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Prediction of lamb carcass composition from GR and carcass weight

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ABSTRACT

The composition of 2 groups, comprising 70 and 837 lamb carcasses, was predicted from hot carcass weight (HCW) and GR separately and together, these being the main observations considered in the export lamb carcass grading system. GR was a better predictor of composition than HCW with the 2 in combination tending in most cases to be slightly better than GR alone. These measurements could account for 50 to over 70% of the variation in carcass fat and bone and 26 to 47% of the variation in carcass muscle. On average, for each 1 mm decrease in GR, carcass fatness decreased by about 1 percentage unit, muscle increased by about 0.5 percentage units and carcass bone increased by just under 0.5 percentage units.

Keywords Lamb carcasses; grading; GR; hot carcass weight; composition

INTRODUCTION

The new export lamb carcass grading system introduced at the beginning of the 1983-84 slaughter season has specified a GR measurement range within each carcass weight range for each fatness grade (Anon., 1983). GR (mm) is defined as total tissue depth between the surface of the carcass and the rib at a point 11 cm from the midline in the region of the 12th rib. It was therefore considered of interest to determine the degree of accuracy with which carcass weight and GR predict lamb carcass composition.

MATERIALS AND METHODS

Animals

The left sides of 20 Southdown x Romney, 13 Romney, 18 Border Leicester x Romney and 19 Perendale lamb carcasses had GR and other linear measurements recorded after the carcasses had been weighed. They were then ground and duplicate samples were taken for chemical analyses following a procedure similar to that described by Kirton *et al.* (1962) except that water was determined by freeze drying. The right sides of the carcasses were dissected into subcutaneous fat, intermuscular fat, internal fat, muscle, bone and waste (mainly bone scrapings). GR measurements, carcass weights and dissection data were also available on 475 Romney, 157 Poll Dorset, 189 Border Leicester and 16 Coopworth lamb carcasses from the Wiremu Lands and Survey Block in Taranaki. In this case, carcasses were ground in the same manner as for the earlier experiment but chemical composition was determined on triplicate 11 g samples on a Superscan (Foss Electric A/S, 69 Slangerupgade, Hillerod, Denmark).

Biometrical

Correlations and regressions relating carcass weight, GR and these measurements in combination to chemical and dissected fat, muscle, bone, protein and water content of the carcasses were computed.

TABLE 1 Mean weight (kg), composition and GR (mm) measurements of lambs studied.

Item	70 lambs		837 lambs	
	Mean	SD	Mean	SD
Hot carcass	14.2	2.8	14.9	2.5
GR	8.0	5.2	6.7	3.1
% dissectible fat[1]	23.5	6.2	21.8	4.2
% muscle	54.3	3.9	57.2	3.1
% bone	16.9	2.9	18.2	2.0
% chemical fat	25.2	6.0	23.8	4.3
% protein	16.9	1.3	17.4	0.9
% water	53.6	4.4	55.4	3.7

[1] Subcutaneous plus intermuscular fat.

RESULTS AND DISCUSSION

The mean measurements of the carcasses evaluated are given in Table 1. The main feature of these data is that, despite being lighter, the 70 carcasses from the first experiment (group 1) were fatter and more variable in composition than the 837 carcasses analysed in the second experiment (group 2). The GR measurements were 16% lower on the heavier group 2 carcasses than on the lighter group 1. Within both groups the mean level of carcass fatness was similar whether determined by chemical means or by dissection and water content was of similar magnitude to muscle content. An additional 1% (internal fat) can be added to the dissectible fat (subcutaneous plus intermuscluar) figures in Table 1 to make the dissectible and chemical figures more equivalent.

TABLE 2 Prediction of carcass composition of 70 lambs from GR (mm) and hot carcass weight (HCW) (kg).

Item	Constant	Coefficients HCW	GR	RSD	R^2
% chemical fat	1.34	1.68	-	3.69	0.63
	17.19	-	0.99	3.34	0.73
	13.35	0.37	0.81	3.10	0.74
% dissectible fat	-1.22	1.74	-	3.77	0.63
	15.17	-	1.03	3.11	0.75
	11.60	0.35	0.87	3.10	0.76
% muscle	66.49	-0.86	-	3.12	0.38
	58.44	-	-0.52	2.91	0.47
	59.68	-0.12	-0.46	2.92	0.47
% bone	28.00	-0.78	-	1.83	0.60
	20.71	-	-0.47	1.50	0.73
	21.78	-0.10	-0.42	1.51	0.73
% protein	21.23	-0.30	-	1.04	0.41
	18.23	-	-0.17	1.00	0.45
	19.40	-0.10	-0.12	1.00	0.46
% water	70.72	-1.20	-	2.75	0.61
	59.38	-	-0.71	2.34	0.72
	62.01	-0.26	-0.59	2.34	0.72

