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WOOL GROWTH IN RELATION TO SULPHUR-CONTAINING AMINO ACID ADMINISTRATION TO SHEEP

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SUMMARY

Methods of administering methionine to increase wool growth of New Zealand Romney sheep were studied. Daily subcutaneous injection of 1.5 g/day of DL methionine gave a small, significant response. Oral dosing with 5 g/day of methionine hydroxy analogue (MHA) did not cause a significant response but some animals, pretreated with sodium bicarbonate, responded to oral MHA probably as a result of the MHA being diverted past the rumenoreticulum by oesophageal groove closure.

In a field trial, 40 mature ewes given a combination of sodium bicarbonate and oral MHA (5 g every second day) for four weeks prior to lambing produced 15% more wool during the treatment period and 13% more in the seven weeks following treatment than the control ewes. There was no effect of the treatment on lamb birth-weights.

WOOL GROWTH is known to respond to treatments which allow sheep to absorb increased quantities of sulphur-containing amino acids (SAA). Increased wool growth has occurred after subcutaneous injection of cystine (Marston, 1935), injection of methionine (Klinskii and Darovskih, 1967), abomasal infusion of cysteine, methionine hydroxy analogue (MHA), and DL methionine (Reis and Schinckel, 1963, 1964; Reis, 1967) and intravenous infusion of cysteine hydrochloride (Dryden *et al.*, 1969).

Wool growth responses to oral administration have been variable. Marston (1935) fed sheep 1 g/day of cystine and obtained a small wool growth response. However, Du Toit *et al.* (1935) reported no effect of the addition of 0.45 g/day of cystine to the diet while Whiting *et al.* (1954) found no effect from a supplement of 2 to 2.5 g/day of DL methionine. It seems likely that these negative results are due to much of the readily available amino acids being degraded in the rumen. Carrico *et al.* (1970) attempted to overcome this problem by mixing MHA with casein prior to treatment with formaldehyde but feeding 1 g/day of MHA in combination with 5 g/day of casein had no effect either on wool growth or free amino acids in the

plasma. Other workers (Starks *et al.*, 1954) have reported stimulation of wool and body growth from methionine supplements, but usually in circumstances where low dietary sulphur levels would limit the synthesis of SAAs by the rumen microbes.

Graceva (1969) reported the effect of methionine supplements (3 g/day) to sheep receiving 6 g/day of SAA in the basal diet. Abomasal supplementation increased wool growth by 42.2% compared with 33.7% from subcutaneous and 17.9% from oral administration.

Despite synthesis by rumen microbes, the microbial protein is known to be low in SAAs (Hungate, 1966). In view of the high demand for cystine to accomplish keratinization, it appears likely that the utilization of protein by sheep would be enhanced by increasing the amount of cystine and methionine available.

A practical method of administering cheap, commercial methionine could be useful in improving several aspects of sheep production. The present results are from some preliminary investigations into methods of administering methionine. These investigations were designed to give information on different methods of administration (drenching; subcutaneous injection) and how infrequently administration could be made. Results are quoted from two indoor trials on New Zealand Romney wethers and one outdoor trial on pregnant Romney ewes.

METHODS

INDOOR TRIALS

Twelve one-year-old Romney wethers were studied in two trials. The wethers were housed in a constant-temperature room and fed a mixture (0.8 kg/day) of barley meal, lucerne meal and ground pea hulls, and molybdenum and sodium sulphate additives to counteract the high level of copper in the lucerne meal. In the final stages of the second trial, this meal was replaced with a pelleted ration of similar constitution. Wool was sampled from a left midside patch and samples degreased with successive washes in petroleum ether, ethyl alcohol and hot water, allowed to reach equilibrium in a humidity room, and weighed.

Drenching Trial

Four groups of three wethers each were given the following treatments:

- (1) Control — no drench.
- (2) Daily dosing with 5 g of MHA in 15 ml of water.
- (3) Weekly dosing with 35 g of MHA in 100 ml of water.
- (4) Daily dosing with 5 g of MHA in 15 ml of 5% aqueous sodium bicarbonate. This dose was preceded by the introduction of 10 ml of 10% bicarbonate into the mouth.

