New Zealand beef export carcass grading

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ABSTRACT

The saleable meat, bone and trimmed fat content was measured on the sides of 643 steer, 273 heifer and 1086 bull carcasses. Saleable meat yield declined from approximately 70% in grade M to 59% in grade T for steers and heifers, while fat trim increased from approximately 8% in grade M to 25% in grade T. Carcass saleable meat yield in bulls was almost constant (72.6 ± 0.6%) regardless of weight. The fat grades of the current New Zealand beef grading system, although based on visual assessment of fatness, appear to be functioning as a meat yield grade system. The only anomaly in the system is the incomplete introduction of conformation in the P fat grade which results in poor conformation P fat grade carcasses being graded in the fatter G grade.

Keywords Grading; steers; heifers; bulls; carcass composition

INTRODUCTION

Carcass grading systems should describe carcasses from both a compositional and economic point of view (Brannang, 1976). The New Zealand beef industry requires an accurate description of carcasses because the majority of beef is purchased, unseen, on a carcass weight and grade basis (Nicol, 1976). At present there is an export carcass grading system which has 6 fatness grades (M, L, P, G, T and E) and 2 conformation grades within fat grade L (1, well muscled, compact; 2, poorly muscled, leggy; New Zealand Meat Producers Board, 1975). Only carcasses of conformation grade 1 are placed in the P grade. These fat and conformation grades are determined by visual assessment.

The export grading system should form the basis for rewarding farmers by fairly reflecting consumer requirements back to the producer. The New Zealand Meat Producers Board ensures the maintenance of consistent standards within the grading system while the price / kg hot carcass weight is fixed by Freezing Company schedules.

Since the introduction of the larger European beef breeds into New Zealand in the early 1970s there has been continuing concern that the grading system does not identify the high-meat yielding carcasses produced from these breeds. At the Ruakura Research Abattoir a routine beef system has been set up which measures the saleable meat yield (90% visual lean), fat trim and bone of beef carcasses broken down into standard retail joints. The present study examines data derived from the Routine Beef System to determine the relationships between saleable meat yields and carcass grades for steers and heifers and meat yield and weight for bulls.

TABLE 1 Numbers and sex of animals slaughtered each year.

	Years					Total
	1981	1982	1983	1984	1985	
Bull	52	243	452	179	160	1086
Steer	8	125	140	201	169	643
Heifer	4	105	26	81	57	273
						2002

MATERIALS AND METHODS

A total of 2002 cattle were slaughtered over the period 1981 to 1985 (Table 1) and the steer and heifer carcasses assigned to an export grade by the senior grader from the AFFCO Horotiu Freezing Works. The left half of each carcass was quartered at the 10th rib and the subcutaneous fat depth E measured (Recommended Procedures, 1965). The side was then commercially jointed and each joint separated into boneless meat, bone and trimmed fat approximating to the New Zealand Meat Trade Guide, produced by the New Zealand Meat Producers Board (1975). The weights of the components within joints were summed to give total side saleable meat, bone and trimmed fat.

Analysis of variance was used to test for differences between grades, within steers and heifers, in the proportions and weights of saleable meat, trimmed fat and bone. The differences in composition between steers and heifers within a grade were examined by analysis of variance and covariance, with hot carcass weight as the covariate. As bulls were not graded on the basis of fat cover the relationship between saleable meat yield and carcass weight was examined by regression. For the steer and heifer data the relationship between saleable meat yield (dependent variate) and subcutaneous fat depth E (independent variate) was also examined by regression.

RESULTS

The percentage of saleable meat in both heifers and steers (Table 2) declined in a curvilinear fashion as carcass grade changed from M to E. Highest yields of saleable meat occurred in grades M and L1, 69 to 70%, approximately 3.5 percentage units more than grade P and 6.5% units more than steers and 8% units more

TABLE 2 Numbers, hot carcass weights (kg) (HCW) and % of meat, trimmed fat and bone in the half carcasses of heifers and steers classified by fatness grade.

