

## New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website [www.nzsap.org.nz](http://www.nzsap.org.nz)

[View All Proceedings](#)

[Next Conference](#)

[Join NZSAP](#)

The New Zealand Society of Animal Production in publishing the conference proceedings is engaged in disseminating information, not rendering professional advice or services. The views expressed herein do not necessarily represent the views of the New Zealand Society of Animal Production and the New Zealand Society of Animal Production expressly disclaims any form of liability with respect to anything done or omitted to be done in reliance upon the contents of these proceedings.

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](http://creativecommons.org/licenses/by-nc-nd/4.0/).



You are free to:

**Share**— copy and redistribute the material in any medium or format

Under the following terms:

**Attribution** — You must give [appropriate credit](#), provide a link to the license, and [indicate if changes were made](#). You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

**NonCommercial** — You may not use the material for [commercial purposes](#).

**NoDerivatives** — If you [remix, transform, or build upon](#) the material, you may not distribute the modified material.

<http://creativecommons.org.nz/licences/licences-explained/>

## The relative intake of three Merino strains under different grazing regimes estimated using alkane technology

M.A. FRIEND, G.E. ROBARDS, A.R. LINDSAY AND S.C. CHAMPION

Department of Wool and Animal Science, University of New South Wales, Sydney NSW 2052 Australia.

### ABSTRACT

Ninety 1991 drop Merino wethers, thirty from each of fine, medium and strong wool strains were randomly allocated on the basis of stratified live weight within strains to one of three treatment groups. The first treatment involved grazing ample good quality natural or irrigated pasture (H) throughout the experiment so that the sheep remained in good to excellent condition throughout. The second involved grazing restricted amounts of poor quality natural pasture (L) throughout the experiment so that the sheep remained in backward store condition. As a control, a third group (C) grazed natural pasture such that the sheep subject to seasonal variations in pasture quality and quantity and their condition varied from store to forward store throughout the experiment.

Intake was estimated on two occasions; in February 1994, and July 1994, by dosing with controlled-release alkane capsules. Pasture samples were taken at these times based on observation of sheep grazing patterns. However, later analysis showed that the pattern of alkanes in the collected herbage was different to the alkane pattern in faecal samples, indicating that the herbage samples were not truly representative of the herbage consumed by the sheep, particularly at the summer sampling.

Actual intake (AI) (expressed as kgOM/day  $\pm$  SE), averaged over the three strains and three pasture types was estimated to be  $1.54 \pm 0.034$  in February and  $1.52 \pm 0.037$  in July; a non-significant difference. The average AI of group L ( $1.61 \pm 0.037$ ) was significantly higher than either group H ( $1.55 \pm 0.033$ ) or C ( $1.42 \pm 0.032$ ). No significant difference in AI existed between the strains. When intake was corrected for live weight (metabolic intake, MI = kgOM/day/kgLW<sup>0.75</sup>  $\pm$  SE), fine wool sheep had a significantly higher MI ( $0.088 \pm 0.0021$ ) than either strong ( $0.082 \pm 0.0019$ ) or medium wool ( $0.082 \pm 0.0019$ ) sheep.

**Keywords:** Alkanes; grazing intake; Merino sheep.

### INTRODUCTION

Feed intake is one of the most important factors determining the productivity of wool-growing sheep. Variation in the intake of pasture by grazing ruminants has a major influence on their performance, making an accurate estimate of intake highly desirable. Much effort has been devoted to developing systems for estimating intake by grazing animals, and research continues as most systems have sampling, analytical or accuracy problems. Until recently the most reliable method appeared to be the use of chromium oxide as a faecal output marker, combined with an estimation of mixed pasture or individual species digestibility, the digestibility estimate usually being made by an *in vitro* technique on herbage collected with sheep fistulated at the oesophagus (Dove 1993). However, as a single estimate of digestibility is applied to all animals, the technique can really only yield data on average intake, not individual intake. In addition, any error in the estimate of digestibility can result in a large error in estimated intake (Dove 1993).

Over the last ten years a new technique has evolved based on the use of n-alkanes which occur as saturated hydrocarbons in the cuticular wax of most plant species (Dove, 1993). The technique relies on measuring faecal concentrations of adjacent alkanes; an alkane with an odd number of carbon atoms (for example, C<sub>31</sub>) naturally occurring in the plant wax and the adjacent alkane with an even number of carbon atoms (for example, C<sub>32</sub>) being given as an oral dose. As alkanes are not

fully recoverable from ruminants the method depends on similar recoveries of adjacent alkanes. Advantages of using alkanes as markers to estimate grazing intake are that an individual digestibility is calculated for each test animal and there appears to be little problem with diurnal variation of the marker in the faeces (Dove and Mayes 1991).

