STIMULATION OF WOOL GROWTH WITH PROTECTED METHIONINE IN WETHERS FED DIETS CONTAINING DIFFERENT TYPES OF GRAIN AND LEVELS OF ROUGHAGE

L.D. STAPLES, S.R. McPHEE, A.H. WILLIAMS*, R.J. JOHNSON**

Summary

The effect of a medicated grain supplement containing 2 g/h/d protected methionine on wool growth, liveweight and condition score was assessed in mature merino wethers in a pen feedlot facility. The incomplete, replicated block design allowed non-orthogonal comparisons of the effect of methionine when animals were fed a maintenance diet consisting of supplements of oats, wheat or lupin grain with 20, 40 or 60% of energy requirements provided by clover hay. By the end of treatment covarite adjusted mean liveweights of treated wethers were 2.17 kg heavier than untreated controls ($P< 0.025$) but condition scores were not affected significantly by treatment. Methionine treatment stimulated both length growth rate and fibre diameter resulting in wool volume growth rate increases of 8.42% ($P< 0.001$) and 12.85% ($P< 0.001$) in the first and second 4 weeks of treatment and of 6.83% ($P< 0.05$) in the post-treatment period. This stimulatory effect of methionine was independent of the type of grain or level of roughage in the diet despite both having independent effects on wool growth. Ten month greasy fleece weight was increased 5.02% ($P< 0.05$) due to methionine treated but there was no significant effect on tensile strength.The data extends previous knowledge on the stimulatory effects of rumen bypass methionine supplementation to group feeding of sheep on a variety of diets.

I. INTRODUCTION

In most previous studies of the effects of abomasal infusions or parenteral injections of sulphur amino acid supplements, the test animals were maintained individually in cages and fed a high quality roughage diet of chopped or pelleted lucerne hay with oat or wheaten chaff (Reis 1979). However, a more typical application of methionine supplementation in the field may involve administration of supplements to animals on poor pasture and receiving grain supplements. The unexpected finding of Reis and Tunks (1974) that abomsal infusion of methionine to animals fed wheat grain resulted in depressed wool growth was of concern since it raised the question as to the effectiveness of methionine supplementation in animals under different types and qualities of ration.

The present study investigated the role of base diet on response to methionine supplementation in animals fed oats, wheat or lupins with 20, 40 or 60% hay. The study also further compared the effects of individual versus group feeding strategies for the animals fed the mid roughage oat diet.

II. METHODS

Mature medium fine merino wethers (N = 390) were ranked in order of pre-trial fleece weight then allocated to high, medium and low fleece weight blocks (n = 130/block). Animals within each block were then allocated at random to 13 treatment groups in a replicated block design (n = 10/group, Table 1). Groups were allocated at random to 6m x 4m pens in an outdoor feedlot. Once in the feedlot, all animals were progressively adapted, over three weeks, from clover hay to a diet of oats, wheat or lupin

Applied Biotechnologies Pty Ltd, P.O. Box 59 East Kew, Vic 3102 and *Rhone Poulenc Animal Nutrition Pty Ltd, 19-23 Paramount Rd West Footscray, Vic 3012 and **Victorian Institute of Animal Science, Werribee, Vic 3030

grain with 20, 40 or 60% clover hay roughage (Table 1). The final diets were of similar energy and were calculated to supply near maintenance requirements. Details of the grains and hay are summarised in Table 2.

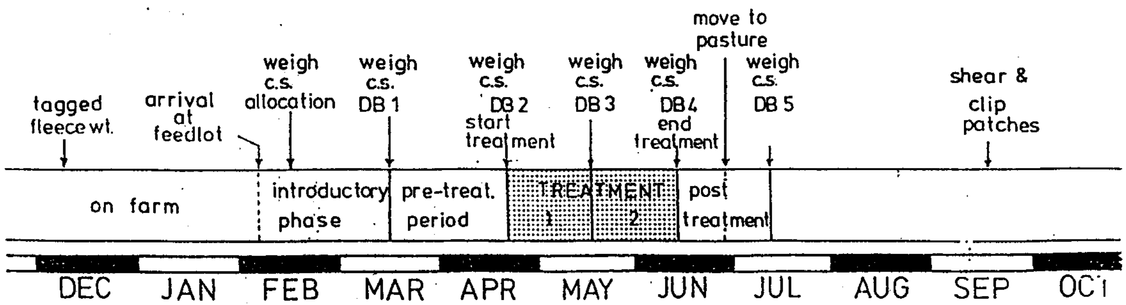

FIGURE 1 Schematic diagram of experimental procedures.

