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WINTER FEEDING HOGGETS

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SUMMARY

Romney hoggets fed swedes alone, or together with a hay supplement, were studied indoors and in the field over a 12-week winter period. Treatment groups indoors were: Swedes (1); Swedes plus 350 g high-quality lucerne hay (H.Q.H.) (2); Swedes plus 350 g average-quality meadow hay (A.Q.H.) (3); H.Q.H. *ad lib.* (4); and outdoors, Swedes (5); Swedes plus 350 g H.Q.H. (6); Swedes plus 350 g A.Q.H. (7); and Swedes plus H.Q.H. *ad lib.* (8). Hay for groups 2, 3, 6 and 7 were offered for 2 hr each day. Weight gains and digestible energy (D.E.) intakes were measured in all groups.

Important features of the results were:

- (a) Weight gains of sheep fed swedes alone were low relative to the D.E. intake when compared with the other treatments. The effect was more marked in the field.
- (b) Sheep fed swedes alone in the field (5) had feed requirements about 90% higher than similar animals fed indoors (6).
- (c) Sheep offered H.Q.H. or A.Q.H. for 2 hr per day as a supplement to swedes (2, 3, 6, 7) had similar D.E. intakes and weight gains.
- (d) When the daily consumption of hay as a supplement to swedes in the field was increased from approximately 110 g per head (6, 7) to 350 g (8), total D.E. intake increased by 35% and weight gain by 50%.

THE GROWTH RATE of young sheep during their first winter requires further examination, particularly for areas which traditionally grow supplementary winter feed crops. Drew (1967) has reported a preliminary study of five winter feeding systems and found that a ration of swedes plus 350 g of high-quality lucerne hay per head per day was much superior to the other rations studied which were swedes *ad lib.*, lucerne hay *ad lib.*, and two levels of autumn-saved pasture. Two aspects emerged which were of particular interest:

- (1) When sheep on swedes in the field were supplemented with 350 g per day of lucerne hay, their total digestible energy intake did not rise, yet they had a 50% higher weight gain than similar animals grazing only swedes.

- (2) Sheep grazing swedes *ad lib.*, or swedes plus hay in the field, consumed 110 to 140% more digestible energy than the same treatments in pens.

In view of these results, a further nutritional trial with hoggets was conducted in 1967. The main purposes of this trial were to study the winter growth performance of the animals in relation to:

- (a) The quality; and
- (b) Quantity of hay used as a supplement; and
- (c) The feeding of sheep in pens in contrast to outdoor feeding, where there are sufficient animals to measure weight changes.

EXPERIMENTAL

Romney wether hoggets were studied during a 12-week period, June 7 to August 30, 1967. Groups 1 to 4 each of 8 hoggets, were fed indoors and kept either in pens (5 animals) or in metabolism crates for urine and faeces collection (3 animals). Groups 5 to 8, each of 16 hoggets, including 6 bagged for faecal collection, were run on swedes in the field. All sheep were weighed fortnightly off feed and also after a 24-hr fast at the start, middle and end of experiment.

The animals were dosed initially with 1 million units calciferol and 5 mg selenium, and at monthly intervals with thiabendazole for parasite control.

TREATMENTS AND MANAGEMENT

Group 1—Swedes: Swedes were pulled, cleaned, chipped and fed to 15% in excess of consumption.

Group 2—Swedes plus 350 g high-quality lucerne hay (H.Q.H.): Treatment as for group 1 but 350 g of hay per head was offered for 2 hr each day.

Group 3—Swedes plus 350 g average quality meadow hay (A.Q.H.): Treatment as for group 2 with the difference in hay quality.

Group 4—Chaffed H.Q.H. offered ad lib.

Group 5—Swedes: The animals had full access to the Calder swede block which was fed off as three third-acre breaks.

Group 6—Swedes plus 350 g H.Q.H.: Animals were allowed full access to swedes but confined in stalls for 2 hr per day and offered the hay ration.

