract (fat)	24	34	46	69	72	110
Total condensed tannins, g STE ²	0.7	2.4	4.1	5.7	7.4	14.1

¹CP = Crude protein ; ²STE = Sorghum tannin equivalents

Table 2 Average feed intake, water intake and blood metabolic profile of sheep fed the different diets

Item	Lucerne hay: Vine husks and pips					s.e. ³	P
	100:0	87.5:12.5	75:25	62.5:37.5	50:50		
Initial body weight, kg	41.7	41.4	41.4	41.5	40.8	2.25	0.99
Final body weight, kg	45.0	44.6	43.3	43.8	41.5	2.40	0.85
DM intake kg/W ^{0.75} , g/day	110	116	114	117	119	0.77	0.94
Water intake kg/W ^{0.75} , mL/day	456	444	458	407	376	32.74	0.46
Blood urea nitrogen, mg/100 mL	9.6 ^a	7.4 ^b	7.5 ^b	6.4 ^b	6.7 ^b	0.73	0.05
Total protein, mg 100/mL	68.0	67.5	69.8	71.3	68.3	2.36	0.79
Creatinine, mg 100/mL	118.8	122.0	119.3	125.3	124.8	5.50	0.87
AST ¹ , units/L	75.8	93.3	73.5	80.5	89.8	6.25	0.25
GGT ² , units/L	80.5	70.0	72.0	76.0	68.5	4.26	0.31

^{a,b,c} Values in rows bearing different superscript letters show significant ($P \leq 0.05$) differences

¹AST = aspartate aminotransferase; ²GGT = gamma glutamyltranspeptidase; ³s.e. = standard error of mean

According to Table 2, the voluntary intake of feed and water were not significantly ($P \geq 0.05$) influenced by the percentage vine husks and pips included in the diet. The final body weight was also not negatively influenced ($P \geq 0.05$) by the inclusion of vine husks and pips up to 50% of the diet. The presence of tannins in forage has been assumed to affect voluntary intake (McLeod, 1974). However, in this trial intake problems were not observed with inclusion levels of up to 50% of diet dry matter. There were no differences between diets in any plasma metabolite except for blood urea nitrogen (Table 2). An increase of creatinine can be related with renal failure, but the level found in the present study fell within the normal range for sheep (Kaneko, 1989). No significant changes in plasma enzymes AST and GGT were found.

These enzymes are used to detect if tannin-related hepatotoxicity occurred (Zhu & Filippish, 1992). In sheep fed with lucerne hay, the blood urea nitrogen concentration was higher ($P \leq 0.05$) than in sheep fed with the diets where vine husks and pips were included, which is directly related to the limitation in protein digestibility in sheep fed vine husks and pips.

The digestibility of the CP, NDF and ADF decreased significantly, while the DM digestibility showed a strong tendency towards a lower digestibility as the percentage vine husks and pips increased in the diet (Table 3). This result may be due to several factors. Firstly, the vine husks and pips had a much higher level of CP-ADF (crude protein bound to the indigestible fibre fraction) than that of lucerne hay (71.5% vs. 17.6% of the total protein is bound to the fibre). Secondly, it could be due to the presence of condensed tannins in the vine husks and pips. These compounds form complexes with proteins and carbohydrates (Makkar *et al.*, 1996), decreasing the available protein and energy for rumen micro-organisms (Silanikove *et al.*, 1994).

Table 3 Apparent digestion coefficients of the diets

Apparent digestibility (%)	Lucerne hay: Vine husks and pips					s.e.	P
	100:0	87.5:12.5	75:25	62.5:37.5	50:50		
Dry matter	57.1	53.9	50.4	46.8	48.0	2.45	0.053
Crude protein	68.4 ^a	64.2 ^{ab}	59.0 ^b	56.3 ^{bc}	52.5 ^c	1.91	0.0002
Neutral detergent fibre	42.6 ^a	33.5 ^b	32.3 ^b	23.9 ^c	18.5 ^c	2.12	<0.0001
Acid detergent fibre	39.9 ^a	26.4 ^b	23.7 ^{bc}	17.1 ^{cd}	12.8 ^d	3.21	0.0003
Ether extract (fat)	39.3 ^a	66.1 ^b	77.7 ^c	82.6 ^c	79.0 ^c	3.82	<0.0001

^{a,b,c} Values in rows bearing different superscript letters show significant ($P \leq 0.05$) differences

Conclusions

Voluntary intake of feed and water were not negatively influenced by the inclusion of up to 50% vine husks and pips in the diet. The decrease in diet digestibility as the percentage inclusion of vine husks and pips increased may be due to factors such as the high levels of proteins bound to the ADF and condensed tannins. However, an inclusion up to 50% in the diet had no toxic effects. Vine husks may therefore play an important role as supplementary feeding in the Mediterranean sheep farming areas of South Africa.

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