Assessment of Sorghum Silage for Sheep

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Summary

From preliminary studies of the feeding value for medium-wool Merino wethers of various samples of sorghum silage, the following points emerge :

1. Mature silage, in addition to being moderately unpalatable, had a low level of digestible protein, a variable digestible crude fibre and a high mineral content. In spite of the latter, most sheep had negative mineral balances. A feature of the ash content of all samples of silage was the high concentration of silica.

2. Young sorghum silage was much more palatable. The addition of molasses made little difference either to palatability or to any digestible nutrient, except that it appeared to lower the protein digestibility coefficient.

3. Supplementation of mature sorghum silage with nitrogen, either in non-protein or protein form, effectively rectified the nitrogen balance and, in some instances, resulted in higher silage consumption.

4. The addition of a balanced mineral mixture led to improved appetite and marked increases in crude fibre and protein digestibility.

INTRODUCTION

A feature of the last five years in many parts of the sheep country of Central and North-West Queensland is the manner in which graziers have been making increasing use of modern machines and techniques to grow and conserve fodder crops as silage. Most of this country consists of grey and brown soils of heavy texture with an average rainfall varying between 15 and 20 in, the greater part of which falls during summer months. It has been shown by Skerman (1957) that by employing a period of fallow, combined with the correct selection of crop variety and use of the most suitable implements, there is a good chance of producing crops of sorghum or sudan grass in two out of every three years.

From 1953, when the first two successful attempts were made at large-scale ensiling of summer fodder crops at Richmond and Muttaburra, the practice has grown until at the beginning of 1956, Skerman (1957) estimated that there are 100,000 tons ensiled, mainly in trenches or pits, throughout the sheep areas of Queensland.

Although so much sorghum silage has by now been conserved, there appear to have been no published studies of its feeding value for the Australian Merino. A series of experiments designed to assess the feeding value of various types of ensiled fodder crops for mature Merino sheep was started by the Department of Animal Husbandry at the end of 1955. This work continues. This, therefore, is in the nature of a progress report.

METHODS

(i) Sheep.-Mature, medium-wool Merino wethers bred in Western Queensland were used throughout. Only sheep found after preliminary trial to be temperamentally suited to confinement in Metabolism crates were used and adequate pre-experimental periods (7-10 days) were employed before each trial.

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TABLE I.

Composition of Silage.

District	No. of Trials	Dry Matter (%)	Moisture-free Basis per cent.				
			Organic Matter	Crude Protein	Ether Extract	Crude Fibre	Ash
Mature silage							
Western Queensland	3	30.3	84.0	4.9	3.1	24.9	16.0 (7.7)*
Coastal Queensland	3	23.5	92.9	3.2	2.0	37.1	7.1 (5.1)*
Young silage							
Coastal Queensland only	Trial No. I (v.young)	12.0	87.8	12.2	2.6	39.1	12.1 (6.3)*
ditto	Trial No. II	14.3	83.9	8.1	2.9	44.4	16.1 (7.6)*
ditto	Trial No. III (Molasses added)	15.5	84.4	5.3	1.8	45.8	15.6 (7.4)*

*Figures in brackets are the concentrations of silica.

(ii) *Sampling.*—A minimum of four sheep, and whenever possible six sheep, were used in each trial and a standard routine of sampling was followed. Daily aliquots of feed, residues of feed, faeces and urine for each sheep were collected. Each daily sample was oven-dried and, at the end of the trial, the bulked samples of each sheep were mixed and ground prior to analysis.

(iii) ***Analyses*** .-Analyses were performed, using the A.O.A.C. methods, with the exception that a micro-Kjeldahl technique was employed for the estimation of nitrogen.

RESULTS

(i) ***Mature Sorghum*** *Silage.*—In a series of trials, some conducted at "Terrick Terrick", Blackall, some at the University Farm, Brisbane, in which mature silage grown at both locations was tested, the variability of feeding value became clear. The term 'mature' refers to sorghum that has set grain, the latter still for the most part being easily crushed, or in the 'milk' stage.

In view of the high silica content of the silage, with consequent concentration in the faeces, all figures both in this and subsequent tables are expressed on a silica-free basis.

The composition of mature sorghum silage is chiefly remarkable for the higher crude fibre and ash contents in comparison with published figures (Schneider, 1947). In other constituents it is comparable to medium quality maize silage or hays made from mixed pasture.

