NUTRITION AND GROWTH OF LAMBS GRAZING LUCERNE OR PHALARIS

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Summary

Grazing intakes of lambs on lucerne or phalaris pastures, their growth, and the quantities of metabolites from digestion of the grazed herbage in stomach and intestines are reported. It is suggested that field studies of this type can assist identification of nutritional inadequacies in pasture herbage and yield guidelines for pasture plant breeders.

I. INTRODUCTION

Sheep generally grow faster on leguminous than on grassy pastures but no clear explanation has come from studies of intakes or digestibilities (Ulyatt 1971). Differences have been reported in ruminal concentrations and molar proportions of volatile fatty acids (VFA) (Grimes, Watkin and Gallagher 1967), the extent and rate of ruminal digestion (Ulyatt and MacRae 1974), and the quantities of amino acids absorbed from the small intestine (MacRae and Ulyatt 1974), but there is some contrary evidence (Weston and Hogan 1971) and Graham (1969) found the net energy value of a clover was in keeping with its chemical composition and digestibility. This paper is a preliminary account of studies on the nutrients gained by lambs grazing lucerne or phalaris, and their growth.

II. EXPERIMENTAL

In Feb.-Apr. 1974 (Expt 1) a lucerne dominant pasture was grazed by 16 Border Leicester x Corriedale weaned lambs, initially four months old and 20 kg liveweight, and again in Oct.-Dec. 1974 (Expt 2) by 16 Corriedale weaned lambs initially 2 mo. and 16 kg. Ten in each group wore harness and faecal collection bags intermittently, and four of these were fistulated at rumen and abomasum (RF/AF). Two phalaris dominant pastures, one with high herbage availability (PH) and one with low availability (PL), were grazed during both experiments by similar groups except that in Expt 1 there were two RF/AF per pasture. Two or three sheep with oesophageal fistula grazed with each group.

Over two periods of 4 d in Expt 1 and three periods of 5 d in Expt 2, digestible organic matter intakes (DOMI) were estimated from faeces outputs and digestibility in *vitro* of oesophageal extrusa. Extrusa were analysed for-nitrogen (N) and lipid; botanical composition was determined by microscopic examination, and frequency of parts of plants was adjusted to % weight in diet by weight/area factors established as by Hamilton and Hall (1975). Body gains of protein, fat, water and energy were determined by the comparative slaughter technique.

For 3 to 4 d before and throughout each intake measurement period, the RF/AF were infused intraruminally with a solution of ^{103}Ru-P (Tan, Weston and Hogan 1971) and ^{51}Cr EDTA (Downes and McDonald 1964). The pumps, designed at this Laboratory, also withdrew ruminal fluid continuously (100 to 200 g d^{-1}) during the last 4 or 5 d, when digesta

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(50 g) was taken from the abomasum each morning and afternoon. Ruminal fluid volumes (RFV) were estimated from ^{51}Cr in fluid taken when the infusions stopped, and 6 h later. Flows of OM, total N, non-ammonia N (NAN), and lipid leaving the stomach were calculated by reference to concentrations of the infused markers in abomasal digesta. Apparent digestibilities in, and absorption from the intestines were calculated by reference to faeces collected, and calculated from marker concentrations.

In other studies with weaned lambs of 8 to 30 kg, measurements had been made by radionuclide dilution of VFA net production rates in the rumen. Relationships established with corresponding VFA pool sizes (concentrations x RFV) were used to predict production rates in the RF/AF.

III. RESULTS AND DISCUSSION

In both experiments, grazing intakes and liveweight gains were greater on lucerne than phalaris (Table 1). Lambs in Expt 2 had been weaned, for a much shorter time than those in Expt 1 and the composition of their body gains resembled that reported by Searle, Graham and O'Callaghan (1972) for lambs they identified as in a "transitional" phase of growth coinciding with rumen development.

Mean values for digestion in the RF/AF Expt 2 are from the first two measurement periods; all results in the third were generally similar except that NAN digestibilities were, unaccountably, about 15% units less than those in Table 1. In PL Expt 1 one of the values averaged for % DOM digested in the stomach was uniquely low (39.3%); differences between pastures were non-significant.

Nitrogen % in DOM was in the range 5.3 to 7.2, except in PL Expt 1 and PH Expt 2 where it was 4.9% and the quantities of N entering the intestines were greater than intakes. Weston and Hogan (1973) reported this effect at less than about 4.3% N in DOM of dry feeds. NAN was 87 to 88% of total N -flow in Expt 1, and 95 to 97% in Expt 2. Amino acid analyses showed no unusual features; lipid flows were greater than intakes (J.P. Hogan,- pers. comm.). In Expt 2 NAN digestibility in the intestines was significantly greater with lucerne than phalaris ($P<0.001$). The proportion that was microbial was calculated by assuming synthesis of 27 g N per kg OM fermented in the rumen (Miller 1973), fermentation being the difference between OMI and observed OM flow from the stomach. The values obtained were less than those reported for fresh herbages by Ulyatt *et al.* (1975) who used diaminopimelic acid (DAPA) as a marker, and by Walker *et al.* (1975) who used a ^{35}S technique.

