THE WINTER NUTRITION OF ROMNEY HOGGETS

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SUMMARY

Five winter feeding systems were examined over 12 weeks with eight-month-old Romney wether hoggets. Treatments were swedes (1); swedes plus 0.6 lb hay (2); hay (3); unrestricted grass (4); and restricted grass (5). Sheep were dosed monthly with thiabendazole. Mean weight gains for sheep in groups 1–5 were 13.2, 20.8, 12.1, 9.9 and 6.2 lb, respectively, and mean digestible energy (D.E.) intakes were 3,450, 3,625, 2,820, 2,200 and 1,500 kcal/head/day, respectively. Simultaneously three groups of four sheep in pens were fed swedes (6); swedes plus 0.6 lb hay (7); and grass (8). Mean D.E. intakes were 1,400, 1,730 and 1,710 kcal/head/day, respectively.

Among the results major features were:

(a) High growth rates of sheep in treatments 1 and 2 (particularly 2).

(b) Sheep in treatment 2 consumed only 5% more D.E. than animals in treatment 1 yet the weight gain was 50% higher.

(c) Intake differences between treatments 1 and 6, 2 and 7, showed that consumption of swedes available *ad lib.* in the field was 110–140% higher than in pens.

(d) Unrestricted autumn saved pasture (4) of average quality did not give as high an intake or as good a growth rate as treatments 1, 2 or 3.

The implications of some of these results are discussed.

IT IS WELL KNOWN that many two-tooth Romney ewes in New Zealand have a low productive performance and, especially, fertility. Because of the relationship between liveweight and reproductive performance in sheep, studies on feedstuffs which allow a high liveweight to be attained by the hogget are of economic importance. In examining the effects of plane of nutrition on growth of hoggets, and later productive performance in the ewe flock, Coop and Clark (1955) found that sheep poorly reared as hoggets subsequently had a slightly lower reproductive performance, a similar wool production, and a shorter productive life than similar sheep well reared. Clarke (1958) reported that hoggets well reared during winter can give 12 to 15% more lambs as two-tooths, even although the liveweight difference between the groups had been overcome by the time of mating, while Allden and Young (1964) found no increase in wool production as a conse-

quence of additional herbage consumed following a period of undernutrition. Coop (1964) noted that, in the seven months from weaning to the following spring, many lambs from New Zealand hill country and high country make little liveweight gain. He suggests these lambs and hoggets are healthy; they do not know what ill-thrift is, and apparently they do not know what good feed is either.

Although some information is available about digestibility and chemical composition of many South Island winter feeds, such as turnips, hay, grass and choumoellier, there appears to be a lack of data about voluntary intake on these crops and its relation to feeding value and liveweight gain (L.W.G.). The few studies in which turnips or swedes have been used suggest that the appetite for root crops when fed sliced to sheep in pens is 0.8 to 1.3 lb D.O.M./day (Lancaster, 1943; Woodman *et. al* 1937; Drew, unpubl.). The maintenance requirement of a 75 lb hogget under pen feeding conditions is close to 0.8 lb D.O.M./day (Coop, 1962) while under grazing conditions this figure could be increased to 1.2 lb D.O.M. (Coop and Hill, 1962). Therefore, appetites of the order of 0.8 to 1.3 lb D.O.M./day should provide maintenance for grazing hoggets. Lewis (1960), however, was able to show substantial weight gains with hoggets grazing turnips. Over four consecutive years, the L.W.G. varied from 0.7 to 1.7 lb/week, or an average increase per head of about 15 lb in 12 weeks. This is a very satisfactory growth rate over the winter period, but suggests that the hoggets were consuming a good deal more turnips in the field than they can be induced to eat in pens.

The present experiment was designed to measure the feeding value of Calder swedes with and without lucerne hay when fed to penned sheep and also the consumption of the same crop when grazed by hoggets in the field. In addition, the feeding value and grazing intake were examined with hoggets fed autumn-saved grass at two levels of intake.

EXPERIMENTAL

During a 12-week period (June 22 – September 15, 1966) 132 Romney wether hoggets were used in a feeding trial. Five groups (1–5) each of 24 animals were fed in the field,

and three groups (6–8) of 4 animals each were fed in pens. Wether hoggets were used as total faecal collection was required from some of the animals. On June 9, 28 from a mob of 140 hoggets were randomly drafted on to each of the field treatments and pre-fed for two weeks before measurements began. Three animals not settling to the feeding routine and losing substantial weight in the pre-feeding period were rejected. The sheep were weighed at fortnightly intervals straight off feed, except that the initial, final and one intermediate weights were taken after a 24 hr fast. All sheep were dosed at the start of the trial with 1 million units vitamin D and monthly with thiabendazole and it is assumed that the results are free from effects associated with parasitism.

Treatments and Management

Group 1—Swedes: The animals were allowed full access to the Calder swede crop. One acre was fed off in three ⅓ acre blocks (*i.e.*, 4 weeks/block).

Group 2—Swedes + 350 g hay/head/day: Full access was given to swedes but animals were confined in stalls for 2 hr daily and offered 350 g per head of high quality chaffed barn dried lucerne hay (mean dig. of D.M. = 66%). Hay refusal on average was 25%.

Group 3—Hay ad lib.: Hay was offered *ad lib.* and the animals were penned on gratings. No animals were bagged in this group, but eight sheep were individually confined and hay intake measured directly.

Group 4—Restricted grass: The sward was 8 to 10 in. long and contained ryegrass, cocksfoot and white clover with some timothy and *Poa trivialis*. It was the original intention that this group would be offered sufficient grass to maintain a L.W.G. similar to that of the group on hay. In the event, this proved impossible because unrestricted grass gave lower gains than hay *ad lib.* and the sheep were given 2 hr daily for two weeks then 4 hr daily and finally, fom August 3, 4.5 hr grazing per day. A fresh area of 80 to 90 sq. yd was offered each day and calculated to provide a small residue at the conclusion of feeding.

Group 5—Unrestricted grass: The group was given a fresh area of grass each day. The area of 160 sq. yd was

calculated to provide little grazing pressure in that substantial residues remained at the conclusion of each day's feeding.

Group 6—Swedes ad lib.: Bulbs were pulled daily from the corresponding field group plot. These were cleaned and chipped before feeding and the quantity offered gave 10–15% residues.

Group 7—Swedes + 350 g hay/head/day: Bulbs were pulled from the corresponding field plot and hay was fed in a similar manner to Group 2.

Group 8—Cut grass: Grass was cut daily with a sickle bar mower from alongside the area offered the restricted grazing group. Feed offered was just to appetite to minimize selection. In each of Groups 1, 2, 4 and 5 in the field, eight hoggets were bagged for faecal collection.

Intake Measurement of Grazing Sheep

Intake was calculated for sheep in Groups 1, 4 and 5 (swedes, restricted and unrestricted grass, respectively) by applying a coefficient of digestibility, derived from the appropriate group of pen-fed animals, to measured faecal output. Bcause both swede-grazing groups consumed two to three times that eaten by the pen-fed sheep, a decrease of three units of digestibility has been used in applying the figures derived from the penned sheep to the faeces from the field groups. This correction was derived from extrapolation of data relating digestibility to intake by Raymond *et al.* (1959), and checked by the formula of Blaxter (1962).

Sheep in Group 2 presented some difficulty in that they consumed a mixed diet. There is evidence that prediction of digestibility of a composite feed can be good if digestibility and relative intakes of the components are known (Harkness, 1963; Drori and Loosli, 1959). A separate digestibility trial was conducted to verify this with swedes and hay.

Analysis of Data

Intakes were measured in terms of D.M. and as kilocalories of gross and digestible energy. Data from daily

measurements were aggregated for periods of one week. Heats of combustion of representative samples were determined directly by bomb calorimetry.

TABLE 1: PRE-EXPERIMENT DIGESTIBILITY TRIAL USING A COMPOSITE RATION OF SWEDES PLUS HAY

(Swede D.M. digestibility = 87.2%. Hay D.M. digestibility = 61.2%)

	Sheep No.			
	9	10	11	12
Ratio swede: hay intake	1:1.24	1:0.74	1:0.80	1:0.85
Predicted digestibility*	72.8	76.1	75.7	75.2
Measured digestibility	72.7	76.5	74.3	76.1
Difference	+ 0.1	—0.4	+1.4	+0.9

*Predicted digestibility assumes that the digestibility of the components does not change when they are fed together.
Mean Diff. = +0.5 dig. units.

RESULTS

DIGESTIBILITY OF THE COMPOSITE DIET

Table 1 presents data from the pre-trial feeding experiment in which chipped swedes and chaffed hay were fed separately and together. The predicted digestibility of the mixed feed was close to the measured figure and this result was supported by data from the four sheep (Group 7) individually fed swedes plus hay over the whole 12-week period.

DATA FROM PENNED SHEEP

Digestibility of the Three Feeds

Figure 1 shows that the digestibility of swedes was high and remained remarkedly constant over the 12 weeks with the exception of a decrease in period 4. This period included the beginning of a new block of swedes, and to simulate field conditions swede tops were picked and fed during this week. It was observed and recorded in residues that some of this material was dead and presumably depressed digestibility. A similar phenomenon was not observed in period 9 when tops were again fed and this seems to be due to the low levels of dead material present at that time. *In vitro* digestibility analysis of feed

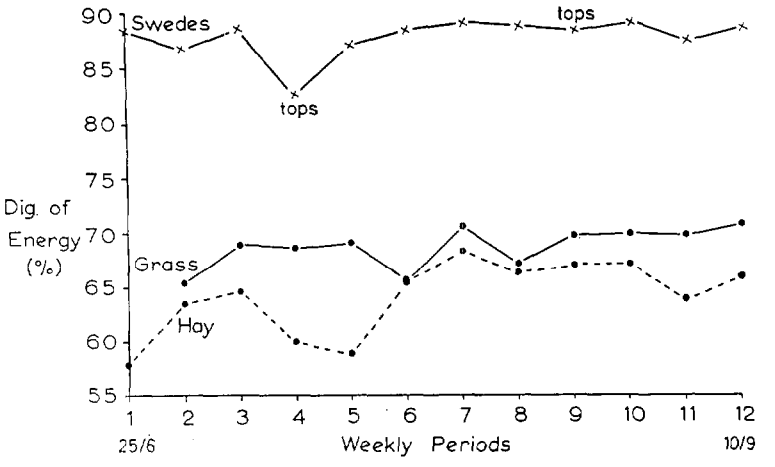

Fig. 1: Digestibility of energy for the three rations fed to the penned sheep.

and residues gave identical figures in period 9, but residue from period 4 was 3% lower in digestibility than the feed.

The digestibility of grass did not change markedly although there is some suggestion of a rise in the last few periods as the grass began to grow in spring.

The figures for digestibility of hay were derived from *in vitro* analysis (Drew, 1966) of hay fed during each period. Fluctuations in digestibility were due to differences between the bales of lucerne hay used.

Digestible Energy (D.E.) Intake

Intake from week to week and from animal to animal with both groups fed swedes was quite variable (Fig. 2). The feeding of tops to these sheep resulted in a decrease in D.E. intake which was largely due, at least in period 9, to insufficient being offered. Supplementing an *ad lib.* chipped swede ration with 2 hr access to 350 g high quality hay per day increased the total intake of D.E. by 25%, but reduced the swede fraction of the composite diet by 16%. Thus the hay contribution to the D.E. of the combined swede plus hay intake was approximately one third. This fraction is in marked contrast to that produced in the field where the hay comprised only one seventh of the total intake.

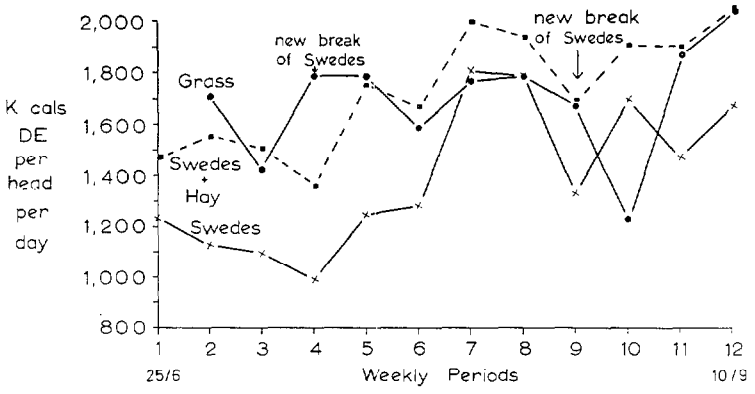

Fig. 2: Intake of digestible energy by the penned sheep. The points are marked where swede tops were pulled and fed. The field groups at that time were shifted on to a fresh area of swedes.

The grass intake, although variable from week to week, was similar between animals. This is probably due to the policy of feeding the sheep so that refusals were small and there was little scope for selection within the feed box.

Data from the Field Groups

Digestible Energy Intake

The relative intakes for the 5 groups in the field are shown in Fig. 3, each point being the mean of eight animals.

Statistical analysis showed no difference in weight gain between bagged and unbagged animals. It was therefore assumed that the intake measured with bagged animals was typical of the whole treatment.

(a) *Swede Treatments*

Both groups had very high intakes and were comparable except for three weeks in August. In Fig. 3 an alternative point has been plotted for period 4 in which swede tops were fed to penned sheep to simulate field conditions. Because these sheep probably ate a higher proportion of dead material than those selecting freely under grazing, the digestibility coefficient of 82.6% probably underestimates field intake and is not considered

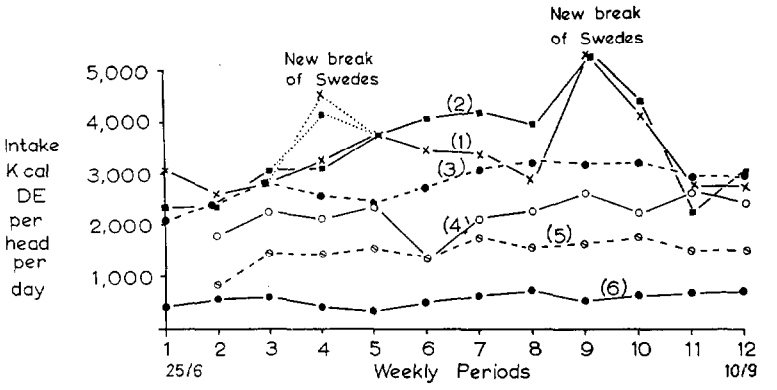

Fig. 3: Intake of digestible energy by the field groups. The points are marked where the swede groups were shifted on to a fresh area. Nos. 1–5 depict intake of sheep on treatments 1–5, respectively. No. 6 depicts intake of hay of sheep on treatment 2 (hay plus swedes).

applicable. A higher value derived from the period 5 digestibility coefficient of 87.2%, when tops were still available, more closely represents the true position.

Between periods 5 and 8, as the swede block was progressively eaten down, the intake of swedes alone fell from 3,750 kcal D.E./head/day to 2,850 kcal D.E. Over the same period, the intake of the animals on swedes plus hay did not show a decline, in fact showed a slight increase. Both groups responded markedly to the shift on to a fresh swede area in period 9. The subsequent dramatic fall in intake, particularly in periods 11 and 12, can only be attributed to softening of the bulbs in warm weather and the consequent lower palatability. Although the swede bulbs at this stage were noticeably rubbery in nature, this does not seem to have affected the digestibility when hand-fed to the penned sheep. The hay consumed by the sheep on swedes plus hay shows a reciprocal relationship with swede availability. Minimal intake of hay was registered when swede tops were eaten and maximal hay intake when swede bulbs were depleted. Hence the hay when offered in limited quantities for a limited time per day rather acted as a buffer in maintaining total intake in the face of decreasing swede consumption.

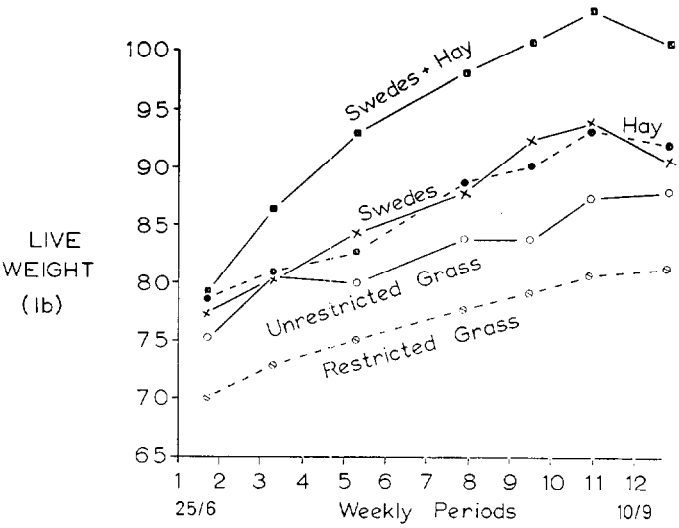

Fig. 4: Mean liveweights of sheep in field groups. The sheep were weighed directly off feed between 1 p.m. and 3 p.m.

(b) *Hay Treatment*

There was a fairly constant energy intake in this group with a slight rise towards the end of the trial. Some of the fluctuation can be attributed to different batches of lucerne hay.

(c) *Grass Treatments*

Groups 4 and 5 (restricted and unrestricted, respectively) were much closer in level of intake than anticipated. The restricted group began with 2 hr per day, but was quickly increased to 4 hr and finally from August 3 onwards was given 4.5 hr grazing daily. This kept intake constant. Intake on unrestricted grass was remarkedly low in view of the abundance of feed offered and as a fresh area was allocated each day. The decreased intake in period 6 was due to a small atypical area grazed during that week.

Liveweight Change

Fortnightly weights of sheep straight off feed are shown in Fig. 4.

The most interesting conclusions from these results were: (a) The very high gains, particularly in the first 6 weeks, made by sheep fed swedes and hay. (b) The similar gains on swedes and high quality lucerne hay. (c) The poor performance of hoggets grazing grass *ad lib.*

DISCUSSION

Perhaps the most startling result achieved in this experiment is the extraordinary rate of growth of the two groups of sheep grazing swedes. If data are deleted for the last two weeks in late winter, when the bulbs were becoming soft and intake dropped, it is found that the hoggets grazing swedes as a sole diet consumed on average 3,450 kcal D.E./head/day and increased in weight by 16.3 lb in ten weeks. Comparable performance for the sheep fed swedes and hay was 3,625 kcal/day for a gain of 24 lb, also in ten weeks. It is stressed that this performance was achieved under rigorous environmental conditions. An anomaly immediately apparent is that, in supplementing hoggets on swedes with 0.6 lb hay/head/day, the mean total D.E. intake was increased by only 5% yet weight gain increased by 50%. Lewis (1960) reported good growth rates with hoggets grazing turnips and this is generally supported here by the growth rate on swedes. He found, however, that in three out of four years supplementation with hay decreased weight gain. This may have been due to palatability differences in the roots (white fleshed turnips) or to poorer quality hay.

The present results with swedes and hay suggest two possibilities, first, the technique of intake-measurement may be at fault, or, secondly, the digested energy is utilized differently.

Accuracy of grazing intake measurement depends upon the assessment of both faecal output and the digestibility of feed eaten. In this experiment faecal output was measured directly by total collection with little chance of error. Confidence is also placed in the digestibility estimation. There is no evidence that digestibility as measured by pen-fed sheep changed systematically, even although the swedes were pulled from within the block being grazed, and of course the availability in the field changed markedly as individual blocks were eaten down. Any error involved in the intake correction to digestibility of

three units applied to both treatments involving grazing of swedes. Hence, it remains that the D.E. is probably partitioned differently with the composite diet. It is possible that differences in fatty acid production from the various feeds are associated with differences in growth rate. Another possibility is that the proportion of the intake used for maintaining the hoggets was higher on a sole diet of swedes. The sheep commenced the experiment carrying eight months' wool and, although the critical temperature with this fleece might be as low as 0°C (Blaxter *et al.*, 1959), there would be a considerable heat requirement to warm the 10 litres or more of water ingested with the swedes each day. If the heat increment from the combination diet was higher than from a sole diet of swedes, this may have had a sparing effect on the energy required to maintain body temperature, thus allowing a greater proportion of ingested energy to be used for productive purposes.

The situation was not the same with the pen-fed sheep. A major point of contrast is the very low intake of swedes with pen feeding, where only 42% of outdoor intake was recorded, yet this compares favourably with the few figures there are on swede intake (Woodman et al., 1937; Lancaster 1943; Drew, unpubl.). When an *ad lib.* swede ration was supplemented with 0.6 lb hay/head/day, D.E. intake rose by 25%. This contrasts sharply with the field figure of 5%, but it must be realized that the hay ration constitutes one third of the total intake in pens and only one seventh in the field. The size of the difference in intake between pen-fed and grazing hoggets is hard to explain, but is nevertheless most important because any experimental work with root crops based solely on pen feeding may be grossly misleading.

The performance of the hay group is interesting because of the similarity in weight gain with the swedes alone group. It might be expected that there would be a lower intake with these sheep for a similar weight gain because they were closely confined and under shelter. This proved to be so in that, while D.E. intake was 16% lower than on swedes, liveweight gain dropped only 8%.

Unrestricted strip-grazed grass might well have been expected to be a very productive feed. That it produced a growth rate substantially lower than the hay treatment

is partly due to the high quality of the hay and partly due to the relatively low nutritive value of the grass. The sward was longer than some would consider desirable. Nevertheless, the O.M. digestibility was 72% as cut and fed to the penned sheep. The intake of 2,200 kcal D.E./ head/day gave a gain of 9.9 lb in 12 weeks with animals whose mean weight over the experiment was 77 lb. Although restriction of grazing time on grass to almost 4 hr daily dropped the intake from 2,200 to 1,500 kcal/day the animals still gained 62 lb.

In assessing the economics of feeding hoggets, one has to reconcile the ideal of maximum liveweight gain over the winter period with scarce or costly food resources. If first-class feeding of hoggets requires a decrease in the ewe flock, then the better nutrition may not be justified. The present results suggest that, where a swede crop fits into a particular farm routine, hoggets can be expected to grow quite well when grazing the swedes. If grass is limited, a rationed system of 4 hr grazing or so a day will provide a modest growth at minimum cost.

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