What was surprising was the very low digestibility of the protein, leading in a majority of instances to negative nitrogen balances. In spite of the high mineral concentration in the silage, the sheep were almost invariably in negative mineral balance.

Results are summarised in Tables I and II.

(ii) ***Young Sorghum*** *Silage*.-The low level of protein in silage made from the mature plant and its comparatively poor digestibility, prompted us to investigate the value of sorghum silage made from plants cut before formation of the seedhead. It has not yet been possible to complete as many trials with this type of silage, but sufficient results have been collected to demonstrate what a very much better feeding stuff it is for sheep. The same crop was used in making the silage tested in trials 2 and 3. Molasses was added to the latter at the rate of 15 lb. per ton. The information from three trials is incorporated in Tables I and II.

The differences in composition between young and mature sorghum silage are those one would expect, namely, lower fibre and higher protein and minerals in the former. Rather surprisingly, the silica content of the young sorghum was at about the same level as in several samples of mature silage, i.e., 7.5 per cent. of the dry matter.

Although the silage to which molasses had been added appeared to have a better colour and texture as well as a more attractive smell, the sheep did not find it any more palatable. The digestibility coefficients for each food constituent examined were similar, except for a reduction in the protein coefficient, due to an increase in faecal nitrogen.

The higher protein content of each sample of young sorghum silage, allied to its greater digestibility meant that the intake of the sheep getting young sorghum silage, was at a mean level of 4.61 g/kg, in contrast to 0.91 g/kg when mature sorghum silage was being fed.

(iii) ***Supplementation*** of ***Sorghum*** *Silage.*—The main deficiencies of the type of sorghum silage conserved in Western Queensland, as revealed by balance measurements, appear to be in nitrogen and minerals. Preliminary trials have been made to see what effect such supplements have.

TABLE II.

Digestibility of Silage from the Various Sources.

District	No. of Trials	No. of Sheep	Amount D.M. Eaten (g)	% Eaten	Digestibility per cent.					
					Dry Matter	Organic Matter	Crude Protein	Ether Extract	Crude Fibre	Mineral Balance
				Mature silage						
Western Queensland	3	16	351	64.9 ±14.4	53.0 ±8.6	53.8 ±8.5	9.8 ±22.0	53.6 ±17.4	56.5 ±13.7	2.5 ±4.9
Coastal Queensland	2	11	382	64.8 ±7.0	48.8 ±5.0	51.8 ±5.1	—7.0 ±52.2	52.9 ±9.4	52.7 ±7.5	9.5 ±5.8
				Young silage						
Coastal Queensland	Trial No. I	4	202	80.0	53.5 ±4.2	53.0 ±4.4	42.5 ±3.9	57.6 ±4.2	70.9 ±6.9	—3.4 ±1.4
ditto	Trial No. II	5	614	72.7	56.8 ±3.6	58.5 ±3.3	38.5 ±6.9	62.8 ±4.9	71.8 ±3.0	—2.6 ±6.1
ditto	Trial No. III (with Molasses)	5	528	90.2	58.8 ±5.6	61.1 ±5.1	15.3 ±10.5	52.4 ±6.7	75.9 ±3.2	0.03 ±7.4

(1) Nitrogen Supplementation: Non-protein compounds tried included ammonia, urea, ammonium sulphate and ammonium nitrate. These were given in amounts calculated to provide equal quantities of nitrogen at the rate of 6.6 g N_2 per 1.5 kg sorghum silage. This was calculated from the mean deficiency figure for nitrogen of an earlier series of balance studies in which similar sheep were fed sorghum silage only. The salts, as well as ammonia, were dissolved in water before being mixed with the feed. In addition to the non-protein nitrogen supplements, some sheep were given silage alone, and others a supplement of a high protein meal (42.2 per cent. crude protein by analysis) at the rate of 40 g daily. The experiment was conducted on a modified Latin square design in which the experimental sheep underwent a feeding period on each of the six treatments. Some results of this experiment are summarised in Table III.

TABLE' III.

Per Cent. Dry Matter Eaten, Nitrogen Balance and Protein Digestibility.