Group 7—Swedes plus 350 g A.Q.H.: Treatment as for group 6 with the difference in hay quality.

Group 8—Swedes plus H.Q.H. ad lib.: Hoggets always had the choice of swedes or high-quality hay.

INTAKE MEASUREMENT IN THE FIELD

The hay intakes and faecal outputs of the sheep fed swedes plus hay were measured directly. The digestibilities of the swedes and H.Q.H. were provided by data from groups 1 and 4, respectively, while the digestibility of A.Q.H. was derived from *in vitro* analysis (Drew, 1966). The digestibility of hay fed as a supplement with swedes does not change significantly from the figure produced when hay is the sole ration (Drew, 1967). Hence, for hoggets in the field, if hay consumption is known, faecal output derived from the hay can be estimated, and, by difference, the faeces derived from swedes. A back calculation using the swede indigestibility will give swede consumption. In this case, a correction based on data from Blaxter (1962), Raymond *et al.* (1959) and Harkness (1963) was applied because of the difference in level of intake between swedes fed in pens and in the field.

ANALYSIS OF DATA

Intakes were measured in terms of digestible energy and data obtained daily were aggregated for periods of one week.

RESULTS

INDOOR GROUPS

Feed Digestibilities

Figure 1 shows the energy digestibilities of the feeds. It can be seen that the swedes were uniformly high in digestibility. There was little difference in digestibilities between the H.Q.H. and A.Q.H. in the first five weeks of the experiment, but, from week 6 onwards the difference was considerable.

Digestible Energy Intake

Figure 2 shows the total digestible energy intakes of the four groups under conditions of hand feeding. After the

first two weeks of the trial, the between-week variation in intake was not great. Feed consumption was almost always lowest on swedes and highest on swedes plus 350 g H.Q.H. with results from the other two treatments virtually the same.

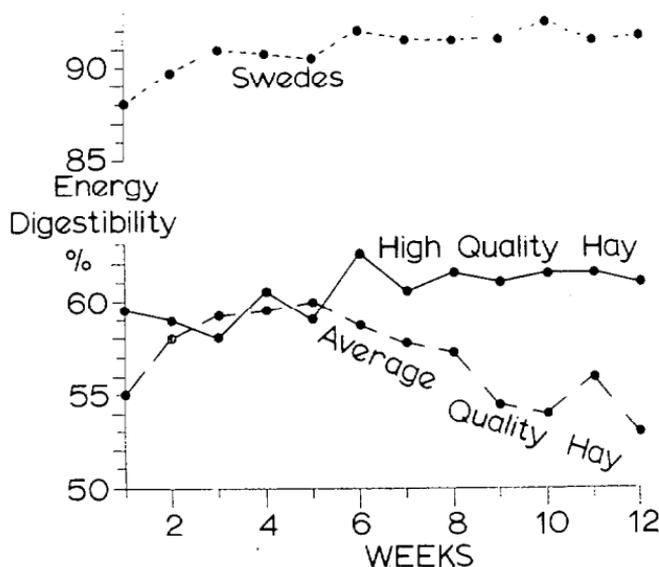


Fig. 1: Energy digestibility of the three feedstuffs.

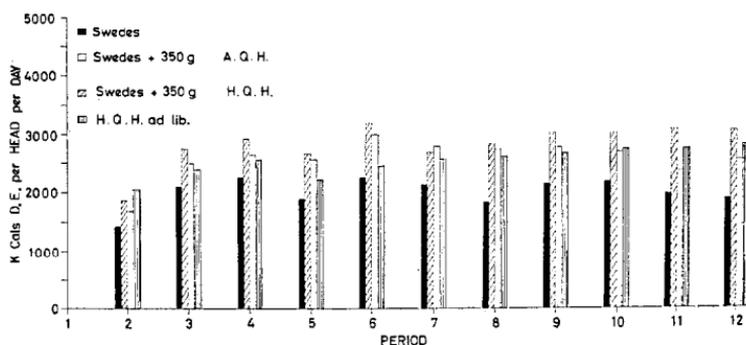


Fig. 2: The digestible energy intake of the indoor groups.

