DETERMINATION OF SALEABLE BEEF YIELD IN CARCASS COMPETITIONS

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SUMMARY

In heavy export carcasses (297-389kg) estimates of saleable beef yield, using subcutaneous fat thickness measurements, varied widely from yields determined in the boning room. A study of four genotypes of bullocks consigned for the Japanese grass-fed, chilled beef trade showed that estimates of percentage saleable beef yield varied by up to 4.9% from boning room yield, using twelfth rib fat thickness, and by up to 6.0% using rump fat thickness. The use of hot side weight in addition to the fat thickness measurements, generally, did not improve predictions of percentage saleable beef yield.

Current techniques used to estimate saleable beef yield, an important points-scoring criterion in Australian carcass competitions, appear unlikely to rank similar carcasses in order of merit, and the use of bone-out techniques is recommended.

INTRODUCTION

The object of a carcass competition is to rank in order of merit carcasses with superior commercial attributes, particularly saleable beef yield. Since fat thickness and carcass weight are the main objective measurements used for quantification in Australian carcass competitions, it is important that they clearly indicate differences between entries of similar type. Charles and Johnson (1976) found that carcass composition and percentage saleable beef yield varied significantly with genotype at constant fat thickness. If this is so, objective carcass measurement which is currently replacing subjective grading techniques in industry, may not be sufficiently accurate to identify superior-yielding carcasses in a competition, or in other situations, where selection for increased yield is exercised.

This study was undertaken to quantify the variation in saleable beef yield at different fat thicknesses amongst genotypes of carcasses consigned for the Japanese chilled beef market.

MATERIALS AND METHODS

Cattle and carcasses

Sixty grass-fed bullocks (494-743 kg) comprising 15 each of Hereford, Brahman, Brahman x Hereford and Simmental x Hereford, consigned for the Japanese market, were slaughtered, dressed and then chilled at 3°C. The right side of each carcass was divided into 12 primal cuts (according to specifications of the Japanese Livestock Industry Promotion Corporation), manufacturing trims (according to specifications of the U.S.A. Department of Agriculture) and waste fat and bone. Each of these products was anatomically dissected into muscle, bone, fat and connective tissue. Details of the carcasses are given in Table 1.

Measurements

Hot sides and all products of commercial and anatomical dissection were weighed. Two fat thickness measurements were taken; 12th rib fat thickness was recorded mid-way between the 12th and 13th ribs over *m.longissimus thoracis et lumborum*, three-quarters of the distance from medial to lateral edge; the rump subcutaneous fat thickness measurement (Johnson and Vidyadaran 1981) was taken 5 cm lateral to the highest point of the sacral crest which is the dorsal spine of the 2nd or 3rd sacral vertebra.

Statistical

Percentage saleable beef yield (cuts plus manufacturing trims) was regressed on each fat thickness measurement, with and without hot side weight. All regressions were examined for curvilinearity using quadratic analysis.

RESULTS AND DISCUSSION

Prediction equations for percentage saleable beef yield from 12th rib fat thickness showed major variations

Table 1. Details of carcasses consigned for the Japanese chilled beef trade in which yield studies were conducted

Genotype[A]	Hot carcass weight (kg)	Fat thickness[B] chilled 12th rib (mm)	Fat thickness[B] chilled rump (mm)	Saleable beef yield[C] (%)	Carcass composition Muscle (%)	Carcass composition Bone (%)	Carcass composition Fat (%)
Hereford	312-388 (353.7)	9-25 (14.6)	6-30 (16.3)	58.09-68.93 (64.70)	47.5-60.6 (54.9)	10.8-15.7 (13.2)	23.2-40.6 (30.6)
Brahman	299-343 (318.6)	2-14 (6.9)	7-17 (10.7)	66.98-74.29 (71.84)	56.5-66.3 (62.9)	13.2-17.0 (14.6)	17.5-28.3 (20.8)
Brahman x Hereford	362-389 (376.8)	4-16 (9.2)	6-19 (12.5)	68.99-75.57 (71.47)	58.4-68.1 (61.8)	11.8-15.1 (13.3)	16.5-28.3 (23.5)
Simmental x Hereford	297-388 (337.9)	3-9 (4.6)	3-10 (6.1)	69.23-73.77 (71.54)	59.0-65.5 (63.3)	13.5-17.8 (15.9)	14.8-25.5 (18.9)

A Fifteen carcasses in each genotype

B Fat thickness measurements defined in MATERIALS AND METHODS

C Percentage saleable beef yield is the weight of the twelve cuts (prepared according to specifications of the Japanese Livestock Industry Promotion Corporation) plus manufacturing trims (prepared according to specifications of the United States Department of Agriculture) expressed as a percentage of cold side weight

Table 2. Regression of percentage saleable beef yield on fat thickness measurements in four genotypes of bullocks prepared for the Japanese chilled beef market (n = 4x15)