Supplement	Percentage of Ration Eaten	Nitrogen Balance	Digestibility Crude Protein (%)
Ammonia	52.7	+1.57	59.7
Ammonium sulphate	73.0	+3.16	71.3
Ammonium nitrate	63.7	+3.48	64.1
Urea	48.6	+3.2	70.7
Protein meal	83.1	+0.73	51.1
Control (no supplement)	56.7	—1.82	—16.1

The well-recognised unpalatability of urea for sheep was clearly demonstrated, while ammonia solution also made the feed somewhat unattractive. The mixture of protein meal and silage was the most palatable.

The effectiveness of the non-protein nitrogen supplements in bringing the sheep into positive nitrogen balance was demonstrated. This work is being repeated and modified so that other factors, including the economics of non-protein nitrogen supplementation can also be assessed.

(2) Mineral Supplementation: It became increasingly clear that there must be some factor operating to reduce the feeding value of sorghum silage, since daily ingestion of 14 g of protein should represent a maintenance level even with a digestion co-efficient as low as 8 per cent. A preliminary trial in which a 'complete' mineral supplement* was added at the rate of 15 g per sheep per day to mature sorghum silage resulted in a pronounced improvement in the utilization of nitrogen and of crude fibre. Appetite improved to the extent that the mean food intake increased from 357 g daily, representing approximately 70 per cent. of the food offered, to 874 g daily, representing 80 per cent. of the food offered. Table 4 summarises this experiment.

*Per cent composition: $CaHPO_4 2H2O$, 29.8; $CaCO_3$, 48.2; S., 0.22; K.I., 0.013; $CuSO_4$, 0.23; $MgSO_4$, 0.051; $CoSO_4$, 0.046; $CaSO_4$, 3.41; Venetian red "300", 0.71; Salt, 17.32.

TABLE IV.

Composition and Digestibility Coefficients of Sorghum Silage.

Treatments	No. of Sheep	Mean Body Weight (lb)	Intake Dry Matter (%)	Dry Matter in Feed (%)	Crude Protein in Feed Dry Matter (%)	Digestibility per cent.					
						Organic Matter	Ether Extract	Crude Fibre	Crude Protein	Nitrogen Balance	Mineral Balance
Sorghum Silage	5	66	69.3 ±5.4	17.9	4.6	49.3 ±4.5	59.3 ±7.3	49.9 ±8.2	—4.1 ±21.3	—2.9	—15.3 ±2.5
Sorghum Silage plus Minerals	5	66	79.6 ±3.2	27.4	5.6	62.6 ±6.3	47.0 ±13.8	69.0 ±6.4	43.4 ±22.0	—1.5	15.7 ±3.1

The improvement in intake and in the digestibility of the organic matter, crude fibre and protein, as well as the change in mineral balance were all found to be statistically significant.

Discussion

Silage is not readily eaten by Merino sheep and several weeks are likely to elapse before they will eat it. Even then, approximately a third of the daily ration is likely to be wasted.

It would appear that mature sorghum silage, apart from the way it may vary in its composition, cannot be regarded as able to provide a satisfactory maintenance diet for Merino sheep. Most sheep exhibited a negative protein and mineral balance when given this material alone; although our data emphasise the manner in which individual Merino sheep will vary in their ability to digest various constituents, particularly protein. In one trial with mature sorghum silage, it ranged from -25.9 per cent. to 64.9 per cent.

The marked improvement of the digestibility of fibre and protein from supplementing mature silage with minerals, suggests that lack of some element is a limiting factor in ruminal bacterial activity. This aspect of the feeding of mature sorghum silage clearly has important practical implications and is being investigated further.

When additional minerals were not added, supplementation with nitrogen in the form of several inorganic salts, urea or a conventional livestock protein meal certainly led to improved appetite and crude protein digestibility with ammonium sulphate, ammonium nitrate and protein meal. The failure of urea and ammonia solution appeared to be largely on the score of palatibility.

When the results of the various western and coastal trials with mature sorghum silage were compared, certain statistically significant differences were revealed. We feel, however, that further work should be completed before these are published.

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References

Schneider, B. H. (1947).—"Feeds of the World: Their Digestibility and Composition". (Agric. Experiment Station, W. Virginia University).

Skerman, P. J. (1957).—"Cropping for Fodder Conservation and Pasture Production in the Wool-growing Areas of Western Queensland". (University of Queensland Press).