THE CONTRIBUTION OF EYE MUSCLE AREA TO THE OBJECTIVE MEASUREMENT OF CARCASE MUSCLE

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Summary

In order to clarify the role of eye muscle area in predicting carcase muscle, 78 steers (Hereford, Brahman and Brahman x Hereford F1) were serially slaughtered, producing carcases weighing from 97kg to 402kg. On the basis of commercial marketing requirements the carcases were divided into "lightweight" carcases (under 270kg) or "heavyweight" carcases (over 270kg) and a side from each was anatomically dissected. Eye muscle area was used in multiple regression with 12th rib fat thickness and hot side weight to predict carcase muscle. In "lightweight" carcases eye muscle area contributed only slightly to the improved prediction of weight or percentage muscle. In "heavyweight" carcases eye muscle area, in combination with hot side weight, was necessary to give satisfactory prediction of weight or percentage carcase muscle.

Introduction

With recent improvements in imaging ultrasound technology, eye muscle area can now be measured more accurately in live animal and abattoir situations. In Australia animal scientists commonly measure eye muscle area in beef cattle and recommend its use in systems aimed at the genetic improvement of beef production. The U.S. Dept. of Agriculture uses eye muscle area in determining "yield grade" standards in beef carcases (ANON. 1965) and Australia includes it in its Beef Carcass Chiller Assessment Scheme to estimate the weight of lean meat yield (ANON. 1991). However, the studies of COLE *et al* (1960), MAGEE *et al* (1960) and GOLL *et al* (1961) indicate that the cross-sectional area alone of *M. longissimus* is a poor indicator of carcase muscle content. If this is so then the role of eye muscle area in carcase evaluation and beef genetic improvement systems needs to be defined. In this paper the contribution of eye muscle area, used in conjunction with other commonly recorded carcase measurements to estimate carcase muscle, is examined.

Materials and Methods

A group of 78 steers comprising 27 Herefords, 26 Brahmans and 25 Brahman x Hereford F1 were grass-fed to pre-determined liveweights then slaughtered, dressed, divided into sides and weighed (hot side weight, HSW). After chilling at 2°C for 24 to 72 hours a number of measurements was made including subcutaneous fat thickness at the 12th rib (FT_{12}) and eye muscle area at the 10th rib (EMA_{10}). The right side of each carcase was then anatomically dissected into its constituent tissues, muscle, bone, fat and connective tissue.

Prior to dissection the carcases were divided into lightweight (or "local") carcases (under 270kg) or heavyweight (or "export") carcases (over 270kg). This arbitrary allocation of carcases was influenced by a consideration of Australia's principal markets which have cut-off points at about 270kg.

In this study the contribution of eye muscle area to the prediction of carcase muscle was examined in lightweight and heavyweight carcases. Details of the carcases are shown in Table 1.

Results and Discussion

Table 2 shows the results of a simple correlation analysis between carcase measurements and carcase muscle.

Table 1. Details of carcases used to study the contribution of eye muscle area to muscle prediction (mean and range)

Measurement	Lightweight carcases (n=44)	Heavyweight carcases (n=34)
Hot carcase weight (kg)	183.5 (97.0-268.8)	329.7 (276.6-402.0)
12th rib fat thickness (mm)	2.8 (0-10)	10.2 (4-31)
Eye muscle area 10th rib (cm^2)	55.6 (32-82)	76.4 (56-93)
Muscle (kg)	109.2 (55.5-156.2)	183.9 (144.4-217.7)
Muscle (%)	65.14 (60.50-70.01)	60.70 (53.72-65.18)

Simple correlation analysis showed that HSW and EMA_{10} were strongly correlated with muscle weight in both lightweight and heavyweight carcases. Twelfth rib fat thickness was highly correlated with both weight and percentage of muscle in the lightweight carcases but was only moderately correlated with percentage muscle in the heavyweight carcases. This suggests that FT_{12} is a less useful indicator of percentage carcase muscle as carcases fatten. The weight of muscle did not appear to be a useful indicator of percentage muscle in lightweight or heavyweight carcases.

Details of simple and multiple regression analyses, using the three carcase measurements to predict the weight and percentage of carcase muscle, are shown in Table 3.