Alkanes have given reliable estimates of intake (Mayes *et al.*, 1986) and have been applied to the estimation of intake in stocking rate experiments involving simple pasture combinations (Dove *et al.*, 1989). However, there are no reports of the use of alkanes to estimate intake of pasture under more extensive grazing systems, or of the value of alkane-based estimates of feed intakes as affected by breed, strain, pasture type or season. In addition, there are no reports on whether hand-harvesting of a diverse pasture will yield a sufficiently representative pasture sample for an accurate intake estimate.

The experiment reported here was designed to use alkanes to estimate the intake of three Merino strains grazing on three different pasture regimes in two seasons.

### MATERIALS AND METHODS

*Experimental site:* The experiment was conducted at the University of New South Wales field station at Hay in south-western New South Wales where the mean annual rainfall is 363 mm. The dryland pastures consisted of a diverse mixture of native and naturalised species, while some sown irrigated pastures were available.

**Experimental animals:** The sheep were part of a wool growth study which involved the comparison of three year old fine, medium and strong-wool Merino wethers grazing each of three pasture allocations for one year. For the purpose of this intake study, five sheep of each strain on each pasture allocation were selected by stratified randomisation based on live weight (5 sheep x 3 strains x 3 pasture allocations = 45 alkane-dosed sheep). Live weight was recorded every six weeks throughout the experiment and corrected for estimated fleece weight.

**Experimental pastures:** The three pasture allocations were designated high (H), control (C) and low (L). The H group involved the sheep grazing natural pastures at times of the year when they were of good quality and available in abundance, and irrigated pastures at other times, so that the sheep remained in good to excellent condition. In contrast, the sheep in the L group were restricted to low levels of poor quality natural pastures. When pasture conditions improved, the L group was offered pasture which had previously been heavily grazed. The result of this management was that the sheep remained in backward store condition. The C group was not subjected to any particular grazing management, hence their condition varied throughout the year.

**Faeces sampling:** The experiment was conducted in both summer and winter, with alkane dosing occurring on 14 February and 23 June 1994, and the subsequent daily faeces sampling occurring on 21 to 24 February and 30 June to 3 July 1994, respectively. The slow-release alkane capsules were prepared and standardised by CSIRO (K. Ellis, personal communication) and administered using a Captex dosing gun. The release rate of alkanes from the capsules used in February was 55mg/day, and 51mg/day from the capsules used in June. The capsules had a maximum life of 25 days. Faecal sampling over four consecutive days commenced seven days after dosing by which time the faecal concentration of dosed alkanes should have reached equilibrium (Dove and Mays 1991).

**Pasture sampling:** A pasture sample was collected from each of the three grazing areas in each season by sampling from ten different sites within each grazing allocation and then pooling equal subsamples for analysis. The pasture was plucked, avoiding coarse stem material or individual species not generally seen to be eaten by the sheep in observations prior to the sampling periods. The apparent accuracy of the sampling procedure was assessed by comparing the pattern of alkanes occurring in the collected herbage with the alkane pattern in the faecal samples. That is, each alkane with an odd-numbered carbon chain ( $C_{25}$  to  $C_{35}$ ) was expressed as a percentage of the sum of the alkanes with odd-numbered carbon chains, and the percentages calculated for the herbage samples were compared with the corresponding percentages calculated for the faecal samples.

**Laboratory analyses:** Faecal samples were dried at 60°C for 48 hours, ground to pass a 1 mm screen and then 1 g placed in a McCartney bottle with 0.5 mg of tetratriacontane ( $C_{34}$  alkane) as an internal standard. Pasture samples were dried at 60°C for 48 hours and ground through a 1 mm screen before 1.5 to 2 g was subsampled for analyses. The samples were processed using a technique (H. Dove, personal communication) similar to that of Mays *et al.* (1986), with final readings

being taken on a gas liquid chromatograph (Dove, 1992). Individual alkanes were identified from their retention times on the column, and peak areas on the printout were converted to concentrations of alkanes (in ppm) by reference to the internal standard (Dove, 1992). The relative concentration of the naturally occurring ( $C_{31}$ ) and dosed ( $C_{32}$ ) alkanes in both herbage and faeces samples were used to calculate the herbage intake in kilograms of organic matter per day.

Pasture samples were also analysed for nitrogen using a kjeldahl system, and acid detergent fibre using the method described by van Soest (1963). Dry matter digestibility was estimated from nitrogen and acid detergent fibre percentages (Oddy *et al.* 1983), and metabolisable energy of the samples was estimated from the dry matter digestibility.

