EVALUATION OF THE TOLAND PROBE TO MEASURE FATNESS OF HOT LAMB CARCASES

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SUMMARY

A system for describing lamb carcases must include an evaluation of fatness. This could be a simple measure of fat depth to predict overall carcase fatness, or a subjective score.

In this study 295 mixed sex progeny of a Poll Dorset ram joined with Border Leicester x Merino (BLM) ewes were slaughtered and dissected. Measurements on the cold carcase included GR and carcase weight (CW), and on the hot carcase the GR (HGR) and fat score (FS). After measurement, subcutaneous fat (SF) was dissected out and weighed.

Cold carcase measurements used to predict SF were CW (RSD = .240) and GR (RSD = .220). These predictors of SF were marginally better than the hot carcase measurements HGR (RSD = .240) and FS (RSD = .236). The RSD's were reduced by the inclusion of CW in the prediction models.

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In practice measurements must be taken on the hot carcase, and despite the possibility of operator error, both fat scoring and the Toland Probe gave good prediction of carcase fatness. Thus it was concluded that a visual system using FS with constant monitoring of fat levels using the Toland Probe would provide a sound basis for lamb carcase description.

INTRODUCTION

It has been widely argued that the saleyard system of selling lambs is too reliant on estimates of carcase characteristics on which to base value. A more objective selling system depends upon the development of a method of describing measured carcase characteristics which are important to the trade.

The original proposal of Moxham and Brownlie (1976) for describing sheep and lambs included age, sex, fat, carcase weight and conformation. Whilst sex was not included for lambs, conformation has been questioned as to its additional value in describing carcases after weight and fat have been described (Thompson and Atkins 1980).

The need to include fat in the system is unquestioned, but the method of measurement has been debated. Moxham and Brownlie (1976) suggested a subjective scoring system on a scale of 1 to 5 based on the system used by the Meat and Livestock Commission (United Kingdom), and Cameron (1979) was able to describe 88% of the variation in carcase fat using this scoring system. However, a scoring system is subject to individual operator variation and research has continued to define a point measurement which is highly correlated to carcase fatness.

Carcase weight (CW) accounts for a large amount of the variation in fatness (Kirton and Johnson 1979; Thompson and Atkins 1980). The GR measurement, which is the tissue thickness measured 11 cm from the midline over the 12th rib (Kirton et al. 1978), was a good predictor of carcase fat. Kirton and Johnson (1979) and Thompson and Atkins (1980) showed that prediction of fatness was best with GR in combination with CW.

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In the recently drafted revision of the Exports (Meat) Regulations it was suggested that Fat Classes be based on a subjective system with an objective reference measure if required (Todd 1983). Currently it is proposed that the reference be the GR measure. To avoid double handling of carcases the GR must be measured on hot carcases prior to carcases moving into the chiller.

This study investigated the degree of fatness explained by fat score and the CR measurement. In particular, it examined the use of the Toland Probe, a point probe developed to measure fat depth on cattle (Toland 1978), to measure GR on the hot lamb carcass.

MATERIALS AND METHODS

The mixed sex progeny of a Poll Dorset x BLM joining from three experiments conducted at Rutherglen Research Institute in 1982 were slaughtered, cut into commercial joints and dissected. The age of the lambs ranged from 70 to 224 days, whilst the carcase weight (head removed, kidney and channel fats in) ranged from 8.5 to 25.6 kg.

The lambs were slaughtered at a local abattoir after 24 hour fasting. The fat score (FS) and hot GR (HGR) was measured with a Toland Probe on the right side of the carcase at the 12th rib (the site of Kirton et al. 1978) before chilling. After 72 hours in the commercial chiller (ca. 6°C) the carcases were placed in the Research Institute chiller (ca. 4°C). After a further 24 hours they were weighed and carefully halved at the mid-line. The kidney and channel fat was removed, and the right side of the carcases cut into commercial joints and then the subcutaneous fat dissected out. Fat depth was measured at the fat/muscle interface on the cold carcase between the 12th/13th ribs (the site of Thompson and Atkins, 1980).

The data were subjected to a multiple regression analysis to determine the best predictor of subcutaneous fat levels, and also to investigate the relationship between the fat measurements.

RESULTS

As expected, there were strong relationships between CW and the three measures of fatness, FS, GR and HGR (See Table 1).