In Expt 2, predicted VFA productions were unreasonably large, indicating the equations were invalid for these newly weaned lambs. In Expt 1 it was assumed 2.2 mole ATP was produced per mole VFA production, and that per mole ATP there was a yield of 12 g microbial material containing 10.5% N (Leng 1973). On this basis, microbial N in NAN was 43% for PL, 37% for PH and 38% for lucerne. OM g -digested in the rumen was estimated (Ørskov, Flatt and Moe 1967) from predicted acetic (ac), propionic (pr), and butyric (bu) acid productions (Y, mole) as:

$$[\text{moles hexose digested} \times 162] = 162\,[{}^1/_2 Y_{ac} + {}^1/_2 Y_{pr} + Y_{bu}]$$

The results plus the marker estimates of OM digested in the intestines indicated total DOMI g of 314 ± 21 for PL, 380 ± 11 for PH and 397 ± 15 for lucerne, values that differed by +21,-12 and -6% respectively from the corresponding DOMI (Table 1) determined by usual methods.

Part of the difference between pastures in liveweight gain was obviously due to differences in DOMI, but in Expt 1 the gains were greater on lucerne than PH though intakes were similar. The energetic efficiency of ruminal fermentation may have been greater with lucerne because residence times tended to be less. No direct measurements were made of

TABLE 1

Grazing intakes of lambs, body gains, and digestion in stomach and intestines

	Expt 1			Expt 2		
Type of pasture [1]:	Phalaris (PL)	Phalaris (PH)	Lucerne	Phalaris (PL)	Phalaris (PH)	Lucerne
Diet composition (% w/w): Total green	55	75	92	83	71	96
Green legume	8	18	68	12	3	66
OM digestibility	57	66	69	67	62	74
Digestible OM intake [2] (g d^{-1})	320	530	580	291	315	426
Mean liveweight [3] (kg)	23.7	26.1	27.0	18.4	18.6	20.8
Liveweight gain [3] (g d^{-1})	30	96	160	51	69	136
Composition of gain [4]: Protein (%)	19	14	15	16	15	18
Fat (%)	20	22	27	2	4	15
Water (%)	51	54	52	80	78	36
MJ kg^{-1}	13.1	12.4	14.6	2.2	4.8	9.8
Feed digestion						
No. of observations [5]	4	4	8	8	6	8
Mean liveweight (kg)	19.2	20.0	20.6	15.3	15.4	16.6
Digestible OM intake (g d^{-1})	259 ± 23	431 ± 30	424 ± 18	148 ± 7	159 ± 24	342 ± 27
% DOM digested in stomach	54.7 ± 5.5	65.3 ± 4.9	63.8 ± 2.1	62.8 ± 2.7	59.0 ± 2.4	67.9 ± 1.4
N intake (g d^{-1})	12.7 ± 1.1	24.7 ± 2.1	22.7 ± 1.1	10.7 ± 0.6	7.8 ± 1.0	20.6 ± 1.6
N leaving stomach (g d^{-1})	15.5 ± 1.9	21.1 ± 0.6	21.5 ± 1.5	9.3 ± 0.6	9.7 ± 1.8	17.7 ± 1.4
NAN leaving stomach (g d^{-1})	13.7 ± 1.5	18.3 ± 0.7	18.9 ± 1.2	8.8 ± 0.5	9.4 ± 1.8	17.0 ± 1.3
NAN digestibility in intestines (%)	63.8 ± 1.4	67.6 ± 1.0	68.5 ± 0.9	66.2 ± 1.6	64.4 ± 1.7	72.2 ± 0.8
Estimated microbial N in NAN (%)	29	42	39	29	28	36
Mean residence Cr EDTA in rumen (h)	3.7 ± 0.2	7.0 ± 2.6	3.7 ± 0.2	6.0 ± 0.4	6.4 ± 0.5	4.3 ± 0.5

1 Phalaris pastures had low (PL) and high (PH) herbage availabilities

2 Means for six lambs with faeces collection harness, no fistulae

3 Means for 12 lambs, six with and six without harness

4 Fleece free empty body

5 Two observations per lamb fistulated at rumen and abomasum except Expt 2 PH when one infusion failure and one lamb unwell. Results are means ± SE

the extent of dietary protein degradation in the rumen, but estimates of microbial protein will be made in future utilizing DAPA as marker and using ^{35}S sulphate. Results can be compared with calculations based on predicted VFA productions, though it is clear that sometimes the latter must also be subject to comparisons with direct measurements. As shown above, the VFA estimates can be used in a calculation that provides an independent check on DOMI. Total collections of faeces can be compared with, and in these experiments were generally similar to, faeces outputs estimated from the dilution of the infused markers.

Nutritional measurements on grazing animals should be cross-checked as much as possible, and several opportunities are provided by the techniques described which have been used on substantial numbers of animals. The nutritional value of pasture plants should be assessed with grazing animals because the quantity and quality of their intakes will correspond to real situations more nearly than those of hand fed animals.

Pasture plant breeders can be expected to give attention to agronomic characters such as ease of establishment and persistence under grazing, and should be concerned with the total and seasonal pattern of plant growth, its digestibility and freedom from deficiencies or toxicities. Animal nutritionists have in general failed to provide other clear guidelines, possibly because these cannot be established without studies such as those reported here, and which should help identify nutritional inadequacies in pastures.

IV. ACKNOWLEDGEMENT

We thank G.H. Parkinson for skilled assistance.

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