THE VALUE OF EYE MUSCLE AREA IN PREDICTING CARCASS MUSCLE

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SUMMARY

The value of eye muscle area in predicting the percentage of muscle in beef carcasses was examined in 3 separate studies. When added to a fat thickness measurement and carcass weight in lightweight carcasses (97-250 kg) or in carcasses with a wide weight range (140-356 kg) eye muscle area was of limited value. In heavyweight carcasses (280-512 kg) eye muscle area improved prediction mainly by explaining more variance but the prediction was not as accurate as that in lightweight carcasses with only fat thickness and carcass weight.
Keywords: eye muscle area, carcass muscle.

INTRODUCTION

The cross-sectional area of M. longissimus has been used for many years in an effort to quantify muscle in cattle and carcasses. This ‘rib-eye’ area (or eye muscle area) is currently used by the US Dept of Agriculture to determine ‘yield grade’ standards in beef carcasses (Anon. 1980). Recently it was introduced to Australia’s Beef Carcass Chiller Assessment Scheme for estimating the weight of lean meat yield (Anon. 1991). Whilst the weight of a muscle in a carcass is closely related to total carcass muscle weight (Butterfield 1963), cross-sectional area alone of M. longissimus, in cattle of varying breeds and shapes, does not exhibit such strong relationships (Cole *et al.* 1960; Magee *et al.* 1960; Goll *et al.* 1961). Whether the addition of eye muscle area (EMA) to other commonly used carcass measurements is useful in the marketing of beef carcasses is uncertain. In this paper the contribution of EMA as an additional regressor in the estimation of percentage carcass muscle is examined.

MATERIALS AND METHODS

Two groups of grass-fed steers and 1 group of grain-fed steers were grown to predetermined liveweights, slaughtered, dressed, divided into sides and weighed (hot side weight, HSW). The first grass-fed group (Group 1) comprised 49 Angus, Hereford, Friesian, Charolais x and Murray Grey cattle (hot carcass weight (HCW) range, 140–356 kg); the second grass-fed group (Group 2) was made up of 78 Hereford, Brahman and Brahman x Hereford cattle (HCW range, 97–402 kg); the grain-fed group (48) was Angus, Hereford, Murray Grey and Santa Gertrudis cattle (HCW 292-512 kg). After the carcasses had been chilled for 24 h at 2°C, a number of measurements were made including chilled side weight (CSW), subcutaneous fat depth at the 10th rib (FT_{10}), 12th rib (FT_{12}) or rump (P8) sites and EMA at the 10th rib (EMA_{10}). The right side of each carcass was then anatomically dissected into muscle, bone, fat and connective tissue and all resulting products were weighed.

Data were examined by regression analyses using a number of carcass measurements to determine the best predictors of percentage carcass muscle.

RESULTS AND DISCUSSION

In Table 1, results are given for the prediction of percentage carcass muscle in the 2 grass-fed groups of cattle.

With the Group 1 steers, FT_{10} was a highly significant predictor ($P < 0.001$) of percentage carcass muscle, and the progressive addition of CSW ($P < 0.01$) and EMA_{10} ($P < 0.01$) improved prediction. Abattoir classification of beef carcasses routinely involves a fat thickness measurement and carcass weight. The addition of EMA_{10} improved the standard error of estimate (s.e.e.) of the routine technique from 2.81 to 2.54% and the variance explained, from 0.76 to 0.81.

In the Group 2 steers, with all 78 carcasses included, the addition of EMA_{10} to rump P8 fat thickness and HCW improved the s.e.e. from 2.23% to 2.02% and explained 8% more variance (0.59 to 0.67). In the 33 lightweight carcasses in this group, the addition of EMA_{10} did not significantly improve the s.e.e. or the coefficient of determination. For the heavyweight carcasses in Group 2, the addition of EMA_{10} was highly significant ($P < 0.001$) improving the s.e.e. from 2.65 to 2.32% and the variance explained, from 0.23 to 0.42.

Table 1. Coefficients of determination and standard errors for the prediction of percentage muscle from combinations of carcass measurements in 2 groups of grass-fed steers

FT_{10}, fat thickness at the 10th rib; CS W, chilled side weight; EMA_{10}, eye muscle area at the 10th rib; P8, rump P8 fat thickness; HCW, hot carcass weight

Regressor	Coefficient of determination (R^2)	s.e.m. (%)
	Group 1	
FT_{10}***	0.72	3.02
FT_{10}*** + CSW**	0.76	2.81
FT_{10}*** + CSW*** + EMA_{10}**	0.81	2.54
	Group 2, all 78 carcasses[A]	
P8(hot)***	0.59	2.22
P8(hot)*** + $HCW^{n.s.}$	0.59	2.23
P8(hot)*** + HCW** + EMA_{10}***	0.67	2.02
	Sub-group 2a, 33 lightweight carcasses (97–248 kg)	
P8(hot)***	0.61	1.47
P8(hot)*** + HCW*	0.68	1.35
P8(hot)*** + $HCW^{n.s.}$ + $EMA_{10}^{n.s.}$	0.69	1.35
	Sub-group 2b, 36 heavyweight carcasses (283–402 kg)	
P8(hot)***	0.22	2.62
P8(hot)* + $HCW^{n.s.}$	0.23	2.65
P8(hot)NS + HCW* + EMA_{10}***	0.42	2.32

[A]When the 78 carcasses were separated into local and export groups, 9 fell between the upper limit of 250 kg for local and the lower limit of 280 kg for export, and were omitted from the subgroups.
*$P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; n.s., not significant.