**Statistical analyses:** The data were analysed by the GLM procedure of SAS on a Vax computer. Pasture and strain of sheep were treated as main effects and season was a subplot effect in the factorial design.

## RESULTS

**Pasture samples:** As pasture sampling was by plucking, and judgements were made about selection by the sheep, it was important to assess the apparent accuracy of the pasture sampling procedure. Comparisons between the pattern of alkanes occurring in faeces and herbage samples showed some variation, particularly in the proportions of  $C_{29}$  and  $C_{33}$  alkanes, and particularly in the summer samples from the low and medium grazing areas. As the variation for  $C_{31}$  was less, it was used for estimation of intake.

**Estimated intake:** Actual intake (AI = kgOM/day  $\pm$  SE), averaged over the three sheep strains and the three pasture types was estimated to be  $1.54 \pm 0.034$  in February and  $1.52 \pm 0.037$  in July; a non-significant difference. When considered between pasture allowances averaged over strains and seasons there was a highly significant ( $P < 0.05$ ) differences between the mean AI of  $1.42 \pm 0.032$  for the C group, and both the H ( $1.55 \pm 0.033$ ) and L ( $1.61 \pm 0.037$ ) groups. There was no significant difference between the mean AI of the L and H groups.

No significant difference in AI existed between strains. When corrected for live weight, the mean metabolic intake (MI = kgOM/day/kgLW<sup>0.75</sup>  $\pm$  SE) of the finewool sheep ( $0.088 \pm 0.0021$ ) was significantly higher ( $P < 0.05$ ) than either the medium wool sheep ( $0.082 \pm 0.0019$ ) or the strong wool sheep ( $0.0082 \pm 0.0019$ ).

**TABLE 1:** Mean actual intakes (kgOM/day) of strains and grazing groups in each season. Mean estimated fleece-free live weights are shown in brackets.

Strain	Strong	Medium	Fine
Pasture and Season			
High - February	1.93 <sup>gh*</sup> (55.0)	2.07 <sup>h*</sup> (53.5)	1.65 <sup>defg*</sup> (46.0)
Control - February	1.30 <sup>abc*</sup> (51.0)	1.31 <sup>abc*</sup> (54.0)	1.34 <sup>abc*</sup> (40.5)
Low - February	1.47 <sup>bd*</sup> (46.5)	1.50 <sup>bcd***</sup> (46.0)	1.27 <sup>ab*</sup> (36.0)
High - July	1.26 <sup>ab*</sup> (56.0)	1.09 <sup>**</sup> (52.0)	1.33 <sup>bc***</sup> (51.0)
Control - July	1.58 <sup>def*</sup> (51.0)	1.52 <sup>bcd*</sup> (55.5)	1.48 <sup>bd*</sup> (46.0)
Low - July	1.82 <sup>efgh***</sup> (50.0)	1.83 <sup>gh*</sup> (48.0)	1.78 <sup>defgh***</sup> (40.0)

Means with \* SE = 0.099; \*\* SE = 0.1217; \*\*\* SE = 0.1517

<sup>a,b,c,\*</sup>: Means with different letters are significantly different at  $P < 0.05$ .

**Pasture analysis:** Estimated crude protein percentages (%CP), metabolisable energy (MJ ME/kg DM) and dry matter digestibility (%) values for the three pasture allowances are shown in Table 2. Digestibility values were calculated by the method described by Dove and Mayes (1991).

**TABLE 2:** Estimated mean crude protein (%), metabolisable energy (MJME/kgDM) and digestibility (%) values for the three pasture allowances in both seasons.

	Crude Protein	ME	Digestibility
High (Feb)	16.90 ± 0.264	10.40	80.57 <sup>c</sup> ± 1.337
High (July)	18.43 ± 0.010	9.72	77.54 <sup>c</sup> ± 1.444
Control (Feb)	11.34 ± 0.038	8.67	69.12 <sup>b</sup> ± 1.337
Control (July)	10.96 ± 0.043	7.52	54.19 <sup>a</sup> ± 1.337
Low (Feb)	10.27 ± 0.04	7.77	67.95 <sup>b</sup> ± 1.337
Low (July)	11.06 ± 0.025	7.79	66.20 <sup>b</sup> ± 1.544

<sup>a,b,c</sup>: Means with different letters are significantly different at P < 0.01.

