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NITROGEN METABOLISM AND DIGESTIBILITY STUDIES WITH MERINO SHEEP GIVEN KURRAJONG *(Brachychiton populneum),* MULGA *(Acacia anew-a)* AND NATIVE PASTURE *(Stipa spp.)*

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Summary

The digestibility of dietary constituents, the nitrogen balance and metabolism of urea in sheep given the leaves of the kurrajong tree, the mulga tree and native pasture were investigated in the Cobar area of New South Wales. When sheep are given an intake representing 90 per cent of their voluntary intake, the apparent digestibilities of dry matter and crude protein of kurrajong (62 per cent and 76 per cent respectively) and pasture (74 per cent and 80 per cent respectively) were higher than those for mulga (54 per cent and 63 per cent respectively). Contrary to previous evidence, both kurrajong and mulga provided sufficient digestible protein to maintain the sheep in nitrogen equilibrium. Sheep given pasture selected a highly digestible portion of the feed offered, and were also in nitrogen equilibrium. The proteins of mulga were apparently less well digested, and less efficiently used for tissue synthesis than were the proteins of kurrajong.

I. INTRODUCTION

In western New South Wales and Queensland, the leaves of indigenous trees such as mulga (Acacia *aneura*) , kurrajong ***(Brachychiton** populneum*) and wilga (*Geijera parviflora*) are eaten by sheep and cattle, and are often used as a supplement in times of low pasture availability. However, few studies have been made of the nutritive value of these fodders for sheep, although by comparison with native pastures, the leaves of these trees are relatively rich in protein (Everist and Young 1967). Harvey (1952) has reported that although the leaves of the kurrajong tree have a high protein content, this protein is not well digested, and he has suggested that additional protein is required if sheep are to be maintained wholly on kurrajong. Similarly, the digestibility of mulga has been reported to below relative to the more commonly available fodders eaten by sheep (Harvey 1952). The success of feeding mulga to sheep, based on practical experience, varies depending on the locality, the variety of mulga available ("umbrella" or "whipstick"), the condition of the sheep when introduced, and of the alternative

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feed available (Everist and Young 1967). The effective use of mulga is well illustrated by Nichols (1944) who reported that the controlled feeding of mulga to sheep during a drought decreased sheep losses, increased lambing percentages and produced a more even wool clip compared with sheep existing on available pasture.

The following investigation is part of a survey of the nutritive value of a variety of Australian fodders. In this study, values are reported for the composition and digestibility of kurrajong, mulga and native pasture by sheep in the Cobar area of New South Wales. Particular reference is made to the nitrogen metabolism of sheep given these diets.

II MATERIALS AND METHODS

(a) Animals

Twelve Merino wethers, aged 4 to 6 years and weighing between 33 and 44 kg, were used. Each sheep had a rumen fistula and was held in a single pen in a wool shed.

(b) Experimental design

Groups of 4 sheep were given either kurrajong leaves, mulga leaves or native pasture for a period of 6 weeks. Fresh pasture was harvested with a rotary lawn mower. The native pasture contained the following species: *Stipa sp.* (50 per cent), *Medicago spp.* (18 per cent), *Panicum sp.* (4 per cent) and *Hordeum sp.* (4 per cent) together with annual and perennial weeds (*Lepidum hyssopitoleum* (6 per cent), *Calotis hispidula* (3 per cent), *Echium plantagineum* (3 per cent) and *Bassia birchii* (4 per cent)).

During the first 4 weeks of the experiment, the intake by sheep given these rations *ad lib.* was determined, and during the final 2 weeks, sheep from the groups fed kurrajong and mulga were given 1400 g fresh feed (approximately 90 per cent of voluntary intake). Sheep from the pasture group were offered 1000 g fresh pasture daily, but seldom consumed more than 500 g. During this period, all groups were given their daily ration in 12 equal portions throughout the day. One sheep given kurrajong and one given pasture refused feed on the last 2 days of the experiment, and the results for these animals were discarded.

Digestibility, nitrogen balance and the urea metabolism were determined during the final 5 days of the experimental period. During this period feed intakes, feed refusals, faecal excretion and urine volumes were recorded and samples taken for analysis. Faeces were collected by harnessing sheep with faecal collection bags, and urine by the use of a metal belly tank as described by McMillan (1971). Entry rates of urea were determined from the specific radioactivities of plasma urea samples taken during a 10 h continuous intravenous infusion of ^{14}C urea ($0.5\mu Ci/ml$, 0.3 ml/min).

(c) Chemical methods

The proximate analysis of feed and faeces were by the methods described by the Association of Official Agricultural Chemists (1965). Total nitrogen (N) and ruminal ammonia were determined by an autoanalyzer method (Clare and Stevenson 1963). The energetic values of feed and faeces were determined in an adiabatic bomb calorimeter.

Plasma and urinary urea were estimated by the methods described by Nolan and Leng (1970). The specific radioactivity of plasma urea was determined by the method of Cocimano and Leng (1967).

(d) Statistical analysis

The significance of treatment differences was determined by analysis of variance and the significance of the differences between individual mean values was estimated by calculating the least significant difference (LSD) required at the 5 per cent level of probability (Steel and Torrie 1960).

III. RESULTS

Table 1 shows the chemical composition and energetic value (expressed on a dry matter basis) of kurrajong, mulga and native pasture used in this experiment. Table 2 gives the mean values, with the standard deviations, for the dry matter intake and apparent digestibility coefficients of some dietary constituents of the experimental rations given to the sheep. Table 3 gives the mean values, with their standard deviations, for the nitrogen balance, urea entry rate, urea excretion rate, plasma urea concentration and for the concentrations of ammonia in ruminal fluid of sheep.