Dependent variable	Independent variables[A] b1 (mm)	b2 (kg)	Regression coefficients[BC] Intercept	b1	b2	RSD at mean of 60 carcasses (%)
Percentage saleable beef, genotype means	FT_{12}		69.66			
			74.16	-0.3394**		1.79
			74.59			
			73.10			
Hereford=64.70						
Brahman=71.84			74.71	-0.5472**		2.41
Brahman x			89.73	-0.3683**	-0.1085**	
Hereford=71.47	FT_{12}	Hot side wt.	85.90	-0.2873*	-0.0757^{NS}	
Simmental x			46.23	-0.2441*	0.1441^{NS}	-
Hereford=71.54			65.97	-0.0445^{NS}	0.0341^{NS}	
	RumpFT		72.27	-0.4634**		1.94
			76.30	-0.4183**		1.29
			74.56	-0.2477*		1.85
			69.01	0.4122*		0.86
			75.26	-0.4714**		2.73
	RumpFT	Hot side wt.	90.96	-0.4228**	-0.1085**	
			79.22	-0.3955**	-0.0198^{NS}	-
			38.19	-0.2500**	0.1908*	
			67.66	0.3832*	0.0090^{NS}	

A FT_{12}, fat thickness at 12th rib; rump FT, fat thickness at rump site (Johnson and Vidyadaran 1981)
B For each independent variable, regression coefficients are shown in the following descending order: Hereford, Brahman, Brahman x Hereford, Simmental x Hereford and breed-ignored (in two cases)
C The regression coefficients for 12th rib fat thickness were not significantly different among genotypes and a pooled coefficient was used
* $p < 0.05$ ** $p < 0.01$ NS Not significant from 0

Table 3. Saleable beef yield calculated for twelfth rib and rump fat thicknesses[A] in four genotypes of bullocks

Genotype	Percentage saleable beef yield[B] at 12th rib fat thickness 3 (mm)	5 (mm)	9 (mm)	14 (mm)	25 (mm)
Hereford	X	X	66.61	64.91	61.18
Brahman	73.14	72.46	71.11	69.41	X
Brahman x Hereford	X	72.89	71.54	69.84	X
Simmental x Hereford	72.08	71.40	70.05	X	X
Breed-ignored	73.07	71.97	69.79	67.05	61.03
Range among genotypes	1.06	1.49	4.93	4.93	-
Maximum variation from breed-ignored equation	0.99	0.92	3.18	2.79	0.15

	Percentage saleable beef yield at rump fat thickness 3 (mm)	5 (mm)	10 (mm)	17 (mm)	30 (mm)
Hereford	X	69.95	67.64	64.39	58.37
Brahman	X	74.21	72.12	69.19	X
Brahman x Hereford	X	73.32	72.08	70.35	X
Simmental x Hereford	70.25	71.07	73.13	X	X
Breed-ignored	73.84	72.90	70.55	67.25	61.12
Range among genotypes	-	4.26	5.49	5.96	-
Maximum variation from breed-ignored equation	3.59	2.93	2.91	3.10	2.75

A Fat thickness defined in MATERIALS AND METHODS and arbitrarily chosen from the ranges observed in the carcasses understudy
B Percentage saleable beef yield defined in TABLE 1
X Percentage saleable beef yield not calculated because the fat thickness did not fall within the range of the respective genotype (see TABLE 1)

attributable to genotype (Table 2). From the common slope ($p < 0.01$) and different intercepts, variations in saleable beef yield of up to 4.93% existed between genotypes at a given fat thickness. For rump fat thickness (with separate regression slopes for each genotype) a similar magnitude of variation in yield between genotypes (5.96%) occurred (Tables 2 and 3). Since a single fat thickness measurement (either at 12th rib or rump) is used in commercial carcass classification to predict saleable beef yield, the breed-ignored equations for each measurement (shown in Table 2) represent the use of the fat thickness measurement in commercial circumstances. Current classification techniques such as AUS-MEAT (Anonymous 1987), therefore, indicate yields of saleable beef with errors of prediction similar to those shown for the breed-ignored regression equations in Table 2. For a greater range of genotypes the errors of prediction may be greater.

In situations where similar carcasses need to be ranked in order of merit, such as carcass competitions or genetic selection, the current use of fat thickness measurements is unlikely to detect significant differences among genotypes. For example, at 12th rib fat thicknesses in this study which produced carcasses most acceptable for Japanese cuts (5-14 mm), the Herefords benefitted strongly from yield predictions using the breed-ignored equation (Table 3). They were over-predicted by up to 3.18% for saleable beef yield; conversely, Brahman and Brahman x Hereford groups were under-estimated by up to 2.79%. For rump fat thicknesses in this study consistent with the most economic production of Japanese cuts (10-17 mm), saleable beef yield was over-predicted in the Herefords by up to 2.91% using the breed-ignored equation.

In general, the addition of hot side weight did not improve the prediction of saleable beef yield (Table 2). Hot side weight did combine with 12th rib fat thickness in negative regression ($p < 0.01$) in the Herefords. It seems that at the heavy carcass weights of the early-maturing Herefords in this study (312-388 kg), increases in fatness (up to 40.6%, Table 1) resulted in such a severe trim as to reduce percentage saleable beef yield. Conversely, rump fat thickness was associated with positive regression in the Simmental x Hereford group indicating that most of the fat in these late-maturing cattle (14.8% to 25.5%), even at carcass weights of 388 kg, was able to be included in the Japanese specification.

CONCLUSION

Percentage saleable beef yield is a most important points-scoring criterion in carcass competitions and it should be assessed as accurately as possible. Current methods of estimating percentage saleable beef, using a fat thickness measurement and carcass weight, are unlikely to rank similar carcasses in order of merit because of the influence of genotype on beef yield.

Since the carcass composition of entries in a competition tends not to vary widely, bone-out assessments appear to be the most reliable technique of estimating saleable beef yield.

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