Intake, digestibility and retention time of 2 forages by kids and lambs

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ABSTRACT

Ten lambs and 10 kids were offered a low quality meadow hay (7.1 gN/kgDM) for 12 weeks. Five of each species were then reallocated to lucerne hay (23.8 gN/kgDM) and the remainder maintained on meadow hay. Feed was offered *ad libitum*. Digestibility was determined at weeks 4, 6, 10 and 16. Animals were fed at 2 h intervals prior to slaughter and the retention time of dry matter in the rumen estimated. Body energy changes were estimated by comparative slaughter.

In the initial 6 weeks kids and lambs digested meadow hay to a similar extent but whereas it was maintained in kids, digestibility by lambs subsequently declined until week 16. At week 16 values for dry matter digestibility were 0.67 and 0.54 for kids and lambs, respectively. There were no significant differences in the digestibility of lucerne hay between species nor in the voluntary intake of meadow hay or lucerne hay. Both species consumed more lucerne hay than meadow hay.

Kids retained lucerne hay longer than did lambs (18.7 h and 11.8 h, respectively) but meadow hay had a similar retention time in both species (24.7 h and 27.8 h, respectively).

Water intake of lambs was approximately double that of kids.

Difficulties in determining maintenance energy requirement from body weight change are discussed.

Keywords Goats; sheep; intake; digestibility; retention time; energy; water

INTRODUCTION

Much of our knowledge of digestion and utilisation of feed by ruminants derives from sheep and cattle. The limited data in which digestion in goats has been compared with sheep suggest that goats digest poor quality diets better than (Jones *et al.*, 1972; Wilson *et al.*, 1975; El Hag, 1976), and high quality diets similarly to, sheep (Watson and Norton, 1982). There is evidence that the maintenance requirement of goats is similar to (Devendra, 1967; Holmes and Moore, 1981; N.R.C., 1981), or substantially greater (Mohammed and Owen, 1980) than, that of sheep. Further information on these aspects is required to determine the extent to which values derived in sheep can be extrapolated to goats.

MATERIALS AND METHODS

Fifteen feral × Saanen crossbred kids and 15 Dorset-Down lambs (approximate age 4 months) with mean live weights of 13.3 and 20.5 kg respectively, were used for the experiment. Five animals from each species were randomly allocated to an initial slaughter group. The remaining 10 animals of each species were offered hammer milled meadow hay twice daily for 12 weeks, in an amount to allow for 10% refusal. Body weight was recorded weekly and digestibility of feed (7-day trials) measured during weeks 4, 6 and 10. At the end of 12 weeks kids and lambs were further randomly allocated into 2 groups of 5 animals. One group was maintained on meadow hay and the other offered hammer milled lucerne hay thus providing a contrasting diet of higher quality. All animals were offered 1.3 times the previous day's intake. Further digestibility trials were conducted during weeks 15 to 16. During these weeks animals were offered the forages at 2 h intervals. At the end of week 16 the animals were anaesthetised 15 minutes after a feed, their gut contents removed and then killed by an over-dose of pentobarbitone. Carcass analysis was carried out on the group offered meadow hay.

Feed and refusals were bulked over weekly periods, sampled, dried to constant weight (70 °C), sub-sampled and ground (1 mm sieve). Whole carcasses were minced and sub-samples freeze-dried for dry matter (DM) determination and further ground for subsequent chemical analysis. Individual faecal samples were oven-dried for DM estimation and sub-samples freeze dried and ground for chemical analysis. The N content of feeds, refusals, faeces and carcass were determined by the Kjeldahl method. The energy content of the carcass, feed and faeces was determined in an adiabatic bomb calorimeter (Gallenkamp) and fat contents by Soxhlet extraction. The metabolisable energy of the diet was calculated as 0.82 × digestible energy content. The retention time of DM in the

rumen was determined as total rumen DM content divided by total DM eaten per hour.

RESULTS

The composition of meadow and lucerne hay offered to kids and lambs is shown in Table 1. The N content of meadow hay was significantly less than that of lucerne hay.

TABLE 1 Chemical composition of forages.

	DM (g/kg)	OM (g/kgDM)	N (g/kgDM)	GE (MJ/kgDM)
Meadow hay	886	951	7.1	16.1
Lucerne hay	885	925	23.8	17.2

Mean values for intake, retention time and apparent digestibility of nutrients by kids and lambs are given in Tables 2 and 3. Voluntary feed intake of meadow hay by kids and lambs, measured over the first 12-week period, was similar and there was no time effect. Intake of lucerne hay was not significantly different between species. Both species ate more ($P < 0.01$) lucerne than meadow hay. Water intake by kids was lower ($P < 0.01$) than that of lambs on both forages (Table 2).

TABLE 2 Mean dry matter intake and retention time of 2 forages and water intake by kids and lambs.

