VISUAL MARBLING SCORE AND CHEMICAL FAT CONTENT OF M. LONGISSIMUS IN BEEF CARCASSES

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SUMMARY

The visually assessed marbling score and the intramuscular fat content at the 5th rib and the 10th rib positions were determined for M. longissimus samples from 48 beef carcasses of 4 breeds. The carcasses were heavy (mean side weight of 195 kg), relatively fat (mean P8 fat thickness of 18 mm), had mean marbling scores of 2.6 at the 5th rib and 2.4 at the 10th rib and mean intramuscular fat contents of 8.63% at the 5th rib and 7.97% at the 10th rib. The correlation coefficient between marbling score and intramuscular fat content at the 5th rib was 0.68 and at the 10th rib was 0.49, with some pronounced breed differences occurring at the 10th rib but not at the 5th rib. Marbling scores assessed at either the 5th rib or the 10th rib did not provide a useful prediction of intramuscular fat content.
Keywords: 5th rib, 10th rib, marbling score, intramuscular fat.

INTRODUCTION

A visual assessment of marbling of the cut surface of the M. longissimus (eye muscle) at the 10th rib is one of the characteristics included in the recently introduced Chiller Assessment Scheme for the Australian beef industry (Anon. 1990). Marbling score has been an integral part of beef carcass grading schemes in the United States of America (Save11 *et al.* 1986) and Japan (Anon. 1970) for many years. The importance of marbling scores in these grading schemes is based on the association between marbling and palatability characteristics, although it is accepted that marbling is not an infallible predictor of the eating quality of beef (Tatum *et al.* 1982).

There is relatively little information available on the relationship between marbling score and the actual fat content of the muscle at the site of assessment. Save11 *et al.* (1986) found a moderate relationship between visually assessed marbling score and percentage ether extractable fat in M. longissimus from the 13th rib region, with increasing marbling score associated with increasing fat percentage. Likewise, Romans *et al.* (1965) reported that 'moderate' marbling score of 10th rib M. longissimus samples had significantly more ether extractable fat than samples with 'slight' marbling.

The beef carcass grading system which operates in Japan involves assessment of marbling of the cut surface of M. longissimus at the 5th/6th rib, whereas most of the reported work on marbling from the United States or Australia involves the 10th to 13th rib positions. The aim of the experimental work reported here is to investigate the relationship between 10th rib and 5th rib marbling scores and how scores at each of these locations relate to intramuscular fat content at each site.

MATERIALS AND METHODS

Muscle samples were taken from the carcasses of 48 steers, 12 each of Angus, Hereford, Murray Grey and Santa Gertudis breeds, which had been grain-fed for 120-204 days. At approximately 48 h post-slaughter, the M. longissimus section from the 5th rib to the 10th rib was removed from the right side of each carcass. Marbling was visually assessed by an AUS-MEAT accredited grader using the AUS-MEAT approved light source and the 12-point marbling score system (0, nil marbling, 12, heavy marbling) at both the 5th rib and 10th rib ends of the muscle section. Samples 2 cm thick were cut from each end of the M. longissimus section and these samples, plus the remaining piece of the muscle were wrapped in plastic film and frozen for later chemical analysis.

The 2 end samples plus the remaining muscle from M. longissimus were minced separately and the percentage ether-extractable fat was determined using standard methods (AOAC 1980). These analyses were made in duplicate and the mean was taken in order to calculate the percentage fat for each sample.

Means and standard deviations were calculated for marbling scores at the 5th rib and the 10th rib and fat percentages for the 5th rib, 10th rib and whole muscle for the total population and for each of the breeds. Simple correlation and regression analyses were carried out using the SAS package (Anon. 1985).

RESULTS

The details for carcass weight, fat thickness, marbling score and intramuscular fat content are presented in Table 1.

The correlations between marbling score and intramuscular fat content at each of the sites studied for the whole population are summarised in Table 2.

The correlations between marbling score and intramuscular fat content for the 4 breed groups displayed some important differences. In particular, marbling score at the 10th rib had very low correlations with intramuscular fat content at the 10th rib for the Hereford ($r = 0.19$) and Santa Gertrudis ($r = 0.38$) breeds while the Angus ($r = 0.81$) and Murray Grey ($r = 0.69$) breeds had high correlations for these factors. Each of the breeds showed a high correlation between intramuscular fat content at the 5th rib and at th e 10th rib (Angus: $r = 0.79$, Hereford: $r = 0.72$, Murray Grey: $r = 0.92$, Santa Gertrudis: $r = 0.93$) and a moderate correlation between marbling score at the 5th rib and at the 10th rib (Angus: $r = 0.55$, Hereford: $r = 0.71$, Murray Grey: $r = 0.68$, Santa Gertrudis: $r = 0.67$).