The intakes of energy due to hay and swedes are shown in Figs. 3 and 4, respectively. Although hoggets in groups 2 and 3 were offered 350 g of H.Q.H. and A.Q.H. for 2 hr per day as a supplement to swedes, the actual consumption of these hays was 270 g and 170 g, respectively. It is clear that more H.Q.H. as a supplement to swedes was consumed than A.Q.H., and there is some suggestion that the difference in intake increased in the last 6 weeks of

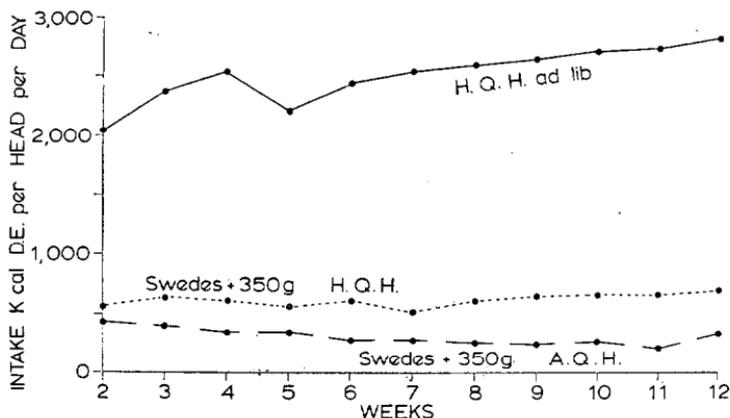


Fig. 3: The hay intake of the indoor groups.

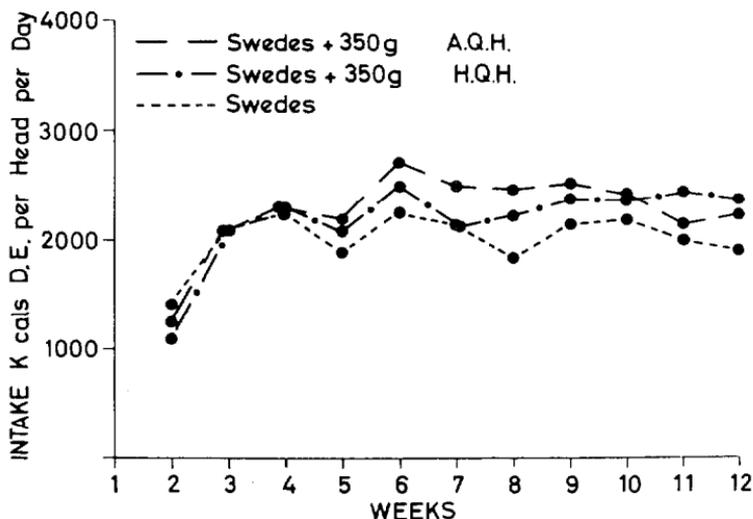


Fig. 4: The swede intake of the indoor groups.

the trial when the digestibility of A.Q.H. fell noticeably. Feed intake of H.Q.H. *ad lib.* (group 4) was fairly stable although a small progressive increase occurred.

In contrast, the consumption of swedes when fed with A.Q.H. was higher than that with H.Q.H. or when fed as sole diet (Fig. 4). A supplement of up to 350 g of hay per day stimulated swede intake by 10% in the case of H.Q.H. and 25% when fed with A.Q.H.

Weight Change

Figure 5 gives the fasted weight gains of animals (lb) for the period of the trial. The treatment, swedes alone, produced weight changes clearly lower than the other three treatments with sheep indoors.