One third of the weekly grain and treatment ration was given on Mondays, Wednesdays and Fridays and treatment continued for eight weeks. Treatment with rumen protected DL-methionine (Rhone Poulenc, Staples et al. 1992) was by mixing the microspheres (2 g/h/day average) with 150 g of wheat pollard then distributing this within the grain ration fed to each group. Animals were removed from the feedlot to pasture two weeks after the end of treatment (ie half-way through the post-treatment period). Untreated control groups for each diet type received the relevant base diets without methionine.

Dye bands were made on wool at five weeks prior to treatment, after four and eight weeks of treatment and at four weeks post treatment (Figure 1) to enable assessment of fibre length growth and fibre diameter at all phases of the trial. This also permitted calculation of effects using pre-treatment measurements as a covariate. Results presented below are for least squares adjusted means after covariate analysis of variance.

TABLE 1 Experimental comparisons for 13 treatment groups each of three replicates of 10 animals.

		Type of grain			
Roughage (% of energy)	Treatment	OATS group*	OATS indiv.*	WHEAT group	LUPINS group
60% (high)	control	-	-	5	-
	pM 2 g/h/d	-	-	6	-
40% (med)	control	1	-	7	11
	pM 2 g/h/d	2	12	8	12
20% (low)	control	3	-	9	-
	pM 2 g/h/d	4	-	10	-

* group = animals fed in groups of 10, indivi = animals fed individually.

TABLE 2 Summary of nutritional value of diet components.

	Dry matter (%)	Protein (% of DM)	Digestibility (% of DM)	Energy (MJ/kg DM)
Oats	89.6	7.2	73.5	10.8
Wheat	88.6	11.5	85.9	12.7
Lupins	91.3	32.2	84.4	12.5
Clover hay	90.5	11.0	59.9	8.1

III. RESULTS

(a) Liveweight and Condition Score

Liveweights of treated and control wethers were not significantly different at the start of treatment (24th April) but thereafter the treated animals gained weight while the control animals lost weight. (Table 3). By the end of treatment treated wethers had gained 1.05 kg and controls had lost 1.38 kg ($P < 0.05$) and this difference persisted into the post treatment period ($P < 0.01$). Although animals on the lupin diet gained significantly more weight then those on either oats or wheat ($P < 0.001$ Table 3), the effects of methionine treatment on liveweight were independent of grain type or level of roughage in the diet. Condition scores fell during the feedlot period in all groups and were not significantly affected by treatment.

TABLE 3 Effect of protected methionine treatment (2 g/h/d), grain type and level of roughage on liveweight of mature merino wethers.
(least square ANOVA means ± SEM adjusted for pre-treatment covariate).

	24 April	19 May	14 June	13 July
Control	50.68 ± 0.46	50.02 ± 0.40 ^{a}	49.30 ± 0.49 ^{a}	51.79 ± 0.50 ^{x}
Treated	50.42 ± 0.52	51.18 ± 0.57 ^{b}	51.47 ± 0.85 ^{b}	53.19 ± 0.61 ^{y}
Oats	50.33 ± 0.41 ^{j}	49.64 ± 0.49 ^{j}	48.96 ± 0.60 ^{j}	50.71 ± 0.51 ^{j}
Wheat	49.41 ± 0.47 ^{j}	49.30 ± 0.44 ^{j}	48.66 ± 0.73 ^{j}	51.14 ± 0.46 ^{j}
Lupins	52.21 ± 1.18 ^{k}	52.85 ± 1.06 ^{k}	53.55 ± 1.24 ^{k}	55.61 ± 1.00 ^{k}

$a \neq b$ $P < 0.05$, $x \neq y$ $P < 0.01$, $j \neq k$ $P < 0.001$

(b) Wool growth and fleece weight

The fibre volume growth rate was increased due to methionine treatment by 8.42% ($P < 0.001$) above control in the first 4 weeks, by 12.85% ($P < 0.001$) in the second four weeks of treatment and by 6.83% ($P < 0.05$) in the post treatment period, despite having been 9.36% ($P < 0.05$) lower than control in the pre-treatment period (Table 4). This stimulation of wool growth resulted from significant effects of treatment on both length growth rate ($P < 0.001$) and fibre diameter ($P < 0.01$-0.001, see Table 4).

