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# Prediction of ewe mutton carcass composition from carcass weight, GR and C measurements, and the Hennessy grading probe

A.H. KIRTON, C.L. FEIST AND D.M. DUGANZICH

Ruakura Animal Research Station, Ministry of Agriculture and Fisheries, Hamilton.

## ABSTRACT

The composition of the dressed carcasses of 54 mixed-breed ewes was predicted from their hot carcass weight (HCW), measurements C and GR, and carcass wall thickness taken on the left (GPL) and right (GPR) sides 13 cm from the mid-line between the 11th and 12th ribs with an electronic Hennessy grading probe. The right side of each carcass was dissected into fat, muscle and bone. Mean HCW was 25.4 kg, GR was 16.9 mm, C was 6.6 mm, GPL was 22.1 mm, GPR was 22.7 mm, dissectible fat was 32.4%, muscle was 52.4% and bone was 14.1%.

Of the variation in carcass fat %, GPR accounted for 74% and GR for 78%. When combined with HCW, GPR accounted for 77% and GR for 80%. This last value was not further increased by adding more variables. GPR accounted for 67% of the variation in carcass muscle % and GR for 68% of this variation. When combined with HCW these values increased to 71% and 73% respectively and were not further increased by adding more variables. GPR and GR were also the best predictors of percentage bone.

**Keywords** Mutton carcasses; grading; Hennessy grading probe; carcass weight; GR.

## INTRODUCTION

The changed grading system for mutton carcasses introduced at the beginning of the 1983-84 slaughter season (Anon., 1983) introduced a GR measurement range for each of the 5 fatness classes specified in the system. GR is a total tissue depth (mm) between the surface of the carcass and the rib in the region of the 12th rib and at a point 11 cm from the mid line. The present experiment evaluated the accuracy with which mutton carcass composition could be predicted from GR, hot carcass weight (HCW), fat depth C (Palsson, 1939), a left (GPL) and right side (GPR) tissue depth taken with the Hennessy grading probe (GP) and combinations of these measurements. The GP measurement is easier to record than GR and, combined with an electronically measured carcass weight, could easily be fitted into an electronically based carcass weighing, grading and marshalling system.

## MATERIALS AND METHODS

Twenty-five Romney, 8 Merino, and 21 Romney x Merino ewes from the Tokanui Research Station were used for this experiment. They averaged 5 years of age. They were slaughtered and dressed according to standard procedures to give a standard commercial mutton carcass (kidneys and kidney fats out).

Carcasses were weighed hot (HCW) and total tissue depth between the 11th and 12th ribs was measured perpendicular to the carcass surface on both sides of the carcass at a distance of 13 cm from the mid-line with an electronic Hennessy grading probe as described by Arndt (1983). Measurement GR on the right side (Kirton and Johnson, 1979) was taken shortly after slaughter and fat depth C (Palsson, 1939) was taken on the left side of the chilled carcass within a few days of slaughter.

The right side of each carcass was dissected into subcutaneous fat, intermuscular fat, muscle, bone and waste by butchers knife dissection (Kempster *et al.*, 1982).

Simple and multiple correlation and regression procedures were used to predict carcass composition from the 4 measurements singly and in combination.

## RESULTS AND DISCUSSION

The variation of the fat measurements (Table 1) was larger than for carcass weight (coefficient of variation = 20%) with that for bone being less (16%) and muscle being least (11%). The mean GP measurements were similar for both sides of the carcass and GPR was 6 mm larger (34%) than the GR measurement on the same side.

**TABLE 1** Mean carcass weight, measurements and carcass composition of 54 ewe carcasses.

| | Mean | SD |
|---|---|---|
| Hot carcass (kg) | 25.4 | 5.2 |
| GR (mm) | 16.9 | 8.7 |
| C (mm) | 6.6 | 4.2 |
| GPL (mm) | 22.1 | 8.5 |
| GPR (mm) | 22.7 | 8.1 |
| Fat % | 32.4 | 8.2 |
| Muscle % | 52.4 | 6.0 |
| Bone % | 14.1 | 2.3 |

**TABLE 2** Interrelationships ($r^2$) between 5 mutton carcass measurements.

| Measurement | HCW | GPL | GPR | GR |
|---|---|---|---|---|
| GPL | 0.67 | | | |
| GPR | 0.71 | 0.93 | | |
| GR | 0.71 | 0.87 | 0.88 | |
| C | 0.59 | 0.80 | 0.76 | 0.81 |

The relationships between carcass measurements (Table 2) indicate good agreement between the GP readings on the left and right sides of these carcasses. As expected, there was also good agreement between GR taken over the rib and GP taken between the ribs at adjacent sites, at least on the right side of each carcass. The poorest relationships were between fatness measurements and HCW.

Of the simple measurements for predicting the fat % of mutton carcasses, C and HCW were least accurate (Table 3). The GP recording on the right side of the carcass (GPR), the easiest side for the right-handed operator to use the probe, gave an $R^2$ value of 74%, and GR gave an $R^2$ value of 78%. When combined with HCW in multiple regression, GPR increased the $R^2$ value for fat prediction to 77% and GR increased the value to 80%. The addition of other measurements to the equation using HCW and GR did not further increase the accuracy of fat prediction above an $R^2$ value of 80% (Table 3).

The same pattern emerged from the equations for predicting muscle % of these mutton carcasses. GPR and GR gave the most accurate prediction and when combined individually with HCW, resulted in $R^2$ values of 71% and 73% respectively. The addition of other measurements did not further improve the accuracy of prediction. The same pattern also followed for bone prediction and when combined with HCW, GPR accounted for 73%, and GR for 77% of the variation in bone %.