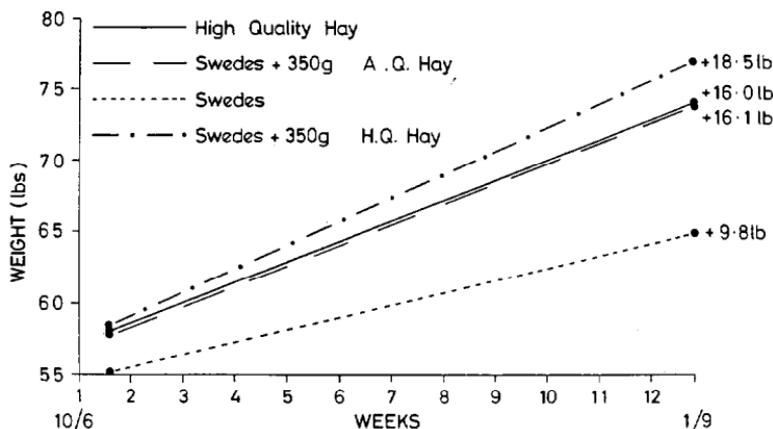


Fig. 5: Average weights (after 24 hr fast) of the indoor groups.

Teeth

All sheep retained the full complement of eight teeth throughout the experiment.

FIELD GROUPS

Digestible Energy Intake

The weekly total digestible energy intakes for the four groups are shown in Fig. 6. During the first 8 weeks, there were only small differences in intake between the groups. However, when shifted on to new swede breaks at the beginning of week 9, a large increase occurred in the

groups fed swedes alone or swedes plus H.Q.H. *ad lib.* This difference persisted for the remaining 3 weeks of the experiment.

The intakes of energy derived from hay are shown in Fig. 7. As with the indoor sheep, although offered 350 g of hay for 2 hr each day, the field sheep consumed, on average, only 120 g of H.Q.H. (group 6) and 105 g of

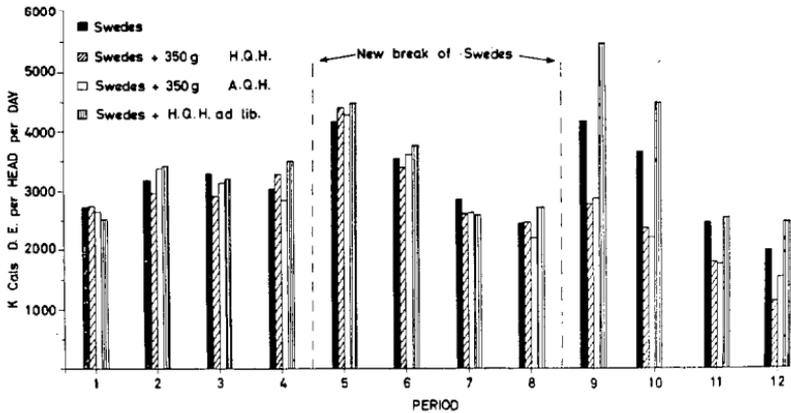


Fig. 6: The digestible energy intake of the field groups. The times are marked where the hoggets were shifted on to a fresh break of swedes.

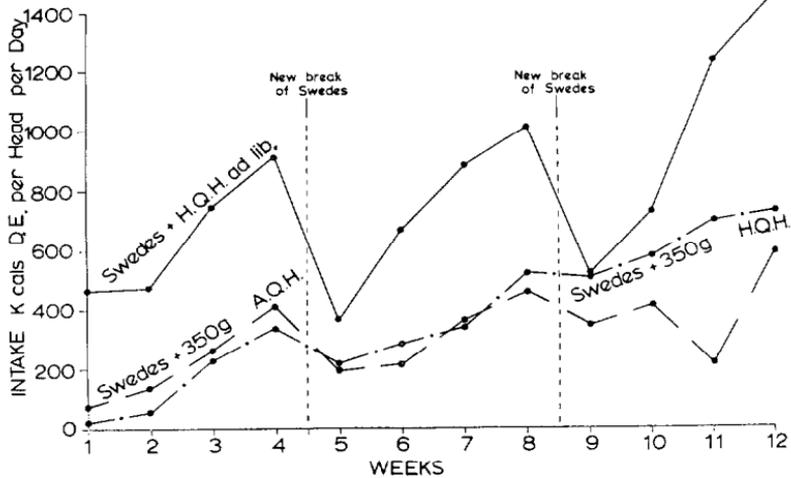


Fig. 7: The hay intake of the field groups.