The treatments were continued for 28 days, wool samples being collected at the start and finish of the treatment period and twice, at fortnightly intervals after treatment.

Injection Trial

The twelve sheep from the previous trial were re-allocated to three groups, randomization being restricted to ensure that one sheep from each of the previous groups was allocated to each new group. The treatments were:

- (1) Control — no injection.
- (2) Daily subcutaneous injection of 1.5 g DL methionine suspended in 5 ml peanut oil.
- (3) Weekly subcutaneous injection of 10 g DL methionine in 35 ml of peanut oil.

Treatment continued for 28 days with wool samples being clipped at fortnightly intervals during treatment and for two subsequent sampling periods.

One sheep from the weekly injection group was eliminated during the post-treatment period as a result of injury.

FIELD TRIAL

One hundred Romney ewes, three years and older, were randomized into two groups and grazed together on ryegrass/white clover pasture. In the month prior to lambing commencing, the sheep were mustered off the paddocks every second day and ewes in one group each drenched with 10 ml of 10% sodium bicarbonate solution followed by 5 g of MHA in 20 ml of water. Wool samples were clipped from the right midside position at the beginning and end of treatment and, when all sheep had lambed, 50 days after treatment.

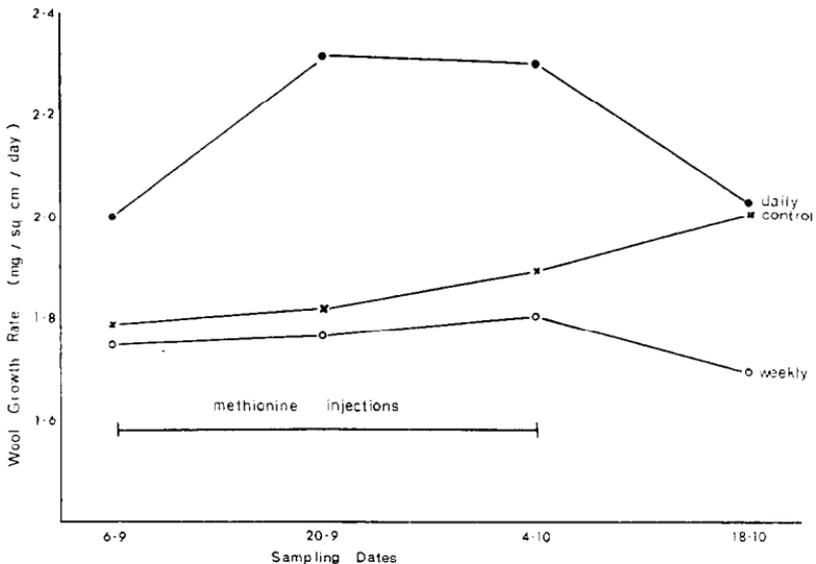
Statistical analysis involved unequal sub-class analysis of variance. Both three-way analysis with sub-classes de-

pending on number of lambs born and age as well as treatment and two-way analysis of age and treatment effects were completed. The small number of ewes which did not lamb inflated the variation and reduced the accuracy of the estimates of the experimental effects so data from such animals were eliminated from the analysis. This restriction and deaths reduced the treated and control groups to 40 and 46 animals, respectively.

RESULTS

INDOOR DRENCHING TRIAL

Table 1 shows the mean daily wool growth of the groups during the period of the trial. The increase of the treatment period value over the pre-treatment period of 14% for the bicarbonate-MHA group and 11% in the group dosed daily compared with the 4% in the control group may be indicative of a small response in these groups but the differences were not significant. Means were not adjusted for the regression on pre-treatment values since there were marked differences between the within-group regressions. This arose because of a marked increase in the wool production of one sheep during bicarbonate-MHA treatment and the marked increase of another member of this group during the post-treatment period.



F.G. 1: Wool growth responses to methionine injections.