In the grain-fed carcasses (Table 2) the addition of EMA_{10} to a fat thickness measurement and hot side weight gave relatively small improvements in the prediction of percentage carcass muscle. In the case of rump P8 fat thickness, the s.e.e. improved from 2.55 to 2.39% with 8% more variance explained. For FT_{10} the improvement in s.e.e. was from 2.83 to 2.66% with 8% more variance explained. The values for FT_{12} were from 2.63 to 2.34% (s.e.e.) and an additional 14% of variance accounted for. These findings are similar to those of Johnson and Priyanto (199 1) who found that EMA_{10} was of limited use in predicting the weight of carcass muscle.

Table 2. Coefficients of determination and standard errors for the prediction of percentage muscle from combinations of carcass measurements in grain-fed steers

P8, rump P8 fat thickness; FT_{10}, fat thickness at the 10th rib; FT_{12}, fat thickness at the 12th rib; HSW, hot side weight; EMA_{10}, eye muscle area at the 10th rib

Regressor	Coefficient of determination (R^2)	s.e.m. (%)
P8***	0.43	2.52
FT_{10}***	0.45	2.80
FT_{12}***	0.39	2.60
P8*** + $HSW^{n.s}$	0.43	2.55
FT_{10}*** + $HSW^{n.s}$	0.45	2.83
FT_{12}*** + $HSW^{n.s}$	0.39	2.63
P8** + $HSW^{n.s}$ + $EMA_{10}^{n.s.}$	0.51	2.39
FT_{10}* + $HSW^{n.s}$ + EMA_{10}*	0.53	2.66
FT_{12}*** + $HSW^{n.s}$ + EMA_{10}***	0.53	2.34

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$; n.s. not significant.

Improved ultrasound technology has led to the accurate measurement of EMA in cattle and carcasses (Simm 1983) and the measurement is now widely used. However, its usefulness in contributing to muscle prediction needs to be carefully evaluated especially in view of the lack of association between EMA and total muscle reported in cattle by Cole *et al.* (1960), Magee *et al.* (1960) and Goll *et al.* (1961), and in sheep by Walker and McMeekan (1944). Butterfield (1963) commented on the 'futility of s.e.e.king an index of total muscle weight in the cross-sectional area of an individual muscle'.

Fat thickness and carcass weight explained most of the variance in percentage carcass muscle and the contribution of EMA was dependent on the particular carcass population. In the 2 grass-fed groups of carcasses (Groups 1 and 2), the contribution of EMA to the improved prediction of muscle was modest. In the 33 lightweight (or local) carcasses of Group 2, EMA did not improve prediction. In the 36 heavyweight (or export) carcasses of Group 2 and in the grain-fed carcasses of Group 3 (heavyweight carcasses), EMA did help prediction, mainly by explaining more variance. However, it should be noted that the variance explained by fat thickness and carcass weight was already low in these heavyweight groups and, after EMA was added, the prediction was still not as good as that for lightweight carcasses using only fat thickness and carcass weight. This observation led Johnson and Priyanto (1991) to recommend a different utilisation of EMA in objective classification methods for local and export beef in Australia. For heavyweight export carcasses they advocated the use of EMA with P8 fat thickness and hot side weight because it contributed significantly to improved carcass muscle assessments; for lightweight local beef carcasses they recommended that EMA not be used because it did not significantly improve carcass muscle assessments when added to P8 fat thickness and carcass weight.

In considering the use of EMA in commercial carcass description it should be noted that in carcasses ranging widely in weight, EMA does make a small but significant contribution to the prediction of muscle. However, with modem beef marketing a comparison of measurements is more valuable in carcasses of a similar weight range or those bound for a particular market. In the group of lightweight (local) carcasses (Table 1) EMA did not help significantly in quantifying carcass muscle. In the group of heavyweight carcasses EMA contributed significantly to the prediction of muscle as well as almost doubling the amount of variance explained. On the basis of these results EMA would be a useful additional measurement in the commercial description of heavyweight carcasses but not lightweight carcasses.

CONCLUSION

Eye muscle area, commonly used in the evaluation of muscle in cattle and carcasses, was generally of limited value for predicting carcass muscle content. In the lightweight carcasses it did not improve percentage muscle prediction and in the heavyweight carcasses, although it almost doubled the variance explained, the total variance explained (42%) and the standard errors of estimate were inferior to those of the lightweight carcass predictions in which fat thickness and carcass weight were used.

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