DIFFERENCES IN BODY COMPOSITION BETWEEN THREE BREEDS OF SHEEP

T.W. SEARLE* and D.A. GRIFFITHS+

Summary

Body composition (fat, protein, water and energy) was predicted from tritiated water space in Camden Park Merino, medium Peppin Merino and fixed halfbred (Border Leicester x Merino) wether sheep on seven to ten occasions post-weaning. Statistical examination of the data for individual sheep of each breed indicated that the final fattening phase of growth commenced at mean live weights of 22, 26 and 32 kg respectively. The corresponding mean body fat contents were 5.4, 5.1 and 6.2 kg. In subsequent growth, the fat content of weight gain was similar in each breed being 66% of live weight gain. At any given live weight the amount of fat was greatest in the Camden Park and least in the halfbred wethers.

In terms of sheep meat production, these results suggest that the only way to satisfy the current preference for heavy, lean carcasses is to use animals of large mature weight.

I. INTRODUCTION

The relationship between the live weight of an animal and the weight of its various components have been used to describe the changes that occur during growth in a particular breed (Searle, Graham and O'Callaghan 1972), to compare species (Reid 1972) and to examine the effect of various nutritional treatments (Burton, Anderson and Reid 1974). The amount of a component present in the body can be determined directly following slaughter or estimated by some prediction procedure. The advantage of the latter procedure is that progressive changes in the same animal can be examined. Searle et al. (1972) predicted the body composition of crossbred (Border Leicester x Merino) wethers from tritiated water (TOH) space and described the relationship between the various body components (fat, protein, ash, water, energy) and live weight in terms of four phases of growth viz. the milk-feeding phase, the period of rumen development followed by prefattening and fattening ruminant phases. The live weight at which the transition between the prefattening and fattening ruminant phases occurred varied between sheep but the authors postulated that the mean live weight at transition was characteristic of the breed. This hypothesis is examined in the present paper.

Searle and Graham (1972) estimated the body composition of two breeds of sheep (medium Peppin Merino and fixed halfbred) on seven occasions post-weaning and made breed comparisons on the basis of the pooled data. These data have now been re-examined on an individual sheep basis together with data derived from Camden Park Merinos, the smallest sheep available to the authors.

* C.S.I.R.O., Division of Animal Physiology, P.O. Box 239, Blacktown, N.S.W. 2148, Australia.
II. MATERIALS AND METHODS

Twelve medium Peppin Merino and 12 fixed halfbred (Border Leicester x Merino) wethers were weaned from ewes at pasture at about three months of age and confined singly in 2 m x 2 m pens indoors. Half the sheep in each breed group were fed a pelleted roughage-concentrate diet (35% lucerne, 35% oat grain, 30% linseed meal) and the others a pelleted roughage diet (equal parts lucerne hay and wheaten hay) ad libitum. TOH space was determined one week after the experiment commenced and on six subsequent occasions four weeks apart (for greater detail see Searle and Graham 1972).

In a later experiment, four Camden Park Merino wethers were weaned from ewes at pasture at three to four months of age, confined as one group in a large pen indoors and fed ad libitum on an unpelleted diet of equal parts lucerne hay and oat grain for the next 24 years. Detailed records of food intake were not kept. TOH space was determined one week after the experiment commenced, on four occasions about 12 weeks apart during the next year and on three (one sheep) or five (three sheep) occasions subsequently.

Body composition was estimated from TOH space and fleece-free fasted live weight by the multiple regression equations of Searle (1970). The data for each sheep were analysed statistically using a piecewise, parallel, linear regression model similar to that of Searle et al. (1972).

III. RESULTS

Details of food intake and live weight changes for the medium Peppin Merinos and fixed halfbred sheep have already been published (Searle and Graham 1972). Briefly, the halfbreds were heavier at birth and weaning, ate more food post-weaning and grew faster than the Peppins.

The Camden Park Merinos were small at birth (1.3, 1.3, 1.7 and 3.7 kg) and weaning weights ranged from 6 to 20 kg. Mean live weight at the end of the first year was 29 kg (range 24 to 33 kg). After two years of age body weights were similar and growth rate low, mean live weights being 42 and 44 kg at two and three years of age respectively.