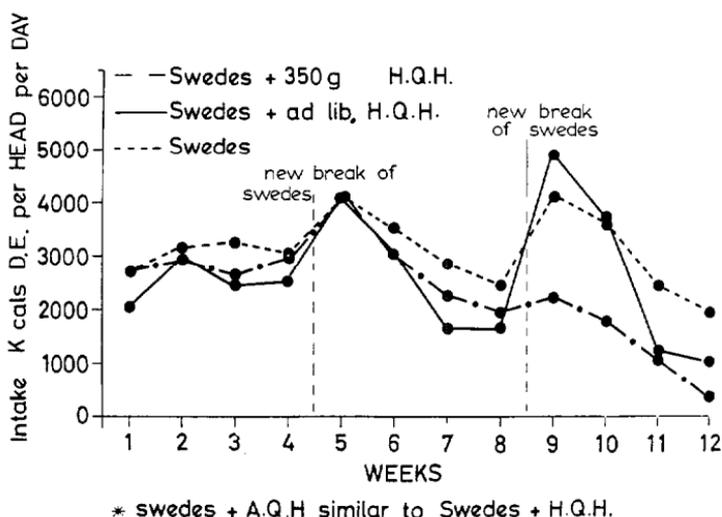


Fig. 8: The swede intake of the field groups.

A.Q.H. (group 7). The results for the animals supplemented with hay *ad lib.* show clearly that when a fresh break of swedes is offered the consumption of hay falls sharply. In contrast to the results from the sheep fed in pens, it was only during the last four weeks that the intake of A.Q.H. was lower than that of H.Q.H. yet the levels of intake of both hays rose towards the end of the experiment.

Figure 8 shows the pattern of swede intake and reveals that a sharp rise occurred when new breaks of swedes were offered. In most cases, a hay supplement has meant a decrease in the quantity of swedes consumed when compared with animals offered only swedes. The progressive fall in intake of total digestible energy as the swedes were eaten down was halted by increased consumption of hay in the group fed swedes plus hay *ad lib.* but did not occur in the other two groups supplemented with 350 g of hay daily.

Weight Change

Figure 9 shows the fasted weight gains of animals (lb) during the experiment. There was a large increase in growth rate occasioned by the hay supplements. Average quality hay was just as effective as H.Q.H. in stimulating

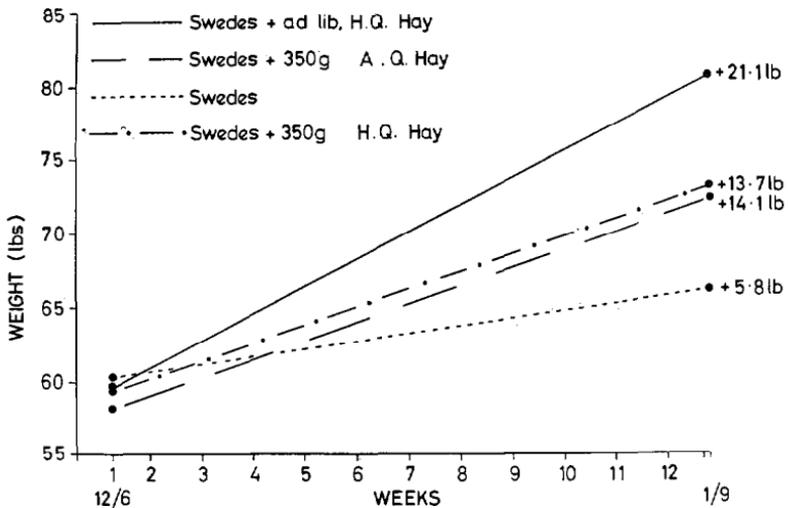


Fig. 9: Average weights (after 24 hr fast) of the field groups.

weight gain when 350 g was offered but growth was much faster with hay offered *ad lib.* as a supplement.

