ESTIMATING THE LEAN MEAT YIELD OF LAMBS

C.L. PLANT, J.J.L. MADEN and P.A. KENNEY

Agriculture Victoria, Institute for Integrated Agricultural Development, R.M.B. 1145, Rutherglen, Vic. 3685

SUMMARY

Data were collected from the carcass dissection of 3,500 lambs from Border Leicester x Merino ewes which were mated to 133 rams from 5 Poll Dorset, 4 Merino, 2 Meridale, 1 White Suffolk and 1 Siromt studs. The lambs were slaughtered in 4 groups per year, over 4 years (1986 -1989), with the slaughter group average liveweights being 30 kg and 35 kg for the ewes and 35 kg and 45 kg for the cryptorchids. The right side of the carcasses were divided into 6 primals (forequarter, flank, ribloin, loin, chump and hindleg) and the subcutaneous fat was removed from each primal and weighed. The hindleg, chump and loin were further dissected to separate the bone from the soft tissue. In 1988, 150 carcasses were selected for total carcass dissection. These carcasses had all 6 primals dissected into subcutaneous fat, bone and soft tissue.

The weight of the lean meat content for both the total carcass and the hindquarter (chump, hindleg and loin) was estimated using 2 models. Model 1 used GR tissue depth and carcass weight to estimate lean meat weight and Model 2 incorporated factors (breed, sex, year, carcass weight and GR tissue depth) known to influence carcass composition.

For estimating total carcass lean meat weight (TCY), Model 2 gave an improved estimate of lean meat ($R^2 = 0.984$) compared to Model 1 ($R^2 = 0.982$). This effect was too small to justify the use of Model 2 in abattoirs, rather than Model 1. Similar small improvements were observed when estimating hindquarter lean meat weight (HQY) ($R^2 = 0.970$ and 0.973 for Models 1 and 2 respectively).
Keywords: lambs, hindquarter, lean meat yield

INTRODUCTION

The Meat Research Corporation's Prime Lamb Key programme was initiated in response to the preference of Australian lamb consumers for a carcass with more lean meat and less fat (Thatcher and Couchman 1983; Hopkins and Congram 1985). Lambs providing such carcasses are larger and leaner than those typically grown in Australia. One of the aims of the Prime Lamb Key programme was to increase the number of prime lambs having a specified carcass weight of 18 kg or heavier, with a GR of 6-15 mm.

Many sectors of the lamb industry are beginning to utilise the LIDS (Lamb Identification & Description System) tickets. The LIDS tickets provide information on carcass weight, fatness (GR tissue depth) and can provide an Estimated Lean Meat Yield (ELMY) expressed as a percentage of the standard carcass weight. Usually, the AUS-MEAT sheep probe is used to give a tissue depth at the GR site and, using a formula (ELMY = 64.84 - 0.68 GR tissue depth) developed by Cabassi (1989), ELMY may be calculated.

Currently ELMY is a indication of the percentage of dissectible muscle in the carcass; however description systems estimating absolute amounts of lean meat in the carcass may be more appropriate. As the lamb industry moves further towards Value Based Trading it is important that descriptive systems and estimates of yields are continually improved.

Factors such as sex, nutrition and breeding can affect lamb growth and may provide further information about carcass composition, and in particular fat distribution. If meat buyers are to have confidence in LIDS tickets, it is important to determine whether other factors are needed to improve the accuracy of ELMY. However, it is also important that the predictors in the formula can be easily recorded without a major increase in cost to the abattoir.

This paper compares 2 models used for predicting the total weight of lean meat in the carcass. The first model is based on carcass weight, and the second, more complex model incorporates other factors (listed above) known to affect carcass composition. For the purpose of this experiment, lean meat has been defined as the muscle and intermuscular fat remaining after the subcutaneous fat and bone have been removed from the joint. This may not exactly represent what the butcher would refer to as 'saleable meat'; however, given that all butchers will vary in their definition of saleable meat, this was the most consistent method applicable to the laboratory environment.

MATERIALS AND METHODS

Animals

Carcasses were from 3500 lambs born to Border Leicester x Merino ewes during 1986-9. Lambs were sired by 133 rams from 5 Poll Dorset, 4 Merino, 2 Meridale, 1 White Suffolk and 1 Siromt studs. These lambs are further described by Kenney *et al.* (1995).

Within each sire group, lambs were allocated to 1 of 4 groups - either high or low slaughter weight and male or female. The male lambs were marked as cryptorchids. Lambs were slaughtered as a group when each group reached the prescribed mean liveweight, 30 kg and 35 kg for the ewes and 35 kg and 45 kg for the cryptorchids. In 1988, 150 Merino and Poll Dorset sired lambs were selected for total carcass dissection.

Dissection routine and measurements

At the abattoir, hot carcass weight (kidneys and kidney fats in) and tissue depth at the GR site (using the Toland probe on the hot carcass) were recorded as described by Kenney *et al.* (1991). The carcasses were placed into stretch cotton stockinettes and hung overnight by the tenderstretch method. Following chilling the carcasses were transported to a cold store for freezing.

For dissection, carcasses were thawed for 24 hours at 4°C then weighed and their tissue depth at the GR site measured; this cold GR was used in the models. The carcasses were then split and the right side cut into hindleg, chump, loin, ribloin, flank and forequarter primals (Thatcher *et al.* 1990). The subcutaneous fat was removed from each primal, and the 3 hindquarter joints (hindleg, chump and loin) were further dissected to separate the soft tissue from the bone. The soft tissue from the 3 hindquarter joints were combined to represent a partial hindquarter lean meat content (HQY). Total carcass dissections involved the flank, forequarter and ribloin also being dissected into subcutaneous fat, bone and soft tissue, and the soft tissue from all 6 joints were combined to represent a TCY.

Statistical analysis

Data were analysed by multiple regression using the statistical package Genstat 5 (Payne and Lane 1987) and the following models were used where the dependent variable TCY was the sum of the soft tissue from all 6 primal joints, and HQY was the sum of the soft tissue from the chump, loin and hindleg only.

Model 1: HQY = k + CW + GR
TCY = k + CW + GR

Model 2: HQY = k + Yr + Sx + Br + CW + GR
TCY = k + Sx + Br + CW + GR

where CW = carcass weight, GR = soft tissue depth at the GR site, Yr = years (1986, 1987, 1988 and 1989), Sx = sex (cryptorchid or ewe) and Br = breed (Poll Dorset, Siromt, Merino, White Suffolk, Meridale for HQY, and for TCY breed = Poll Dorset and Merino).

RESULTS

In Model 1, there was a close relationship between both TCY (R^2 = 0.982, RSD = 0.357) and HQY (R^2 = 0.970, RSD = 0.097) with carcass weight and GR, and when sex, breed and year (for HQY only) were included (Model 2) the relationship improved slightly (R^2 = 0.984, RSD = 0.332 for TCY and R^2 = 0.973, RSD = 0.092 for HQY). Year, sex and breed were found to be significant ($P<0.01$). At a given carcass weight and GR tissue depth, Merino sired lambs had 295 ± 60.6 g less TCY than Poll Dorset sired lambs. Siromt, Merino and Meridale sired lambs also had less HQY than Poll Dorset or White Suffolk sired lambs ($P<0.01$, Table 1).

Table 1. A comparison of genotypes with Poll Dorset when estimating hindquarter lean meat yield ± SE (HQY) (g) in Model 2

	Siromt	Merino	White Suffolk	Meridale
HQY (g)	-70 ± 7.4	-84 ± 5.6	-11 ± 7.0	-53 ± 6.8

In 1986 there was significantly less HQY than in the years 1987 (18 ± 6.0) and 1988 (38 ± 5.1) ($P<0.01$); however there was no significant difference between 1986 and 1989 (5 ± 5.1).