The relationship between body fat and live weight for the Camden Park, medium Peppin and halfbred wethers is illustrated in Figure 1 (a), (b), (c) respectively. As previously determined by Searle and Graham (1972) the relationship could not be adequately described by a single straight line. In terms of the phasic model discussed by Searle et al. (1972) it may be assumed that the present data relate to sheep in the pre-fattening and fattening phases of growth. Statistical analysis of the data on individual animals in the upper weight range indicated linearity and parallelism between animals of all breeds. There was a limited amount of data in the lower phase and although for some animals this was insufficient to adequately define the relationship between fat and weight, statistical analysis confirmed that the relationship for the remaining individuals could be satisfactorily represented by parallel lines.

The data for each individual over the whole weight range were then examined to obtain final estimates of the common slope for all.
animals in each of the two phases and to estimate join points of the
piecewise, linear relationship for individual animals. The relationships
for the components other than fat were determined from the fat/weight
relationship as in Searle et al. (1972). The piecewise, linear
relationships for fat are illustrated for an average animal of each breed
in Figure 1 and the relationships for all components are summarised in
Table 1.

TABLE 1

<table>
<thead>
<tr>
<th>Phase</th>
<th>Extractable Fat (kg)</th>
<th>Crude Protein (kg)</th>
<th>Total Water (kg)</th>
<th>Energy (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-fattening</td>
<td>0.35 ± 0.02</td>
<td>0.12 ± 0.002</td>
<td>0.48 ± 0.01</td>
<td>16.4 ± 0.5</td>
</tr>
<tr>
<td>Fattening</td>
<td>0.66 ± 0.01</td>
<td>0.09 ± 0.001</td>
<td>0.24 ± 0.01</td>
<td>26.1 ± 0.3</td>
</tr>
</tbody>
</table>

The mean live weights at which the fattening phase commenced were
22, 26 and 32 kg with mean body fat contents of 5.4, 5.1 and 6.2 kg for
Camden Park Merino, medium Peppin Merino and halfbred sheep respectively.
At any given live weight in either phase the amount of fat tended to be
greatest in the Camden Park and least in the halfbred wethers.

Fig. 1. Relationship between estimated amounts of extractable fat in
the body and fleece-free live weight (30 h fasting).
(a) Camden Park Merino (b) medium Peppin Merino (c) Halfbred (Border
Leicester x Merino). The open symbols represent four individual sheep of
each breed. The closed symbols represent the remaining sheep.
The graph lines portray the average composition.
IV. DISCUSSION

The ad libitum fed crossbred wethers of Searle et al. (1972) and the halfbred sheep of the present experiment entered the fattening phase of growth at approximately the same live weight (31 v 32 kg), while the intrinsically smaller Camden Park and medium Peppin wethers commenced fattening at lower live weights (22 and 26 kg respectively). This supports the hypothesis that the live weight at which the transition from pre-fattening to fattening occurs differs between breeds with the intrinsically smaller sheep fattening at lower live weights. Like those of Searle et al. (1972) all sheep in the current studies started to fatten when the fat content of the body was 5 to 6 kg and subsequent gain consisted of about 66% fat and 9% crude protein.

Weight gain in the pre-fattening phase contained more fat (35% v 24%) and less water (48% v 55%) than found by Searle et al. (1972), but similar amounts of protein (12%). This probably represents a weaning effect as lambs in the previous experiment were only suckled for the first six weeks of life whereas those in the present experiments had access to the ewe for three to four months. This difference is also consistent with the results of subsequent experiments in which it has been found that the body composition of sheep in the pre-fattening phase is influenced by the time spent suckling.

Comparisons of fatness between breeds can be made in terms of the fat content at a given live weight or the live weight at which a given fat content is attained. At any given live weight (say 36 kg) the Camden Park, medium Peppin and halfbred wethers contained 39%, 32% and 25% fat respectively, while an equal proportion of fat (say 25%) was obtained at live weights of 24, 30 and 36 kg. Thus heavy, lean carcasses come from intrinsically large animals. Within a given breed, entire males are heavier at maturity than ewes or wethers. Corbett et al. (1973) reported a lower fat cover on carcasses from entire males (and cryptorchids) than from wethers slaughtered at the same live weight. The larger breeds such as the Hampshire and Suffolk contain less fat at any given live weight (Reid 1972) than breeds currently being used in Australia for fat lamb production and perhaps warrant investigation.

V. REFERENCES