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Independent Variable</th>
<th>Constant</th>
<th>R*</th>
<th>R.S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HGR</td>
<td>1.304 CW</td>
<td>-8.493</td>
<td>.83</td>
<td>2.910</td>
</tr>
<tr>
<td>GR</td>
<td>0.984 CW</td>
<td>-6.237</td>
<td>.73</td>
<td>3.035</td>
</tr>
<tr>
<td>FS</td>
<td>0.453 CW</td>
<td>-3.348</td>
<td>.84</td>
<td>0.945</td>
</tr>
<tr>
<td>HGR</td>
<td>2.708 FS</td>
<td>0.872</td>
<td>.92</td>
<td>2.011</td>
</tr>
<tr>
<td>GR</td>
<td>2.333 FS</td>
<td>1.653</td>
<td>.81</td>
<td>2.618</td>
</tr>
<tr>
<td>HGR</td>
<td>0.977 GR</td>
<td>2.250</td>
<td>.84</td>
<td>2.821</td>
</tr>
</tbody>
</table>

*All values of R significant P<.001

The inclusion of carcase weights with the measures of fatness to predict SF reduced the RSD (Table 2). The effects of also including sex and age were not significant (P>.05). Interaction terms were examined between all
potential predictors of SF but their effects on the RSD were not significant (P>.05).

TABLE 2  
Regression equations for the prediction of subcutaneous fat (SF)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Constant</th>
<th>R²</th>
<th>R.S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>.069 HGR</td>
<td>.180</td>
<td>.83</td>
<td>.240</td>
</tr>
<tr>
<td>.077 G1</td>
<td>.240</td>
<td>.04</td>
<td>.220</td>
</tr>
<tr>
<td>.205 FS</td>
<td>.167</td>
<td>.84</td>
<td>.236</td>
</tr>
<tr>
<td>.113 CW</td>
<td>-.856</td>
<td>.86</td>
<td>.219</td>
</tr>
<tr>
<td>.035 G1 + .010 G2</td>
<td>-.642</td>
<td>.89</td>
<td>.193</td>
</tr>
<tr>
<td>.031 HGR + .072 G2</td>
<td>-.559</td>
<td>.83</td>
<td>.199</td>
</tr>
<tr>
<td>.095 FS + .070 G2</td>
<td>-.541</td>
<td>.89</td>
<td>.201</td>
</tr>
</tbody>
</table>

*All values of R significant P<.001

DISCUSSION

CW provided the best explanation of variation in SF (RSD = .219), although GR was comparable (RSD = .220). On the hot carcase FS (RSD = .236) was marginally better than HGR (.240). These results compare to Kirton and Johnson (1979) who found CW a better predictor than HGR, whilst Thompson and Atkins (1980) found CW better than GR measured cold. Cameron (1979) was able to explain a greater proportion of the variation using FS (r = .96) than the current study (r = .84), which emphasises the concern about individual operator expertise inherent in this technique.

When taken in conjunction with CW, the order of improvement of prediction of SF was GR, HGR and FS (RSD’s = .193, .199, .101). The additional explanatory power of the regression of CW with a fat measure is consistent with Kirton and Johnson (1979) and Thompson and Atkins (1980).

It is important for the assessment of the Toland Probe that the relationship of SF with HGR was not significantly worse than with GR. This study has shown that RSD with HGR is greater than with GR, but the difference is small both when used as a single predictor, or in association with CW.

As expected, there is a strong relationship between HGR and GR, with the regression coefficient approaching 1. However the size of the constant in the regression equation reflects on some consistent difference between the two measures. This could be due to the slightly different site of measurement, shrinkage on cooling of the carcase, or operator error in using the instrument.

No data are available to examine the site difference or the amount of shrinkage taking place on cooling. It is expected that these would be consistent differences, and would be related to fat thickness.

Of importance is the likelihood of operator error in using the probe. Anderson and Truscott (1982) identified operator variation in the use of the Toland Probe on beef carcases. This could be expected to occur to a lesser degree for sheep carcases, since measurement related to identifying the interface between muscle and bone gives less opportunity for error than finding the fat and muscle interface in beef carcase measurements. There still remains...
some individual variation in application of the probe in attempting to probe to the rib. The pressure applied to the base plate, or the distortion in fat caused by sideways movement of the probe, would both cause variation in measurement. These two problems could be overcome by introducing a series of prongs within the same instrument. The depth would be given by the prong adjacent to the shallowest flesh depth at the peak of the rib surface.

The subjective scoring technique to estimate FS resulted in similar RSD's to measuring HGR. However, operator error is likely to be more variable than using the Probe. In the current study operator error was probably minimised due to the practice of measuring HGR and estimating FS on a carcase prior to its entering the chiller. In effect, there was a constant monitoring of FS taking place.

The results support the suggestion by Todd (1983) that in the Exports (Meat) Regulations a visual score could be used on carcases, with supporting fat measurements taken on some carcases. If measurement was required to be totally objective, it is estimated that about 350 carcases per hour could be measured using the Toland Probe. However, this could be substantially increased if a probe with multiple prongs were developed.

ACKNOWLEDGEMENTS

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REFERENCES


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