THE PREDICTION OF BEEF CARCASS LEAN CONTENT

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SUMMARY

Five hundred and thirty-one beef carcasses were used to establish if probe measurements provided a more accurate assessment of carcass lean content than a visual scoring system for fat and muscle thickness or conventional Canadian carcass grading procedures. Carcasses were probed warm on the slaughter floor and at 24h post-slaughter using a Hennessy Grading Probe at several locations. Carcasses were visually appraised at 1h and 24h post-slaughter. The accuracy of probe measurements for the prediction of carcass lean was highest at the 12/13th ribs in both the warm (RSD 3.18%) and cold (RSD 3.15%) carcass. Current Canadian grading procedures had a similar accuracy for the prediction of lean content to probe measurements. A visual scoring system for fatness and muscle thickness gave the most precise prediction (RSD 3.03%) of beef carcass lean content.

INTRODUCTION

The evaluation of beef carcasses for carcass lean content is conducted in most countries by the use of subjective scoring systems for fatness and conformation or by making measurements of fat thickness and other traits such as carcass weight, marbling score, loin muscle area and kidney and channel fat. Consumer demand in most developed countries is primarily for lean beef, and the identification of carcasses with superior lean content is a pre-requisite to provide cattle producers with the necessary targets for breeding and feeding programs. In recent years, electronic probes have been developed which can measure both fat thickness and lean depth. The objectives of this study were to compare existing procedures for the evaluation of carcass meat yield to those provided by probe measurements.

EXPERIMENTAL METHODS

This study used 531 beef carcasses from animals that would be representative of commercial cattle in the Canadian beef industry (mainly European x British crossbreds). All cattle were slaughtered in a research abattoir following commercial procedures except that the hide was removed with a rotary air knife rather than a hide puller. The Hennessy Grading Probe (Hennessy and Chong, New Zealand) as developed for use in beef carcasses with a 125 mm probe shaft was used to record fat thicknesses and muscle depths at several locations approximately 1h post-slaughter. Probe measurements were taken between the 5/6, 11/12, 12/13 ribs, 2/3 lumbar and the P8 (as defined by Phillips et al. 1987) position. For the rib and lumbar positions, measurements were made at 50, 90 and 130 mm lateral to the mid-line of the carcass, except for the 5/6th rib where distances of 80 and 120 mm were used. These measurements were repeated 24h post-slaughter, after which the carcass was ribbed (12/13 ribs) and the fat thickness was measured at the same locations as for the probe (only at the 12/13th rib). In addition, the minimum fat thickness over the rib and the loin eye area was also recorded. Carcasses were also assessed warm and cold for overall fat cover (7 point scale, 1 = extremely lean to 7 = extremely fat) and muscle thickness (5 point scale, 1 = extremely concave shape in round to 5 = extremely convex shape in round).

All carcasses were fabricated into primal cuts which were then dissected into fat, lean and bone. Statistical analysis of the data set included the use of regression and analysis of variance procedures.

RESULTS

The cattle used in this study had an average age at slaughter of 13-14 months, live weight at slaughter of 447 kg, carcass weight (warm) of 263 kg and a side fat content of 24.1% (SD 4.29%). The fat content of typical Canadian carcasses ranges from 18-28% and so the data-base used would reflect a similar range.

Probe measurements made on the warm carcass showed most variability for the prediction of carcass lean and fat content at the 5/6 th ribs and the P8 site. Residual standard deviations were the lowest at the 11/12th and 12/13th ribs at a position 90 mm lateral to the carcass mid-line (Table 1).

Probe measurements made on the cold carcass showed a similar relationship with carcass lean and fat content as those found for the warm carcass. There was little improvement in precision obtained by measuring fat which was firm in the cold carcass compared to the soft fat of warm carcasses (Table 2). The data showed the same trends for precision on the cold carcass as the warm carcass, with the lowest RSD and highest R^2 values found in the area of the 12/13th rib.

In Canadian grading procedures the minimum fat thickness over the loin muscle at the 12/13th rib is used to place carcasses into one of four yield classes. Minimum fat cover had RSDs of 3.16 and 3.17, respectively for the prediction of carcass lean and fat content.