Table 2. Estimated weight of the total lean meat (TCY) from 20 kg carcasses, using Model 1 for ewes and cryptorchids from Poll Dorset and Merino genotypes

Sex	Genotype	GR [A] (mm)	TCY (kg)
Ewe	Poll Dorset	15.6	12.6
	Merino	11.5	12.9
Cryptorchid	Poll Dorset	10.1	13.0
	Merino	6.8	13.3

[A] GRs are estimates for 20kg Poll Dorset and Merino lamb carcasses of difference sex, using the full data set of Kenney *et al.* (1995).

Although the focus of this paper is on carcass measurements which can be easily recorded in the abattoir situation, cold rather than hot carcass weight and hot GR tissue depth were used because all data for hot measurements were not available. Subsequent analyses on the reduced database showed a high correlation between hot and cold carcass weight ($R^2 = 0.99$) and a high correlation between hot GR and the more accurate cold GR ($R^2 = 0.82$).

DISCUSSION

Model 1 used carcass weight and GR tissue depth to calculate TCY and HQY, an absolute lean meat amount. In contrast only GR tissue depth is used by the AUS-MEAT probe to predict ELMY for the LIDS ticketing system, and it gives lean meat only as a percentage figure. At a recent meat industry meeting, concern was expressed regarding the expression of lean meat as a percentage yield and, given the movement towards Value Based Trading, it must be more beneficial to the meat buyer to be able to see at a glance the actual amount of lean meat a carcass will yield. Model 2 included year, breed and sex, but did not substantially change the amount of variation explained by Model 1. This indicates that Model 1 was adequate, though the use of Model 2 may reduce the biases of year, breed and sex. To decide if this reduction in bias of the estimate warrants incorporating year, breed or sex into the commercial model it is necessary to look at their real effect in terms of estimation of the lean meat.

The year effect shown in Model 2 probably reflects the different growth rate of lambs because of difference in seasons, but further research would be required to prove that it is a real year effect and not an effect of the difference in technique between staff who dissected the meat or carcass water loss due to freezer temperatures. However, given that the season affects all lambs to the same extent, there is little need to adjust for it within the model. The exception to this could be when the processor purchases lambs from widely differing environments resulting in large differences in ELMY.

The difference in TCY between lambs sired by Poll Dorset and Merino was 295g per carcass, or in dollar terms Merinos had a $1.77 less TCY (@ $6.00/kg). Although caution should be used when drawing breed comparison when the forequarter has not been dissected, HQY showed similar trends with a maximum difference between breeds of 84g per carcass between lambs sired by Poll Dorset and Merino, or in dollar terms Merinos had a 50 cents less HQY. Merinos are known to have less fat at a given weight than the Poll Dorset. By using the full data set (Kenney *et al.* 1995), 20 kg carcasses sired by Poll Dorsets and Merinos were estimated to have GRs of 15.6 and 11.5 mm respectively for ewes, and 10.1 and 6.8 mm respectively for cryptorchids. These figures were used in Model 1 to determine TCY (Table 2). This shows that a 20 kg carcass from a Merino sired lamb is likely to have more lean meat than a 20 kg carcass from a Poll Dorset sired lamb, because it is 4 mm leaner in GR tissue depth. Merino sired lambs and carcasses are generally discounted when purchased for prime lamb production (B.Warren, personal communication). Discounting is unjustified if it is assumed the Merino sired lambs, at the same carcass weight, have a lower lean meat yield than the meat type breeds (eg. Poll Dorset).

When comparing cryptorchids and ewes of the same breed, GR and carcass weight, Model 2 estimated 28 g less lean meat (TCY) on a cryptorchid, or 17 cents less (@ $6/kg), indicating ewes have more lean meat than cryptorchids. This, however, needs to be looked at in the context of what really happens when the lambs grow. The analysis compares the ewes and cryptorchids of the same carcass weight and assumes their fatness (GR) will also be the same, when in reality at a given weight the ewe lambs have a much higher GR and hence less lean meat. When the more realistic GR is used in model 1 (Table 2), at the same weight, a cryptorchid will have more lean meat than the ewe.

Given the extra work which would be involved in recording breed and/or sex on the abattoir chain, this paper finds that a model using carcass weight and GR gives very good estimates of TCY and ELMY, and thus proves they are sufficient predictors of lean meat.

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