Table 2. Correlation analysis between carcase measurements and carcase muscle

Measurement	Correlation coefficient			
	Lightweight carcases		Heavyweight carcases	
	Muscle (kg)	Muscle (%)	Muscle (kg)	Muscle (%)
Hot side weight (kg)	0.99**	-0.31*	0.90**	-0.28^{NS}
12th rib fat thickness (mm)	0.59**	-0.53**	0.20^{NS}	-0.44**
Eye muscle area 10th rib (cm^2)	0.79**	0.07^{NS}	0.68**	0.33^{NS}
Muscle (kg)		-0.16^{NS}		0.17^{NS}

* p < 0.05   ** p < 0.01   NS Not significant

Table 3. Simple and multiple regression analyses used to predict the weight and percentage of carcase muscle

Intercept	Hot side weight	12th rib fat thickness	Eye muscle area 10th rib	RSD (kg or %)	R^2	Significance of regression
Lightweight carcases (kg)						
1.491NS	0.579**			2.39	0.97	**
45.862**		3.181**		11.19	0.35	**
0.098NS			0.981**	8.51	0.63	**
-1.047NS	0.626**	-0.638**		2.07	0.98	**
-2.097NS	0.524**		0.155**	2.11	0.98	**
3.504NS		1.930**	0.824**	7.19	0.74	**
-3.198*	0.575**	-0.504**	0.116**	1.92	0.98	**
Heavyweight carcases (kg)						
9.950NS	0.497**			4.59	0.80	**
87.612**		0.425NS		10.10	0.04	NS
26.597*			0.855**	7.58	0.46	**
6.824NS	0.451**	-0.401*		4.28	0.83	**
-3.946NS	0.414**		0.362**	3.89	0.86	**
22.046NS		0.433NS	0.857**	7.38	0.50	**
-4.135NS	0.454**	-0.265NS	0.313**	3.77	0.87	**
Lightweight carcases (%)						
68.127**	-0.033*			2.36	0.10	*
66.526**		-0.505**		2.10	0.28	**
67.277**			0.015NS	2.47	0.05	NS
65.921**	0.008NS	-0.555**		2.12	0.28	**
63.213**		-0.603**	0.064*	2.02	0.35	**
64.637**	-0.086**		0.151**	2.09	0.30	**
63.725**	-0.044NS	-0.417*	0.119**	1.97	0.40	**
Heavyweight carcases (%)						
67.964**	-0.044NS			2.78	0.08	NS
63.305**		-0.254**		2.61	0.19	**
51.837**			0.116NS	2.74	0.11	NS
66.214**	-0.019NS	-0.225*		2.63	0.20	**
54.499**		-0.253**	0.115*	2.47	0.30	**
59.052**	-0.098**		0.232**	2.30	0.39	**
58.956**	-0.077**	-0.134NS	0.208**	2.26	0.43	**

* $p < 0.005$ ** $p < 0.01$ NS Not significant

In calculating the weight of muscle in lightweight carcases the use of EMA_{10} with HSW and FT_{12}, or with HSW alone, gave a marginal improvement over prediction using HSW and FT_{12}. The residual standard deviation (RSD), using all three variables improved to 1.92kg from 2.07kg for HSW and FT_{12}.

For the prediction of muscle weight in heavyweight carcases the use of HSW, FT_{12} and EMA_{10} together was superior (RSD = 3.77kg) to HSW and FT_{12} (RSD = 4.28kg). However, the use of the three variables was only marginally better than using HSW and EMA_{10} (RSD = 3.89kg). Twelfth rib fat thickness was important to the precision of muscle weight prediction in lightweight carcases but played a relatively less important role in heavyweight carcases. The use of EMA_{10} improved only marginally, the prediction of muscle weight in lightweight carcases but it was necessary in heavyweight carcases to give an accurate prediction.

For the prediction of percentage muscle in lightweight carcases FT_{12} played an important role. Used alone it predicted with an RSD of 2.10% and the addition of HSW gave no further improvement.

When EMA_{10} was added to FT_{12} there was a slight improvement in prediction (RSD = 2.02%). With all three independent variables, FT_{12}, HSW and EMA_{10} used together there was only a marginal improvement in carcase muscle prediction (RSD = 1.97%). When the three variables were used to predict percentage muscle in the heavyweight carcases, EMA_{10} was necessary to obtain the best prediction. FT_{12} alone (RSD = 2.61%) was not improved by the addition of HSW, but when EMA_{10} was added to HSW or to HSW and FT_{12} the RSD's were reduced to 2.30% and 2.26% respectively.

The contribution of EMA_{10} to the prediction of weight or percentage carcase muscle seemed to depend on the weight or fatness of the carcases involved. In lightweight carcases (to 270kg) the use of EMA_{10} only very slightly improved the predictions. However, in heavyweight carcases EMA_{10} was necessary to obtain improved predictions of both weight and percentage of carcase muscle.

Conclusion

In commercial practice the use of EMA_{10} to improve the prediction of carcase muscle in lightweight carcases seems hardly warranted. In heavyweight carcases its use is necessary in order to obtain a reasonably accurate prediction of either weight or percentage of carcase muscle.

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