TABLE 4 Effect of protected methionine treatment (2 g/h/d from 24th April to 14th June) on length growth (µm/d), fibre diameter (µ) and volume growth rate (μm^3/d) in merino wethers.
(least square ANOVA means ± SEM adjusted for pre-treatment cavariate after 24 April)

Parameter	Treatment	Pre-treatment 14 June-13 July	Treatment 24 Apr-19 May	Treatment 19 May-14 June	Post treatment
length growth rate	C	236 ± 3	251 ± 3 ^{x}	260 ± 3 ^{j}	257 ± 3 ^{j}
(µM/d)	T	234 ± 3	61 ± 2 ^{y}	277 ± 3 ^{k}	270 ± 3 ^{k}
Fibre Diameter	C	20.57 ± 0.27	20.31 ± 0.29 ^{j}	20.58 ± 0.33 ^{j}	20.57 ± 0.35^a
(µ)	T	19.87 ± 0.19	20.92 ± 0.23 ^{k}	21.45 ± 0.26 ^{k}	21.07 ± 0.27^b
Volume growth rate	C	82.12 ± 2.47 ^{a}	83.90 ± 3.09 ^{j}	90.78 ± 4.02 ^{j}	89.66 ± 4.24^a
(μM^3/d)	T	74.43 ± 2.13 ^{b}	90.97 ± 2.52 ^{k}	102.45 ± 2.95 ^{k}	95.78 ± 2.85^b
		- 9.36%	+ 8.42%	+ 12.85%	+ 6.83%

$a \neq b$ $P < 0.05$, $x \neq y$ $P < 0.01$, $j \neq k$ $P < 0.001$, C = untreated, T = 2 g/h/d pM.

Wool volume growth was also significantly affected by grain type at all times (oats < wheat < lupins, P< 0.001 in most comparisons) and after 19th May was higher in the low roughage (high grain) diets than in the medium or high roughage diets (P< 0.01 - 0.001). Despite these direct effects of grain and roughage the enhancement of wool growth resulting from protected methionine was independent of diet and provided an added stimulus in all nutritional circumstances tested.

Greasy fleece weights at shearing in September 1991 were 5.02% higher (P< 0.05) in treated than in control ewes even tough treatment was applied for only 2 months of a 9 month interval from previous shearing in December 1990.

Tensile strength was not significantly different between treated (58.96 ± 1.37 N/Ktex) and control wethers (59.43 ± 1.18 N/Ktex) and these relatively high tensile strength values are consistent with the constancy of nutrition while under feedlot conditions.

(c) Comparison between group fed and individually fed animals.

Liveweights and condition scores did not differ significantly between group fed (group # 2) or individually fed animals (Groups # 13). However fibre volume growth rates of individually treated animals were 10.64% higher (P< 0.005) than in group fed animals during the second 4 weeks of treatment due to both 5.15% higher (P< 0.025) linear growth and 0.68 μ higher (P< 0.02) fibre diameter at this time. These effects were not seen in fleece weights which were similar in animals treated individually or in groups.

IV. DISCUSSION

This data shows that rumen bypass methionine provides an effective way increase wool growth in mature wethers under a wide range of diets. Although the type of grain had a large effect on wool growth, presumably due to differences in the type and quantity of protein, the responses to methionine were additive and independent of grain type, suggesting that all diets used were deficient in sulphur amino acids.

The data are consistent with most studies of the effects of sulphur amino acid supplementation by bypass infusion (Reis 1979) or using analogue forms of supplement in animals grazing sheep (Langlands 1972). The data also shows that reposes can be obtained in wheat diets containing 20% or more roughage. These results thus contrast with the suppressive effects of sulphur amino acid infusions previously reported for sheep on pure wheat grain (Reis and Tunks 1974).

Overall the protected methionine supplements should provide a practical way to increase wool production in group fed animals receiving a variety of supplementary feeds.

REFERENCES

LANGLANDS, J.P. (1972). Proc. Aust. Soc. Anim. Prod. 9: 321.

REIS, P.J. (1979). In "Physiological and Environmental Lautations to Wool Growth", p233, eds. by J.L. Black and P.J. Reis. (Univ. New England).

REIS, P.J. and TUNKS D.A. (1974). Aust. J. Agric. Res. 25: 919.

STAPLES, L.D., JOHNSON, R.J., WILLIAMS, A.H. and McPHEE, S.R. (1992). Proc. Nutr. Soc.Aust. 17: