CHANGES IN THE BODY COMPOSITION OF SHEEP FED AT A MAINTENANCE LEVEL

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SUMMARY

One way undernourished animals can reduce their maintenance requirement is to reduce the weight of metabolically active tissues. Changes in the weight and composition of body components were measured in sheep fed to maintain weight for either 12 or 17 weeks. During the first 12 weeks there was a small loss of total tissue (665±876 g) that was not significant. There was a significant reduction in the weight of the liver, digestive tract and hide, In the case of liver and digestive tract this consisted of a significant loss of protein. During the subsequent 5 weeks there was a significant increase in both fat and protein despite remaining at the same feed intake. There *were* small increases in the weight of the liver and digestive tract due entirely to the deposition of fat, the protein remaining unchanged. The results indicate that the maintenance requirement of the animals declined during the initial 12 weeks and remained at a low level for the subsequent 5 weeks.

INTRODUCTION

Grazing sheep and cattle are often subjected to periods where nutrition is not sufficient to supply their maintenance requirements. Animals respond to undernutrition by lowering their metabolic demand and reducing their maintenance requirement. Graham and Searle (1975) found that the basal metabolic rate was reduced in animals held at constant weight for either 4 or 6 months. Gingins et *al.* (1980) estimated the maintenance requirement of sheep by regressing energy retention on energy intake. Energy retention was measured by indirect calorimetry. Maintenance requirement for those losing weight was estimated to be 275 kJ/kg $W^{0.75}$, while for animals gaining weight it was 374 kJ/kg $W^{0.75}$. Similar reductions have been observed by Ledger and Sayers (1977). They found that the quantity of feed needed to maintain animals at the same weight was reduced over 24 weeks to as low as 52% of the initial amount.

Maintenance requirements might be reduced during periods of undernutrition if the metabolically active tissues are reduced in weight relative to the less active tissues in the body. The liver and the gastro-intestinal mucosa are among the more metabolically active tissues in the animal body (Stangassinger and Giesecke 1986) with relatively high levels of both ion transport and protein synthesis. Animals at constant weight might reduce their maintenance requirement by reducing the weight of the metabolically active tissues. Searle and Graham (1975) have shown that animals held at the same weight for 4 to 6 months have less protein, more water and the same fat content compared to the control sheep. However, these changes were measured over the total animal and not within individual tissues and organs, The experiment reported here was designed to examine the changes in the weight and composition of body components (carcase and noncarcase) of animals fed to maintain weight for either 12 weeks *or* 17 weeks.

MATERIALS AND METHODS

A total of 12 Merino wethers aged seven to eight months old was used. They were housed in pens in an animal house and were considered to be within their thermoneutral zone. Four sheep were allocated for slaughter at the start of

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the experiment to determine initial (I) body composition. The remaining eight sheep were fed a mixed diet of 50% hay, 35% wheat and 15% lupins at a level estimated to maintain their live weight, Half of these sheep were slaughtered after 12 weeks of maintenance feeding (M1). The remaining four sheep were maintained at the same feed intake for an additional 35 days and slaughtered 119 days after the start of the experiment (M2).

Immediately after slaughter all parts removed from the animal were weighed. The digestive tract was cleaned prior to weighing, The carcase was chilled overnight and weighed before being boned into meat and bone. All the soft tissues were stored overnight in the chiller with the carcase and minced the day following slaughter along with the meat from the carcase. Following mincing a subsample of each tissue was further homogenized in a high speed cutter (Stephan 40 litre Cutter, Globus Casing Co, Perth) normally used for making sausage mince. The tissues containing bone (carcase bones, head and feet) were frozen and then minced, while still frozen through a Weiler Grinder (Model 1109, 100HP, Weiler & Co., Wisconsin, USA) using a plate with 9.5 mm holes. The material was passed through the mincer ten times after which a subsample of about 1.5 kg was collected and frozen in a sealed plastic container.

The tissues were then analysed for water, fat , protein and ash content using methods detailed in Ryan (1989).

RESULTS

The feed intake of the sheep during both periods of weight stasis was identical and averaged 427 g of dry matter per day.

During the first 12 weeks of the experiment (I to Ml) the average liveweight loss was 2.7 kg (those to be slaughtered at 12 weeks lost 3.0 kg, those that carried on lost 2.4 kg). Most of this loss was in the first 2 weeks and, over the next 10 weeks, their weight fell by only 0.2 kg. The four sheep maintained at the same feed intake for the additional 5 weeks gained 2.6 kg *over* this time. The live weight of the I group at slaughter was 31.1 kg with the Ml and M2 groups weighing 28.7 and 31.3.

During the first 84 days of weight stasis (I to Ml) the sheep lost only 665 g of body tissue and this was not significant. There was also no change in the chemical composition of the animals. The sheep maintained for the additional 35 days gained more than 1 kg in carcase tissues during this time (Ml to M2) with both protein and fat increasing significantly.

Between I and Ml there were changes ($P<0.05$) in the individual carcase tissues (Fig. 1) with the liver heart, digestive tract and hide losing weight and the head gaining weight. During the subsequent period (Ml to M2) the gain of more than 1 kg in carcase tissues was due mainly to an increase in meat.

There were changes in the chemical composition of individual carcase tissues during both periods of weight stasis (Fig. 2). Protein in the liver and the digestive tract decreased ($P<0.05$) by 30% and 36% between I and Ml and remained lower during the subsequent period (Ml to M2). Protein increased in the meat ($P<0.10$) from Ml to M2 as did fat ($P<0.05$) in the digestive tract and the meat. Chemical composition of the hide was not determined as only a sample of hides was analysed. Had the composition of the hide remained unchanged, the protein in the hide would have decreased from I to Ml and remained lower between Ml and M2.

Table 1 The weight (g) of each chemical component of sheep slaughtered at the start of the experiment (I), after 12 weeks (Ml) *or* 17 weeks (M2) of weight stasis.

		I	M1	M2
Water	(g)	12373 ± 669.3[a]	12176 ± 333.1[a]	11977 ± 347.0[a]
Protein	(g)	3591 ± 143.1[ab]	3366 ± 114.8[a]	3690 ± 53.6[b]
Fat	(g)	2816 ± 183.5[ab]	2590 ± 316.3[a]	3537 ± 293.7[b]
Ash	(g)	1006 ± 32.0[a]	989 ± 43.4[a]	948 ± 31.8[a]
Total	(g)	19786 ± 896.1[a]	19121 ± 366.0[a]	20152 ± 462.2[a]

Mean values ± s.e.m. Within rows, means not followed by a common superscript differ significantly (P<0.05)

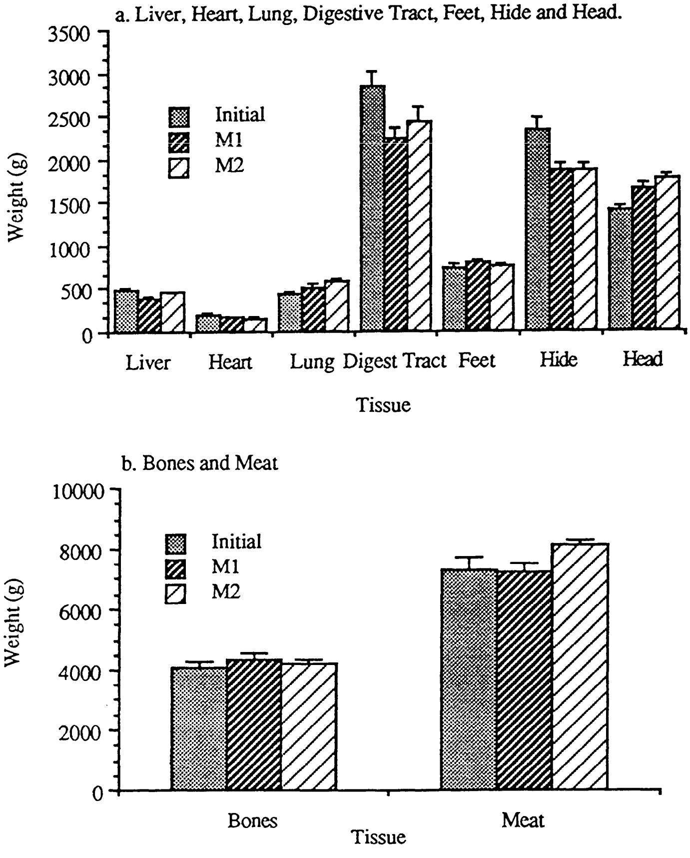

Fig. 1. The weight (g) of carcase tissues of sheep slaughtered at the start of the experiment (I), after 12 weeks (Ml) or 17 weeks (M2) of weight status

DISCUSSION

When animals ate a constant amount of food designed to maintain live weight they lost 665 g over the first 12 weeks and then gained more than 1000 g over the next 5 weeks. This pattern of live weight change suggests that the animals adapted to undernutrition by reducing their maintenance requirement. During the first 12 weeks of undernutrition the liver was reduced in weight by 17% and the digestive tract by 21%. Since these tissues are metabolically more active than skeletal muscle and adipose tissue this supports the hypothesis that a change in weight or size of these tissues accounts for the reduction in maintenance.

During the subsequent 5 weeks the small increases in the weight of the liver and the digestive tract *were* due entirely to the deposition of fat, the weight of protein in these tissues remaining unchanged. It is likely that the increase in fat in these tissues did not increase their energy usage and hence their contribution to the maintenance requirement during this period.

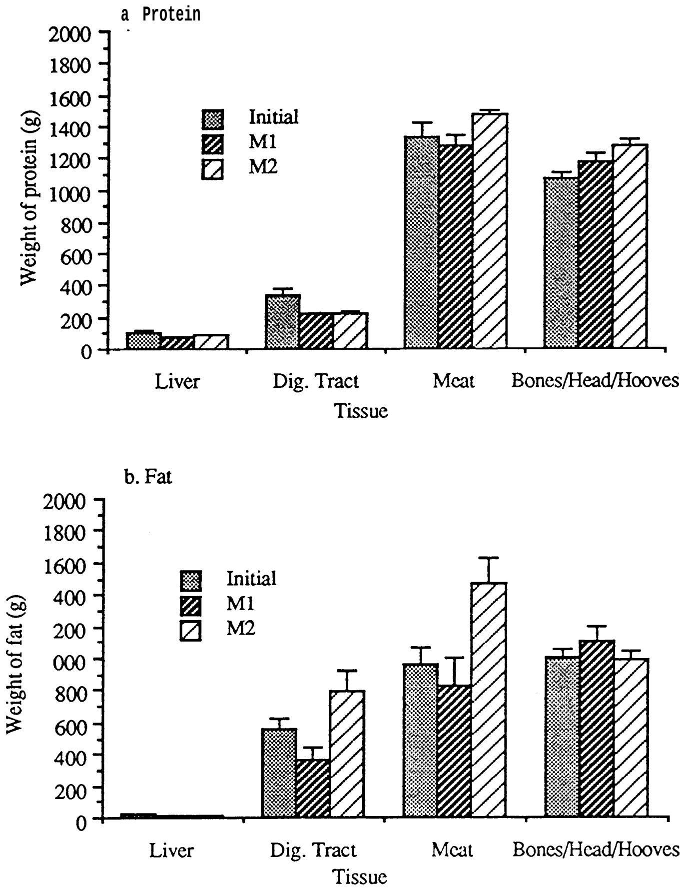

Fig. 2. The weight of protein and fat in the carcase tissues of sheep slaughtered at the start of the experiment (I), after 12 weeks (Ml) or 17 weeks *(M2)* of weight stasis

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