The relationships for predicting carcass composition of each group from hot carcass weight (HCW) and GR separately or together are reported in Table 2 and 3. In general, the R^2 values reported in Table 2 are higher than in Table 3 largely reflecting the more variable nature of the carcasses of group 1 lambs. However, the RSD values for equivalent regressions are smaller for group 2 except for percent water, although not significantly so ($P>0.05$).

The regression coefficients for predicting carcass composition from HCW alone are higher for group 1 lambs than for those in group 2 ($P<0.01$) but the GR coefficients did not differ between groups. In all cases GR is more effective in reducing residual variation in carcass composition than HCW. The improvement from including HCW after GR is very small for all components. Although statistically very significant ($P<0.001$) for fat and bone in group 2 lambs, the effect of using HCW after GR did not increase R^2 by more than 0.03. This effect has been noted previously (Kirton and Johnson, 1979; Kirton *et al.*, 1984). Fat in these carcasses increased by about 1 percentage unit for each 1 mm increase in GR, while muscle and bone each decreased by about 0.5 percentage units per 1 mm increase in GR.

Analysis of the combined data showed that group 1 lambs were about 0.7 percentage units fatter than group 2 lambs at the same GR and HCW values ($P<0.05$).

TABLE 3 Prediction of carcass composition of 837 lambs from GR (mm) and hot carcass weight (HCW) (kg).

Item	Constant	Coefficients HCW	GR	RSD	R^2
% chemical fat	6.87	1.02	-	3.39	0.36
	15.88	-	0.93	3.12	0.46
	11.84	0.37	0.71	3.06	0.48
% dissectible fat	6.46	1.03	-	3.31	0.38
	15.34	-	0.97	2.91	0.52
	12.05	0.30	0.79	2.86	0.53
% muscle	65.00	-0.52	-	2.85	0.17
	60.64	-	-0.51	2.70	0.26
	61.87	-0.11	-0.44	2.70	0.26
% bone	25.60	-0.50	-	1.58	0.38
	21.27	-	-0.46	1.43	0.50
	23.09	-0.17	-0.36	1.40	0.52
% protein	17.11	-0.068	-	1.00	0.03
	16.59	-	-0.074	0.99	0.05
	16.59	-0.0002	-0.073	0.99	0.05
% water	71.70	-0.87	-	3.36	0.29
	63.96	-	-0.78	3.19	0.36
	67.66	-0.34	-0.57	3.14	0.38

More complex statistical models were tested on the data using classification information on the breed group, sex and birth rank, and incorporating quadratic regression terms. The "fullest" model considered included the 3 classification effects, linear and quadratic HCW and GR regression terms and all first-order interactions. This model gave R^2 values of 0.64, 0.66, 0.48 and 0.65 for percentage chemical fat, percentage dissectible fat, percentage muscle and percentage bone, compared with 0.52, 0.57, 0.29 and 0.55 for the overall GR and HCW multiple linear regression. As well as being statistically significant, this appears to provide a considerable improvement in fit. However, this much more complex model has only reduced the RSDs from 3.06 to 2.80, 2.86 to 2.65, 2.70 to 2.45 and 1.40 to 1.29 respectively.

In practice, how does the New Zealand lamb grading system based on carcass weight (hot weight less 4½%) and GR (mainly not measured) stand up in comparison with other systems? The results given show that if one of the objectives is to sort carcass into groups differing in composition, the proportion of the variation in composition accounted for by GR and HCW — 50 to over 70% for fat and bone and 26 to 47% for muscle — is disappointingly low. However the present lamb results should be compared with those for pigs where a system that accounts for 64% of the variation in meat yield is considered satisfactory in Sweden (Hansson and Andersson, 1984), and the Queensland situation where most abattoirs use a fat measurement that accounts for less than 30% of the variation in saleable meat when trading cattle (Ball, 1984).

At present most GR values are assessed by graders rather than being measured, and it is possible that a visual assessment of fatness can sort carcasses into fatness groups better than a GR measurement. We consider this unlikely, but this hypothesis is currently being tested. The present results suggest that the search should continue for relatively simple methods to apply which will permit the more accurate sorting of lamb carcasses into groups differing in composition.

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