Table 1. Residual standard deviations (RSD) and R^2 for the prediction of carcass lean and fat content using the Hennessy Grading Probe in warm carcasses

	Lean		Fat	
Measurement site	RSD	R^2	RSD	R^2
5/6 rib (120mm) F	3.37	0.13	3.52	0.25
11/12 rib (90mm) F+L	3.26	0.18	3.37	0.31
12/13 rib (90mm) F+L	3.18	0.23	3.24	0.36
2/3 lumbar (90mm) F	3.33	0.15	3.48	0.27
P8	3.30	0.16	3.47	0.27

F and F+L refer to fat and lean depth

Table 2. Residual standard deviations (RSD) and R^2 for the prediction of carcass lean and fat content using the Hennessy Grading Probe in cold carcasses

	Lean		Fat	
Measurement site	RSD	R^2	RSD	R^2
5/6 rib (120mm) F	3.39	0.17	3.53	0.29
11/12 rib (90mm) F+L	3.27	0.23	3.36	0.36
12/13 rib (90mm) F+L	3.15	0.29	3.22	0.41
2/3 lumbar (90mm) F	3.33	0.20	3.46	0.32
P8	3.47	0.13	3.72	0.21

F and F+L refer to fat and lean depth

Table 3. Residual standard deviations (RSD) and R2 using visual scores to predict carcass muscle and fat content.

	Lean		Fat	
Score	RSD	R^2	RSD	R^2
Fat score (warm)	3.03	0.37	3.15	0.47
Muscle sore (warm)	3.45	0.18	3.78	0.23
Fat score (cold)	2.93	0.42	3.01	0.52
Muscle score (cold)	3.44	0.20	3.76	0.24

The visual scores for fatness and muscle thickness and their relationship with carcass lean and fat content is shown in Table 3. Fat score both on the warm and cold carcass had a lower RSD than those provided by probe or ruler measurements.

DISCUSSION

Probe measurements made in this study showed that the 12/13 rib area provided the most precise prediction of carcass lean and fat content. Chadwick and Kempster (1983) working with earlier prototypes of existing probes reported that no one location was consistently best for predicting carcass tissues percentages. A more recent study by Kirton et al. (1987) indicated that probe readings of fat thickness at the rump site gave the best prediction of edible meat yield. It is likely that dressing procedures (particularly the use of hide pullers) might explain the differences among these studies. When substantial amounts of fat are removed along the potential measurement sites, the variation will be increased for the prediction of carcass meat and fat yield. In the present study, an air knife was used to remove the hide from the carcass which results in a minimal disruption of the subcutaneous fat depot. However, as pointed out by Kirton et al. (1987), the future use of probes to measure carcass tissue content will depend on finding a measurement site which is not damaged during commercial slaughter and dressing procedures.

There was no difference found in this study in precision for predicting tissue percentages from probe measurements made on the warm or cold carcass. Chadwick and Kempster (1983) reported that probes provided more accurate predictions of lean content from measurements made on the cold carcass. The programming of the probes has improved since the study of Chadwick and Kempster (1983) which may account for this discrepancy. However, lean depth measurements made by the probe did not result in an increase in precision for predicting lean content which indicates that considerably more work remains to be done in the programming of the probe to measure lean depth in a repeatable manner. Similar results were reported by Kirton et al. (1987).

The visual scoring system adopted for this study provided the most accurate predictions of carcass tissue percentages. These findings are in agreement with those of Chadwick and Kempster (1983) and Kempster et al. (1986). The major problem with a visual scoring system is its standardization across different regions in a country, and the possibility of human error in the interpretation of the chosen scales. A compromise would be to choose a system which incorporated both a visual scale and linear carcass measurements to estimate composition. For example, Kempster et al. (1986) considered that visual scores, percentage kidney fat, marbling score and a fat thickness measurement together gave a more precise estimate of carcass lean percentage than visual scores alone.

CONCLUSIONS

This study has shown that probe measurements made on the warm carcass have a similar accuracy for predicting carcass lean and fat content to ruler measurements made on the cold carcass. In the Canadian context, probes could be used to grade warm carcasses for meat yield instead of ribbing the carcasses at 24h for assessment of fat cover over the loin muscle. A visual scoring system for fatness was found to be more precise than probe or ruler measurements to predict carcass tissue percentage. A multiple regression approach is therefore recommended combining a visual fat score with carcass measurements to estimate beef carcass lean and fat content.

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