Table 1. Mean ± s.d. for the carcass and muscle characteristics for the whole population and each of the breeds

	No. of steers	Hot std. side wt (kg)	P8 fat thickness (mm)	Marbling score[A] 5th rib	Marbling score[A] 10th rib	Intramuscular fat (%) 5th rib	Intramuscular fat (%) 10th rib	Intramuscular fat (%) Whole section
All breeds	48	195 ± 23	18 ± 5	2.6 ± 0.9	2.4 ± 0.7	8.63 ± 3.21	7.97 ± 3.61	7.65 ± 2.65
Angus	12	201 ± 18	18 ± 7	2.9 ± 1.1	2.4 ± 0.7	9.76 ± 2.64	9.42 ± 3.39	9.09 ± 2.36
Hereford	12	209 ± 30	20 ± 4	2.4 ± 0.7	2.5 ± 0.7	6.86 ± 2.23	6.49 ± 2.26	6.57 ± 2.25
Murray Grey	12	179 ± 17	18 ± 5	2.5 ± 0.8	2.5 ± 0.7	9.36 ± 3.74	8.53 ± 2.95	7.84 ± 3.05
Santa Gert.	12	188 ± 15	15 ± 4	2.4 ± 1.0	2.2 ± 0.8	8.59 ± 2.95	7.48 ± 3.46	7.13 ± 2.51

[A]Marbling scores 0, nil, 12, heavy marbling.

Table 2. Correlation coefficients for marbling score and intramuscular fat content at the 5th rib and 10th rib positions for the whole population

	Marbling score[A] 5th rib	Marbling score[A] 10th rib	Intramuscular fat (%) 5th rib	Intramuscular fat (%) 10th rib
Marbling. score 10th rib	0.61			
Intramuscular fat(%) 5th rib	0.68			
Intramuscular fat(%) 10th rib	0.70	0.44		
Intramuscular fat(%) whole	0.57	0.32	0.77	0.77

[A]Marbling scores 0, nil, 12, heavy marbling.

Linear regression analyses (using an equation of the form: $y = a + bx$) were carried out on these measurements. Highly significant ($P < 0.001$) relationships were found between marbling scores (x) and intramuscular fat percentages (y) at the 5th (r.s.d. = 2.39%) and 10th ribs (r.s.d. = 2.78%). The marbling score at the 5th rib had a highly significant relationship ($P < 0.001$) with the intramuscular fat percentage of the whole M. longissimus section (r.s.d. = 2.19%), whereas the marbling score at the 10th rib was only moderately related ($P < 0.05$, r.s.d. = 2.53%) to the intramuscular fat percentage of the whole muscle section. The intramuscular fat percentage at both the 5th rib and the 10th rib were highly significantly related ($P < 0.001$, r.s.d. = 1.70%, in both cases) to the intramuscular fat percentage of the whole M. longissimus section.

DISCUSSION

The heavy carcass side weights and relatively great fat thickness together with moderate marbling scores and intramuscular fat contents for the carcasses used in this trial can be observed in Table 1.

The moderately high correlation coefficient (0.61) between marbling score at the 5th rib and the score at the 10th rib is evident in Table 2 and it should be noted that this was consistent within each of

the breed groups. The relationship between the scores at these two sites is important if scoring in different countries is being done at these different sites.

R. F. Thornton (pers. comm.) observed that marbling score increased linearly along M. longissimus from the 12/13th rib to the 5 /6th rib, with scores at the 5/6th rib end being one score higher (on a marbling scale, 1 = slight, 6 = abundant) than those at the 12/1 3th rib end. A similar gradation in intramuscular fat percentage along M. longissimus was observed and a correlation coefficient of 0.72 was detected between marbling score and intramuscular fat percentage over all sites assessed (R. F. Thornton, pers. comm.). The results reported here are in general agreement with those observations.

The high correlation coefficients between the intramuscular fat content at the 5th rib and the 10th rib (0.86) and between the intramuscular fat content at these two sites and the fat content of the whole M. longissimus section are also evident in Table 2. The intramuscular fat percentages at these 2 locations were not significantly different for any of the breed groups or for the population as a whole, but the general trend was for the 5th rib values to be slightly higher than the 10th rib values in all cases (Table 1).

It is apparent from the correlations presented in Table 2 that the marbling score assessed at the 5th rib provided a better indication of the intramuscular fat content at that site, at the 10th rib and for the whole muscle section than did the marbling score assessment at the 10th rib. The reasons for this difference are not apparent but may be associated with the relative size of the cut surface of M. longissimus at each site (eye muscle area being approximately twice as great at the 10th rib as at the 5th rib) and the ease or difficulty in visually assessing marbling score in eye muscle surfaces of different area. The variation between breeds in the correlations between marbling score at the 10th rib and intramuscular fat content at this site is also of interest as these breed differences were not apparent at the 5th rib site.

The results of the simple regression analysis indicated that marbling score at the 5th rib site provided a better prediction of intramuscular fat content than the marbling score at the 10th rib. However, it is clear from the size of the r.s.d.'s relative to the mean intramuscular fat percentage that marbling scores at either site are not useful for predicting intramuscular fat percentage. As mentioned previously, in countries where marbling scores are included in carcass grading schemes the objective of this assessment appears to be the prediction of the eating quality of the meat, rather than the prediction of intramuscular fat percentage.

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