The equations for composition prediction were rerun after omitting 8 carcasses with extreme residuals (2 in HCW, 1 in bone %, 2 in GR, 3 in GPR). Such calculations reduced the RSD values for predicting muscle % from GPR and GR from those given in Table

**TABLE 3** Equations for predicting fat, muscle and bone content of 54 mutton carcasses.

| Y variate | Constant | HCW | GPL | GPR | GR | C | RSD | $R^2$ |
|---|---|---|---|---|---|---|---|---|
| Fat (%) | -0.39 | 1.29 | | | | | 4.64 | 0.685 |
| | 14.52 | | 0.811 | | | | 4.50 | 0.703 |
| | 12.80 | | | 0.865 | | | 4.24 | 0.736 |
| | 18.32 | | | | 0.832 | | 3.90 | 0.777 |
| | 22.13 | | | | | 1.55 | 5.00 | 0.633 |
| | 5.07 | 0.665 | 0.473 | | | | 4.06 | 0.763 |
| | 5.46 | 0.562 | | 0.559 | | | 3.97 | 0.774 |
| | 10.70 | 0.454 | | | 0.600 | | 3.71 | 0.802 |
| | 6.46 | 0.822 | | | | 0.764 | 4.19 | 0.748 |
| | 10.20 | 0.441 | | 0.155 | 0.497 | -0.024 | 3.76 | 0.804 |
| Muscle (%) | 75.70 | -0.918 | | | | | 3.64 | 0.641 |
| | 64.79 | | -0.563 | | | | 3.70 | 0.628 |
| | 66.07 | | | -0.605 | | | 3.51 | 0.666 |
| | 62.15 | | | | -0.578 | | 3.36 | 0.675 |
| | 59.57 | | | | | -1.089 | 3.95 | 0.577 |
| | 72.29 | -0.528 | -0.295 | | | | 3.37 | 0.698 |
| | 71.92 | -0.448 | | -0.361 | | | 3.30 | 0.710 |
| | 68.68 | -0.389 | | | -0.380 | | 3.20 | 0.728 |
| | 71.15 | -0.607 | | | | -0.507 | 3.40 | 0.693 |
| | 68.98 | -0.357 | | -0.110 | 0.286 | -0.032 | 3.25 | 0.731 |
| Bone (%) | 22.89 | -0.344 | | | | | 1.49 | 0.600 |
| | 19.26 | | -0.232 | | | | 1.27 | 0.708 |
| | 19.68 | | | -0.244 | | | 1.24 | 0.723 |
| | 18.14 | | | | -0.236 | | 1.13 | 0.770 |
| | 16.99 | | | | | -0.429 | 1.49 | 0.598 |
| | 20.88 | -0.115 | -0.173 | | | | 1.23 | 0.730 |
| | 20.84 | -0.089 | | -0.196 | | | 1.22 | 0.734 |
| | 19.04 | -0.053 | | | -0.209 | | 1.13 | 0.774 |
| | 20.72 | -0.196 | | | | -0.242 | 1.38 | 0.678 |
| | 19.32 | -0.037 | | -0.064 | 0.187 | -0.061 | 1.14 | 0.780 |

2 by 11-14% and those for fat % by 9-12%. However, in the practical grading situation, such unusual values would not be recognised, and the regression coefficients were not greatly altered by their removal.

The probe results obtained in this trial are likely to be better than in a working situation where it is likely that only one side of each carcass would be probed. Where marked disagreement between sides was noted in this trial, both sides usually were reprobed because when probe sites on both sides of mutton or lamb carcasses are measured by ruler, the readings on both sides are usually fairly similar. Reprobing usually resulted in identification of the original erroneous reading which was then discarded. The high correlation between GPL and GPR reported in Table 2 would be lower if the extreme readings had not been rejected.

As is usual with most data of this type, slightly different prediction equations applied on a within breed basis. Biases due to breed, source of animals (Murray, 1978; Kirton *et al.*, 1984; Kirton *et al.*, 1985) and other factors have to be accepted in any sheep carcass classification system based on linear measurements. In the longer term development of prediction equations for grading purposes, animals from several sources must be included if such equations are to be generally applicable.

A grading system based on GR and carcass weight has been adopted in New Zealand for lamb and can account for 50 to 70% of the variation in carcass fat % and 30 to 50% of the variation in carcass muscle (Kirton *et al.*, 1985). For pig carcass classification in Holland, Canada and Sweden, a system based on the GP has been accepted. The Swedish system which uses 2 fat depths and 1 muscle depth, accounts for 64% of the variation in meat yield in the pig carcass (Hansson and Andersson, 1984). In Queensland, most abattoirs use a fat depth near the sacral crest that accounts for less than 30% of the variation in saleable meat (Ball, 1984). Compared on this basis, both the GR measurement and the GP tissue depth look promising for use in a mutton carcass grading system.

Although the current GR probe costs little, the need for manual application and visual assessment with the results punched onto a keyboard to get electronic output allows greater scope for error, particularly when grades rather than the individual measurements are the keyboard input. That is, the present mutton grading system based on manually determined GR on borderline carcasses only, does not record individual GR measurements as was done in the present experiment. Only the classification GR fatness range of each carcass is recorded.

If the results from this trial are confirmed when grading probe measurements are taken on a larger number of carcasses from a variety of sources and breeds, then the use of the Hennessy grading probe should be considered for use in the export grading system. The GP is a markedly more versatile and reliable instrument than the fat depth indicator (FDI) probe tested in earlier trials on sheep (Adam *et al.*, 1982).

If carcasses are weighed electronically and measured for fatness with the GP, grade tags can be automatically printed and carcasses automatically sorted into groups according to the requirements of particular markets. Such a system could permit much greater flexibility in selecting mutton carcasses for different markets or end uses than is achieved by the current system of grading carcasses into 5 fatness grades which are then manually sorted in a chiller into their grade groups.

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