Teeth

Sheep fed on swedes alone lost an average 5.1 of their original 8 teeth; in the other three groups teeth losses averaged 4.1 per hogget.

COMPARISON OF PEN AND OUTDOOR FEEDING

Table 1 gives a summary of the intakes of digestible energy and weight gains for the eight groups. The animals fed swedes as a sole ration both indoors and outdoors gained proportionately much less weight than their intakes would suggest and the effect was most marked in the field.

DISCUSSION

MEASUREMENT OF INTAKE

The problems of intake measurement in sheep grazing swedes are fewer than for sheep grazing pasture. This is because the digestibilities of the leaf and bulb portions of the swede plant are approximately similar (Drew, 1967). Thus, the selection of plant material by sheep is

TABLE 1: MEAN DIGESTIBLE ENERGY INTAKES AND WEIGHT GAINS OF HOGGETS DURING 12-WEEK WINTER PERIOD

Group No.	Treatments	D.E. Intake		Weight Gain	
		kcal/ head/ day	Relative to Group 4	lb/wk	Relative to Group 4
1.	Swedes	1,985	79	0.90	62
2.	Swedes + 350 g H.Q.H.	2,790	111	1.68	116
3.	Swedes + 350 g A.Q.H.	2,554	102	1.46	101
4.	H.Q.H. <i>ad lib.</i>	2,514	100	1.45	100
5.	Swedes	3,110	124	0.53	37
6.	Swedes + 350 g H.Q.H.	2,726	108	1.25	86
7.	Swedes + 350 g A.Q.H.	2,745	109	1.28	88
8.	Swedes + <i>ad lib.</i> H.Q.H.	3,616	144	1.91	132

not a problem in using data derived from pen-fed sheep for estimation of intake of swedes in the field, as it is for estimation of pasture intake in the field. However, because of the extremely high energy digestibility of swedes, the correction of data from outdoor sheep for the effect of "level of intake" is not entirely satisfactory. In estimating field intake, it is necessary to multiply faecal output by $100/100 - \text{digestibility}$. If digestibility is high (e.g., 90%, for swedes), a small change in digestibility (e.g., 2 units) will markedly change the value for indigestibility and hence of the intake. Because such estimates of intake are extremely sensitive to change in digestibility, study of other methods for intake determination should be attempted. The size of the correlation between wet swede intake and urine output appears promising and such a method has the advantage that estimation of swede intake is not sensitive to small variations in urine output. Drew (unpubl.) has found that 77 to 83% of the water ingested as swede appeared in the urine of sheep even when a hay supplement was fed.

INDOOR DATA

Sheep fed H.Q.H. *ad lib.*, or swedes supplemented with hay, had similar digestible energy intakes and weight gains. In comparison with these results, swedes as a sole diet caused a 20% depression in intake and a 40% depression in weight gain. The swede intake of the hoggets supplemented with H.Q.H. and A.Q.H. were 9% and 24% higher, respectively, than from a sole diet of swedes. These results indicate there was poorer utilization of the digestible energy when fed in the form of swedes than as

mixed diet. One possible reason for this is a different rumen fermentation leading to a change in the proportions of the fatty acids produced. A second suggestion is that swedes are an unbalanced diet and it has been shown that energy utilization can be affected by a nutrient deficiency (Forbes and Swift, 1944). The evidence with swedes, however, is that they are really a "dilute concentrate" because, not only is energy digestibility very high, but crude protein levels, on a dry matter (D.M.) basis, are in the range of 15 to 20%. The penned sheep in the present experiment consumed sufficient swedes (0.55 to 0.68 kg D.M. per day) to get 68 to 90 g digestible crude protein per day, or enough to meet standard recommendations. Perhaps the most likely explanation lies in the balance achieved between the heat increment of the ration and the heat required for body metabolism, body thermoneutrality and to raise the temperature of the 6 or 7 litres of cold water ingested as swede each day by about 30° C. This latter cost would account for over 10% of the gross energy intake. If there is a low heat increment from a swede diet, some chemical regulation may be required for some body function, and, therefore, a lower-than-expected weight gain recorded.