TABLE 1

Chemical composition of kurrajong (Brachychiton populneum) ***, mulga*** (Acacia aneura) ***and native pasture*** (Stipa spp.) ***given to sheep during the experimental period***

Diet	Dry matter (g/100g)	Gross energy (2kJ/ gDM)	Composition on dry matter basis % Crude protein	Crude fibre	Ether extractives	Ash	NFE*
Kurrajong	44.8	20.20	14.6	27.1	4.2	6.1	48.0
Mulga	46.6	21.05	14.9	34.1	3.4	3.9	43.6
Pasture	75.0	17.98	7.9	36.9	0.9	10.2‡	44.1

*Nitrogen free extractives (by difference).
‡Contaminated with soil.

TABLE 2

Mean values, with the standard deviations per observation, for the dry matter intake and the apparent digestibility coefficients of constituents of kurrajong, mulga and native pasture given to sheep

Diet	Dry matter intake (g/day)	Apparent digestibility coefficients (%) Dry matter	Organic matter	Energy	Crude protein	Crude fibre	Ether extractives	Nitrogen free extractives*
Kurrajong (3)‡	641_a†	61.6_a	63.3_a	57.6_a	75.8_a	50.4_a	43.6_a	68.7_{ab}
Mulga (4)	609_b	52.7_a	53.7_a	48.9_a	63.1_b	37.2_a	45.0_a	64.4_a
Pasture (3)	448_c	74.3_b	76.8_b	77.1_b	80.0_a	75.9_b	44.0_a	77.2_b
Standard deviation per observation (±)	11	6.9	6.2	6.7	5.8	7.8	14.8	11.3

*By difference.

‡Figures in parentheses represent the number of animals used.

†Values within a column having differing subscripts differ significantly at the 5% level of probability.

IV. DISCUSSION

The chemical compositions of kurrajong and mulga were similar to other published values (Harvey 1952, Everist and Young 1967). Harvey (1952) has reported that the apparent digestibilities of dry matter and crude protein in kurrajong were 52 per cent and 16 per cent respectively, and for mulga, 37 per cent and 30 per cent respectively. These values are considerably lower than those found in the present experiment. The digestibilities of both kurrajong and native pasture compare favourably with those of a good quality lucerne hay (Schneider 1947), but the constituents in mulga were, in all cases, less digestible than those in the other two diets.

Sheep offered the native pasture (7.9 per cent crude protein) selected a highly digestible part of this ration which contained approximately 12 per cent crude protein. Observation of the species present before and after selection, suggested that burr medic (*Medicago sp.*) and galvanized burr (*Bassia birchii*) comprised a relatively high proportion of the selected ration. A high apparent digestibility of crude protein may not necessarily be an indication of the availability of protein to the sheep? since if extensive deamination occurs in the rumen, this N may eventually be lost to the animal as urea. As an example, Weston, Hogan, and Hemsley (1970) have found that although the apparent digestibility of crude protein was 76 per cent with sheep given salt-bush (*Atriplex nummalaria*), the available protein was only about 60 per cent of the total protein eaten. Apparently, extensive deamination of dietary protein occurred in the rumen, with resultant high ruminal ammonia concentrations (27 mg/100 ml), and this ammonia was eventually excreted in the urine as urea. In the present studies, the

TABLE 3

Mean values, with the standard deviations per observation, for some parameters of nitrogen metabolism in sheep given kurrajong, mulga or native pasture

Diet	N intake (g/day)	Urinary N (g/day)	Faecal N (g/day)	N balance (g/day)	Urea entry rate (gN/day)	Urinary urea excretion (gN/day)	Urea degradation rate (gN/day)	% Recycling of urea to the digestive tract	Plasma urea (mgN/100ml)	Ruminal NH_3 (mgN/100ml)
Kurrajong (3)*	15.0_a‡	8.1_a	3.6_a	3.3_a	11.30_a	2.83_a	8.46_a	74.4_a	11.4_a	8.5_a
Mulga (4)	14.5_a	7.9_a	5.4_b	1.5_a	14.56_a	3.63_a	10.93_a	75.5_a	15.7_b	8.2_a
Pasture (3)	8.7_b	5.0_b	1.8_c	2.0_a	7.66_b	1.56_b	6.10_b	80.0_a	8.3_a	6.4_a
Standard deviation per observation (±)	0.4	1.5	0.7	1.9	2.28	0.99	2.28	9.1	1.8	2.4

‡Values within a column having differing subscripts differ significantly at the 5% level of probability.

*Figures in parentheses represent the number of animals used.

low ruminal ammonia concentrations (6-8 mg/100ml) in all groups, and the low plasma urea levels in sheep given kurrajong and pasture suggests that little dietary protein N was lost as ammonia absorbed from the rumen.

Sheep offered mulga received less digestible energy (6.26 MJ/day) than those given kurrajong (7.45 MJ/day), and the higher plasma urea entry rates and lower nitrogen balances of the sheep given mulga may indicate that either absorbed dietary or tissue proteins were being catabolized as a source of energy by these sheep. Parallel studies of energy metabolism in sheep given these diets also showed that sheep given mulga were in negative energy balance, whilst those given kurrajong maintained energy equilibrium (Rohan-Jones *et al,* 1972).

The major conclusions drawn from these studies are that when kurrajong and mulga are the only source of feed available to sheep, they provide sufficient digestible energy and protein for at least the maintenance of nitrogen equilibrium. It could be suggested that by conservation measures and controlled lopping, these trees may provide a strategic protein supplement for sheep when pasture quality is low, particularly for working rams, ewes at joining and during lactation.

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