	Meadow hay		Lucerne hay	
	Kids	Lambs	Kids	Lambs
DM intake ($gDM/kgW^{0.75}/d$)	50.0	50.1 NS	73	84 NS
DM retention time (h)	24.7	27.8 NS	18.7	11.8 *
Water intake (ml/kgDMI/d)	1143	2281 **	1517	2634 **

Meadow hay was retained longer in the rumen of both lambs and kids than was lucerne hay ($P < 0.05$). Lambs retained the DM of lucerne hay for a shorter time than did kids ($P < 0.05$) but with meadow hay both animal species retained the DM for a similar time.

Kids and lambs digested the DM and N of meadow hay similarly until week 4 and DM until week 6. However from week 10 and particularly at week 16, DM and N digestibilities had fallen significantly in lambs ($P < 0.01$) but not in kids. The apparent digestibility of lucerne hay was similar in both species.

TABLE 3 Apparent digestion of DM and N by kids and lambs.

	DM		N	
	Kids	Lambs	Kids	Lambs
Meadow hay—week 4	0.62	0.61	0.29	0.26
6	0.60	0.57	—	—
10	0.60	0.55**	0.32	0.22**
16	0.67	0.54**	0.32	0.16**
Lucerne hay	0.59	0.60	0.62	0.62

Throughout the trial both lambs and kids maintained live weight. However, there was a change in the gross energy content of the empty body over this period (Table 4). This resulted in positive energy balances of +24.2 MJ and +2.7 MJ for kids and lambs, respectively.

TABLE 4 Energy values for kids and lambs consuming meadow hay.

	Kids	Lambs
ME intake ($MJME/kgW^{0.75}/d$)	0.393	0.379
Net change in gross energy content of empty body (MJ)	+24.2	+2.7
Net change in protein energy content of empty body (MJ)	−4.7	−9.9
Net change in fat energy content of empty body (MJ)	+28.9	+12.6
Estimated maintenance energy from live weight change ($MJME/kgW^{0.75}/d$)	0.393	0.379
Estimated maintenance energy from body energy change and theoretical efficiency parameters (M.A.F.F. 1975)	0.312	0.372

DISCUSSION

This trial demonstrated clearly that the digestive efficiency of kids and lambs may be different. Whereas initially both kids and lambs digested a low quality meadow hay (7.1 g N/kg DM) to a similar extent and the kids were able to maintain this digestive efficiency over a long period, digestibility in lambs gradually declined. Previous comparisons have provided conflicting and variable results (Jones *et al.*, 1972; Wilson *et al.*, 1975; El Hag, 1976; Devendra, 1977; Watson and Norton, 1982) but no trials appear to have continued for the 16 weeks used here. Watson and Norton (1982) observed higher rumen NH_3 levels in goats and suggested this might enable them to digest low quality herbage to a greater extent. The time-related differences in digestibility observed here would be consistent

with this hypothesis, especially in view of the low N content of the forage. In the short term of 4 to 6 weeks there was no difference between species in their ability to digest DM of either meadow hay or lucerne hay.

Differences in digestibility of forages in sheep and cattle have been related to differences in retention time of DM in the rumen (Poppi *et al.*, 1981). However the retention time of meadow hay in the rumen was similar for both kids and lambs. This further suggests that differences in microbial digestion rate may have been important in determining the differences in the extent of digestion. When offered lucerne, kids retained DM in the rumen for a significantly longer time than did lambs but this did not result in any difference in the extent of digestion. It may be that the potential digestibility of the lucerne had already been reached or that there were differences between species in digestion in distal parts of the tract.

Voluntary feed intake by kids and lambs was similar for each forage in agreement with the findings of El Hag (1976) and Watson and Norton (1982). Even with a low quality, N-deficient forage there was no corresponding time effect on intake as observed in digestibility.

The two-fold greater water consumption (ml/kg DM intake) in lambs compared to kids supports the observations of Gihad (1976) and Gamble and Mackintosh (1982).

Both species maintained constant live weight during the 16-week period. Using live weight as a basis for calculation, the intake of metabolisable energy is therefore the maintenance energy requirement. This was estimated as 0.393 and 0.379 MJME/kg$W^{0.75}$/d for kids and lambs respectively and is comparable with results of M.A.F.F. (1975) and Holmes and Moore (1981) for sheep and goats. On the other hand Mohammed and Owen (1980) calculated a higher maintenance requirement for goats compared to sheep (0.43 *v* 0.30 MJME/kg$W^{0.75}$/d) based on the assumption that intake at a constant live weight represented maintenance energy requirement. In the present experiment body fat deposition caused a positive energy balance in kids, but not in lambs (Table 4). Using this and a theoretical k_g calculated from the M/D of the ration (M.A.F.F., 1975) the maintenance energy requirement was estimated as 0.312 and 0.372 MJME/kg$W^{0.75}$/d for kids and lambs, respectively. The calculation assumes similar k_g values for both species.

It may be concluded that, in the short term, intake and digestibility of temperate forages by kids and lambs may be similar. Kids may be better adapted than lambs to maintain digestive function on low quality forages. Maintenance energy requirement of kids appeared to be lower than that of lambs.

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