FEED INTAKES OF SELECTED GROUPS OF MERINO WETHERS ON DIETS OF WIDELY DIFFERING QUALITY

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SUMMARY

Merino wethers chosen from 4 strains were allocated to wool groups based on their ability to produce high or low amounts of fine or coarse wool. No evidence was found in 4 periods of feeding that origin of animals influenced the voluntary feed intake of diets differing in protein and energy. There were, however, interactions with wool group for intake of the different diets. Animals producing large amounts of coarse wool increased intake by about 33% in response to improving diet while those that produced limited amounts of fine wool only responded by about 15%. Digestibility estimates taken for 1 of the diets were common across all animals despite a wide range of intakes.

Keywords: wool, digestibility, liveweight change, fibre diameter, fleece weight.

INTRODUCTION

It was not until the late 1970s that substantial premiums began to be paid for fine wool in the Australian wool market. This change forced breeders and scientists alike to face the problem of trying to improve 2 characters, fleece weight and fibre diameters, simultaneously. This is difficult because they have a positive biological (both phenotypic and genetic) correlation and a negative economic correlation.

To be able to overcome this difficulty we need to understand the biological mechanisms that cause variation in wool production and average fibre diameter in the Merino population. A major component of this may be related to feed intake and nutrient utilisation. While previous work has addressed this general area, the diets used have been either extreme in quality and composition (Hynd and Allden 1985; Hynd 1989) or fed in restricted amounts (Williams and Winston 1965).

In this work we have used a set of diets that provide an approximation of the protein and mineral content, and digestibility, that a sheep might encounter when grazing annual pastures or crop stubbles in southern Australia. The objective of this work was to examine feed intake using these diets in groups of animals selected for particular wool growth and fibre diameter relationships. Animals were studied in the animal house prior to determining the repeatability of their performance in the field over a range of seasons. This paper reports only on the animal house study.

MATERIALS AND METHODS

Sheep

A group of 42 Merino wethers representing Peppin, Collinsville, Bungaree and AMS strains and coming from a total of 16 studs throughout Western Australia (WA), were selected from 460 animals in flocks held at the Great Southern Agricultural Research Institute, Katanning, **WA.** The initial selection using hogget clean fleece weight (CFW) and average fibre diameter (AFD) produced 4 groups with combinations of high (H) or low (L) values for the respective parameters; HH (4.03 kg CFW, 22.48 μm AFD), HL (4.10 kg, 18.92 μm), LH (2.80 kg, 22.00 μm) and LL (2.59 kg, 18.16 μm). The animals (HH = 9, HL = 12, LH = 9, LL =12) were housed in individual pens on deep litter for the duration of the trial.

Diets

The 3 diets used were mixtures of wheat straw, with the addition of either about 20 or 40% gristed lupins and 5% minerals (Siromin®, Table 1). The addition of the minerals to diets 2 and 3 was to ensure some **balance in** overall supply and also to provide additional sulphur for the lupin protein. The diets were fed in sequence from lowest to highest quality, with the wheaten-straw diet being repeated again as a last treatment to provide an indication of what might happen with rapidly declining feed quality in the field. These periods will be referred to as diets l-3, and the repeat of diet 1, as diet la. All diets and water were offered *ad libitum* throughout the trial, with the first 2 weeks on any diet being an acclimatisation phase, and a subsequent 4 week period being the treatment phase. Each day, in both acclimatisation and treatment periods, residues were weighed and new feed added to ensure continuous feed availability. Feed containers were cleaned out weekly. Dry matter digestibility was estimated using intakes and total faecal collections over the last 14 days of the experiment for diet **la** only.

Table 1. Summary of composition and digestibility estimates for the diets offered to sheep

(%)	Diet 1	Diet 2	Diet 3	Lupins
Wheat chaff	100	76	57	-
Lupins	-	19	38	100
Minerals	-	5	5	-
Ash	5.80	6.83	4.46	2.79
Organic matter	94.2	93.2	95.5	97.2
Dry matter digestibility	57.4	63.9[A]	70.4[A]	90.0
Crude protein	6.58	11.48	16.74	34.64

[A]Derived from linear relationship of lupins substituting for chaff (after Murray 1992).

Statistics

Data were analysed using a general linear model containing strain, wool group and diet and their interactions as sources of variation.

RESULTS

Liveweight change

When liveweight at the start of the animal house diets was used as a covariate, all animals had a similar change until the end of the feeding of diet 3. Animals gained about 9 kg, growing from 45 to 54 kg, over 150 days. When returned to diet la the animals lost about 2.5 kg over 6 weeks. Animals from the HH group tended to gain weight more rapidly on diet 3 and lose more weight (6 kg) in the transition to diet la than other groups.