## DISCUSSION

The mean intake estimated in this experiment was 1.53 kg OM/day or about 1.7 kg DM/day. As the overall average live weight of the sheep was 48 kg this indicates an intake equivalent to 3.5% of live weight. This relatively high value may have resulted from an underestimate, particularly in summer, of the level of C<sub>31</sub> in the intake of the sheep, as there was some discrepancy between herbage and faecal alkanes indicating the herbage sample was not truly representative of what the sheep were selecting from the pasture. The intake estimation would have been inflated by 17% by an underestimate of C<sub>31</sub> of 20%.

The significantly higher metabolic intake of fine wool Merinos relative to strong and medium wools deserves further study as a real difference in this trait would have implications for the relative efficiency of wool production of Merino strains. The result is different to Lee *et al.* (1991) who found that only 10% of variation in dry matter intake could be accounted for by flock among the 15 lines of Merinos they studied at Trangie, and even this value declined when live weight correction was applied. Similarly, Langlands and Hamilton (1969) noted that a statistically significant difference in actual intake of about 10% in favour of strong wools relative to fine wools was no longer significant when corrected for live weight.

The intake data suggests an interaction between pasture allowance and season, with the sheep on the high allowance having relatively low intakes in winter compared to summer. However, these pasture descriptions related to a year-round grazing system and no measures of pasture availability are available when the intake estimates were made. However, the general similarity in average intake across strains and pasture systems in summer and winter is in keeping with the laboratory measures of nutritive value of the pasture samples. The average crude protein and metabolisable energy contents of the summer and winter pastures were 12.8% and 9.6MJME/

kgDM, and 13.5% and 8.3MJME/kgDM, respectively. In other years one would expect a higher nutritive value for winter pastures at Hay, but the winter of 1994 was severely affected by drought, and the pasture, particularly in the high pasture allocation paddocks contained an unusually high proportion of mature pasture residues.

Future studies of intake on mixed dryland pastures such as those at Hay would be enhanced by sampling the pasture more rigorously, by the use of oesophageally fistulated sheep to indicate selectivity of grazing animals, or possibly by including a range of even numbered carbon chain alkanes in the dose given to the test sheep to estimate the amounts of each species consumed (Dove and Mayes, 1991).

The alkane technique appears to offer a sound means of estimating grazing intake of sheep on dryland mixed pastures, although particular attention needs to be given to obtaining a herbage sample for analysis which is truly representative of what the dosed sheep are consuming as errors in intake estimates can be almost directly proportional to any errors in estimation of the key alkanes consumed by the test animals.

## ACKNOWLEDGMENTS

We are particularly indebted to Dr Hugh Dove of CSIRO for his advice and guidance with the analysis of alkanes and for the loan of laboratory equipment. Thanks are also due to Noel Corliss and David Wilson for their technical assistance. Support for this project was provided by Australian wool-growers and the Australian Government through the Australian Wool Research and Promotion funds as MAF was the holder of an AWRAP postgraduate scholarship, and ARL had the support of an AWRAP vacation scholarship.

## REFERENCES

- Dove, H. (1993). Advances in the estimation of intake and diet selection in the grazing animal. Recent Advances in Animal Nutrition in Australia 1993. pp34-44.
- Dove, H. and Mayes, R.W. (1991). The use of plant wax alkanes as marker substances in studies of the nutrition of herbivores: a review. *Aust. J. Agric. Res.* 42: 913-52.
- Dove, H., Foot, J.Z. and Freer, M. (1989). Estimates of pasture intake in grazing ewes using the alkanes of plant cuticular waxes. Proc. XVI Int. Grassls Cong. Nice. pp. 1091-2.
- Langlands, J.P. and Hamilton, B.A. (1969). Efficiency of wool production of grazing sheep: 2. Differences between breeds and strains varying in age. *Aust. J. Exp. Agric. Anim. Husb.* 9: 254-7.
- Lee, G.J., Mortimer, S.I. and Atkins, K.D. (1991). Genetic variation in pasture feed intake and its relationship with productivity. Final Report to AWC. NSW Agriculture, Trangie.
- Mayes, R.W., Lamb, C.S. and Colgrove, P.A. (1986). The use of dosed and herbage n-alkanes as markers for the determination of herbage intake. *J. Agric. Sci., Camb.* 107: 161-70.
- Oddy, V.H., Robards, G.E. and Low, S.G. (1983). Prediction of *in vivo* dry matter digestibility from the fibre and nitrogen content of a feed. In Feed Information and Animal Production. (Eds. G.E. Robards and R.G. Packham) pp. 395-8. (CAB: Farnham Royal, UK.)
- van Soest, P.J. (1963). Use of detergents in the analysis of fibrous feeds. 2. A rapid method for the determination of fibre and lignin. *J. Assoc. Off. Agric. Chem.* 48: 829-35.