It is not possible to compare closely the feed requirements of sheep in the present experiment with the maintenance requirements for sheep reported in the literature because the hoggets were all gaining substantial weight. However, if a correction is applied to the intakes on the basis of 2 kg D.O.M. or 9,317 kcal D.E. per kg gain (Evans, 1960; Coop and Hill, 1962; Gardner *et al.*, 1964; Grimes, 1966), the maintenance requirement of a 65 lb sheep is 1,690 kcal D.E. per day for groups 2 to 4 and 1,440 kcal per day for group 1 fed swedes. These figures are higher than 1,335 kcal per day derived from an indoor estimate (Coop, 1962) for a 100 lb sheep of 1,960 kcal D.E. It is surprising that the sheep fed hay alone or fed swedes plus 350 g hay were higher in energy requirement than sheep given swedes alone, but this may be due to the approximations in correcting for a considerable weight gain.

OUTDOOR DATA

Animals in the three groups fed swedes and hay outdoors show close agreement in performance with those kept indoors and fed hay *ad lib.* (group 4) if a "cost of outdoor living" allowance of 20 to 25% is made. Animals offered swedes plus H.Q.H. *ad lib.* consumed an average

of 350 g of hay per day. Their total intake was 35% higher and weight gain 50% greater than the group offered a 350 g hay supplement for only 2 hr per day.

The consumption of swedes in the field when given as a sole diet was extremely high, yet only low weight gain resulted. Compared with hoggets fed indoors on hay *ad lib.* (group 4), the intakes for animals of group 5 were 24% higher and the weight gains 64% lower. It is quite conceivable that it is energetically very costly to harvest about 20 to 25 lb of swedes per day with a teaspoon which is in effect what the sheep is required to do. These sheep (group 5) ate 20 to 30% more swedes than were consumed by animals fed both hay and swedes. In the process, they lost 5 of their 8 teeth. This may account for the below-maintenance intake during the last two weeks of the trial.

Realizing that the correction for weight gain is an approximation, the intake for maintenance in the field on swedes is about 2,800 kcal D.E. per day or 590 g D.O.M. per day for a 65 lb hogget. This is 90% higher than in a pen and 45% higher than the estimate by Coop and Hill (1962) for a 56 lb lamb grazing pasture. With the rations of swedes plus 350 g hay per day (groups 6 and 7), similar calculations for maintenance showed this to be 2,000 kcal D.E. per day (similar to Coop and Hill's estimate). This lower maintenance value may be partly due to a lower harvesting cost because the swede consumption was 30% less but no explanation can be offered for the maintenance requirement of 2,500 kcal per day in the animals fed swedes plus hay *ad lib.* (group 8).

Comparisons of treatments common to both indoors and outdoors, showed that, when combinations of swedes and hay were fed outside, a 20 to 25% increase in feed intake occurred over the indoor groups for a similar performance. When swedes alone were fed, however, the outdoor requirements were 90% above the intakes of sheep fed indoors. Many workers have examined the relationships between indoor feeding and outdoor feeding and most have found increased intake by outdoor animals, although the magnitude of the increase was variable and of the order of 25 to 100% (Lambourne, 1961; Coop and Hill, 1962; Langlands *et al.*, 1963; Grimes, 1966). The suggestions put forward for the increases in intake, such as effects of climate, energy spent in locomotion, energy spent in harvesting the feed, and increased metabolic rate, do not seem to explain adequately the difference between indoor and outdoor feeding when the ration is

consumed either as swedes or as swedes and hay. Difficult and costly heat production studies might show more clearly the reasons for some of the observed effects.

Finally, the present work has established that hoggets fed on swedes and hay can attain increases in weight of 20 lb during the winter period. The question of whether or not this gain in hogget weight is economic when feed resources are scarce needs further investigation.

ACKNOWLEDGEMENTS

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