Table 2. Daily intake of feed (kg DM/day) and crude protein (g/day) by wool group, for the 4 diets over the 4 week treatment period for each (± s.e.m.)

Wool group	Diet 1	Diet 2	Diet 3	Diet 1a
Dry matter intake				
HH	1.08 (0.068)	1.44 (0.068)	1.43 (0.064)	0.88 (0.063)
HL	1.05 (0.058)	1.35 (0.058)	1.29 (0.054)	0.94 (0.053)
LH	1.05 (0.077)	1.35 (0.076)	1.27 (0.072)	0.94 (0.071)
LL	0.99 (0.056)	1.15 (0.056)	1.10 (0.053)	0.84 (0.052)
Crude protein intake				
HH	70.8 (4.56)	159.3 (7.60)	239.2 (10.9)	53.0 (3.85)
HL	69.0 (3.89)	149.3 (6.49)	215.2 (9.27)	57.2 (3.29)
LH	68.8 (5.66)	149.6 (9.46)	213.8 (13.5)	56.1 (4.79)
LL	65.0 (3.76)	126.6 (6.28)	183.9 (8.97)	51.0 (3.18)

Intake

There were no differences between strains in dry matter (DM) or crude protein (CP) intake but wool group approached significance ($P < 0.08$) for DM intake and was significant ($P < 0.05$) for CP intake (Table 2). There was a significant difference in DM intake between the diets ($P < 0.001$), with diets 2 and 3 causing a rapid increase in intake that resulted in 2 and 3-fold increases in CP intake. The DM intake (± s.e.m.) of diet la was lower (0.90 ± 0.03 kg/day) than diet 1 (1.04 ± 0.03 kg/day) despite being the same batch of feed. There was a significant interaction between wool group and diet ($P < 0.001$), the major component of which, was the change in ranking of the wool groups on diet la, and the relatively poor response of LL animals to diets 2 and 3.

Digestibility

Despite there being a wide range of DM intakes (Tables 2 and 3) there were no differences between any of the experimental groups in the digestibility of diet la. If intakes (± s.e.m.) during this period were

Table 3. Mean dry matter digestibility (%) and intake (g DM/day) for wheaten chaff (diet la) - pooled across all animals

	Dry matter digestibility	Intake
Mean	58.1	896
Range	49.8 - 68.3	534 - 1240
s.e.m.	0.51	26.4

related to metabolic body size, the animals from the HH group consumed significantly less feed (41.5 ± 2.27 g/kg$^{0.75}$) than the other groups (48.7 ± 2.15 g/kg$^{0.75}$).

DISCUSSION

By selecting our experimental sheep using wool production parameters (fleece weight and fibre diameter) we have demonstrated clearly that the response patterns for intake were independent of the 4 strains used. This occurred for diets with a wide range of DM and CP content where animals could continuously express their individual capacity to consume by always being offered feed *ad libitum*.

However, when the wool groups were considered, there were interactions with diet. When the higher quality diets were offered, DM intakes increased by 11-33% relative to diet 1 which resulted in a 2 or 3-fold increase in protein intake for diets 2 and 3. The LL group did not respond as strongly as the others, while maximum DM intake occurred for the HH group (Table 2). When the final diet (diet la) was offered after the highest quality diet, DM intake fell rapidly, with the relative decline of about 50% being greatest for the HH group. This decline, which resulted in a rapid loss in liveweight, could have consequences for wool strength. Such interactions present a challenge in planning studies to identify biological mechanisms for variation in wool growth and efficiency (Butler and Maxwell 1985).

It is unclear why intake of diets 1 and la differed as they were a single batch of feed material. There may have been a seasonal effect (Hutchinson 1962) with one diet being fed in late spring and the other in autumn or, the response to the poorer diet may relate to the feed quality and intake in the preceding period. This type of interaction is consistent with the findings of Hynd and Allden (1985) and adds further need for caution concerning bias in measurements of wool parameters over short periods depending on whether the diet is improving or declining from some previous equilibrium.

Even though higher intakes often result in depression in digestibility (Van Soest 1982), the digestibility of diet la was common across all animals despite a wide range in intake (Table 3). Weston (1959) also found similar digestibilities for a diet where animals, chosen for different wool growth, had about a 30% difference in intake. While Weston (1959) concluded that this indicated no difference in digestive efficiency, the HH group in this work had a lower intake (g/kg$^{0.75}$) relative to the other groups of animals during the feeding of diet la which seems to suggest some alteration in efficiency.

The natural conclusion to this work is to now take these experimental animals to the field to determine if the intake variation remains consistent when the animals can select from the mixture of plants in the sward and the seasonal changes in herbage quality.

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