INJECTION TRIAL

Figure 1 shows actual wool growth responses recorded during the trial; adjusted means of wool growth from analyses of covariance are given in Table 2. Highly significant differences were induced between groups during the treatment period with the adjusted means indicating a 17% increase in wool growth resulting from daily injection

TABLE 1: GROUP MEANS FOR MIDSIDE WOOL GROWTH OF SHEEP IN MHA-DRENCHING TRIAL (mg/cm²/day)

Sample Period	Treatment Groups			Bicarbonate Before MHA
	Control	MHA Daily	MHA Weekly	
Pre-treatment	1.41	1.47	1.41	1.66
Treatment	1.47	1.63	1.51	1.90
Post-treatment (1)	1.56	1.48	1.54	1.85
Post-treatment (2)	1.85	1.67	1.91	2.00

tion of 1.5 g of DL methionine. There were no significant differences in the post-treatment period but there may be an indication of a suppression of wool growth in the weekly injection group.

FIELD TRIAL

Analysis of variance of wool growth and allowing for the effect of number of lambs born indicated that single- and twin-bearing ewes were similar in wool production during the trial. For this reason a two-way analysis of covariance probably gives the best estimate of the effect of the bicarbonate-MHA treatment; the results are presented in Tables 3 and 4. The estimate of the response indicates a

TABLE 2: GROUP MEANS FOR MIDSIDE WOOL GROWTH RESPONSES TO D.L. METHIIONINE INJECTED SUBCUTANEOUSLY (mg/cm²/day)

Data adjusted for the regression on pre-treatment values

Sample Period	Control	Daily	Weekly	F
1st 14-day treatment	1.87	2.19	1.84	8.7**
2nd 14-day treatment	1.92	2.24	1.85	13.1***
14-day post-treatment	2.01	1.91	1.77	NS

P < 0.01 *P < 0.005

TABLE 3: SUMMARY OF ANALYSIS OF COVARIANCE OF MIDSIDE WOOL GROWTH OF LAMBING EWES IN BICARBONATE-MHA FIELD TRIAL

(Pre-treatment wool growth used as the independent variable)

Source	d.f.	Treatment Period Mean Square	Post-treatment Period Mean Square
Age	3	0.0287	0.1467***
Treatment	1	0.0746*	0.1061*
Age × treatment	3	0.0098	0.0358
Due to regression	1	0.4416***	0.5283***
Residual	77	0.0125	0.0236

* $P < 0.05$ *** $P < 0.005$

TABLE 4: ESTIMATED MEAN DAILY WOOL GROWTH FROM ANALYSIS OF COVARIANCE

(mg/cm²/day)

Class	Treatment Period	Post-treatment Period
Control	0.441	0.598
Bicarbonate-MHA	0.506	0.675

14.6% advantage of the treated group over the control group in wool production during the dosing period and a 12.9% advantage during the 50-day post-treatment period. No effect of MHA treatment on lamb birth-weight was detected by analysis of variance.

DISCUSSION

The wool growth response to daily, subcutaneous injection of DL methionine agrees with the Russian work using this method of administration (Klinskii and Darovskii, 1967). The response was relatively small and together with the absence of a carry-over effect probably indicates a suboptimum dose level. The lack of response to weekly injection makes the task of finding a commercially acceptable method of methionine administration more difficult since the work involved in dosing sheep is the main factor determining commercial use. The large quantity of liquid vehicle required for weekly injections of methionine creates a difficulty. Implanted pellets may be more suit-

able provided that uptake can be closely controlled to avoid excessive absorption and toxicity of methionine.

The lack of response to MHA in the indoor drenching trial indicates microbial degradation despite the relatively low solubility of this substance. The bicarbonate-MHA combination was designed to induce and use oesophageal groove closure but there is no definitive proof that closure was accomplished. Sodium bicarbonate has proved very effective in inducing oesophageal groove closure in calves (Riek, 1954) and it was favoured because of the toxicity of copper salts which were the main alternative (Watson, 1944). Copper salts may be more suitable for less frequent application. There is little information on the pharmacology of oesophageal groove stimulation and a more reliable stimulant is required if a commercially acceptable technique of avoiding ruminal fermentation by oesophageal groove closure is to be developed.

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