	Fat grade						
	M	L1	L2	P	G	T	E
Heifers							
No.	10	44	8	184	16	9	2
HCW	161	203	182	214	262	311	315
Meat %	70.5	69.7	67.7	67.2	62.6	57.9	58.9
SE	0.9	0.3	1.3	0.2	0.9	0.6	
Fat %	7.3	9.5	10.3	13.3	21.0	27.1	26.2
SE	0.6	0.2	1.3	0.2	1.3	0.7	
Bone %	21.3	20.1	21.4	19.0	15.6	13.8	13.6
SE	0.5	0.2	0.7	0.1	0.6	0.3	
Steers							
No.	41	124	55	330	91	2	
HCW	187	223	208	252	291	421	
Meat %	69.2	69.2	66.9	65.7	62.6	60.0	
SE	0.5	0.2	0.4	0.2	0.3		
Fat %	8.4	9.6	11.4	14.8	17.7	23.5	
SE	0.5	0.2	0.4	0.2	0.3		
Bone %	22.0	20.3	21.2	18.9	19.3	16.1	
SE	0.4	0.1	0.2	0.1	0.2		

than heifers in grade G. The change in % saleable meat was brought about largely by a very rapid increase in carcass fatness rather than large changes in bone. From grade M to T, bone % declined 7.5 units in heifers and 5.9 units in steers. At the same time mean bone weight increased by 4.2kg in heifers and 11.0kg in steers. In contrast, weight of fat as expressed by fat trim increased from an average of 6.7kg in grade M to 25-27kg in grade P. In the fatter T grade, fat trim weight was over 40kg.

As carcass grade changed from M to E, carcass weight also tended to increase steadily in both steers and heifers. The pattern of decreasing meat yield with increasing carcass weight was not found with bulls (Table 3); rather, % saleable meat was nearly constant at 72.6 ± 0.59% from 160 to 345kg carcass weight. For a given carcass weight, the saleable meat yield of bulls was considerably higher than in steers or heifers, reflecting their much lower fatness. At 307kg carcass weight, the midpoint of the weight range for bulls (Table 3) and grade P steers (Table 2), saleable meat yields were 73% for bulls and 62.6% for steers. Bone content did not differ between bulls (19.1%) and steers (19.3%). Steers had an average 10.4% units more fat trim than bulls (steers — 17.7%; bulls — 7.3%).

When the proportions of carcass components were compared between steers and heifers within a

TABLE 3 Numbers, hot carcass weights (kg) (HCW) and % of meat, trimmed fat and bone in the half carcasses of bulls classified by weight groups.

	Weight group (kg)						
	to 195	196-220	221-245	246-270	271-295	296-320	321-345
No.	184	363	382	115	23	16	3
HCW	180	209	231	255	279	306	339
Meat %	71.9	72.3	72.5	73.2	73.4	73.0	72.0
SE	0.1	0.1	0.1	0.2	0.6	0.8	
Fat %	6.6	6.9	6.9	6.7	7.1	7.3	9.7
SE	0.2	0.1	0.1	0.1	0.5	0.8	
Bone %	21.0	20.2	19.9	19.5	18.8	19.1	17.7
SE	0.1	0.1	0.1	0.2	0.4	0.4	

TABLE 4 Comparisons of side weights (kg) and % of saleable meat, fat trim and bone in steers and heifers adjusted within fat grades to hot carcass weights of 210 (L1), 198 (L2), 230 (P) and 275kg (G).

	L1			L2			P			G		
	Steer	Sig. of difference	Heifer	Steer	Sig. of difference	Heifer	Steer	Sig. of difference	Heifer	Steer	Sig. of difference	Heifer
Meat%	69.5	ns	69.8	67.0	ns	67.4	65.9	***	66.9	62.6	ns	62.3
Fat %	9.6	ns	9.4	11.3	ns	11.2	14.4	ns	14.0	17.6	***	21.4
Bone %	20.3	ns	20.2	21.1	ns	20.9	19.1	***	18.6	19.3	***	15.5

grade (Table 4) there was no effect of sex on meat yield for grades L1 or L2 and only small, yet significant effect, in grades P and G when the effect of carcass weight was removed. In grade P, heifers had 1.04% units more saleable meat than steers while in grade G, heifers had 3.82% units more trimmed fat. These differences between sexes, particularly in grade G, may be partly a reflection of the unbalanced sample size, but are also a result apparently brought about by variation in bone content.

On average, saleable meat yield in steers declined from 69.6% in grade L1 to 67.2% in grade L2, 66.4% (grade P) and 62.4% in grade G, a drop of 7.2% units within the commercially most important and numerically most common grades (New Zealand Meat Producers Board, Annual Report, 1985).

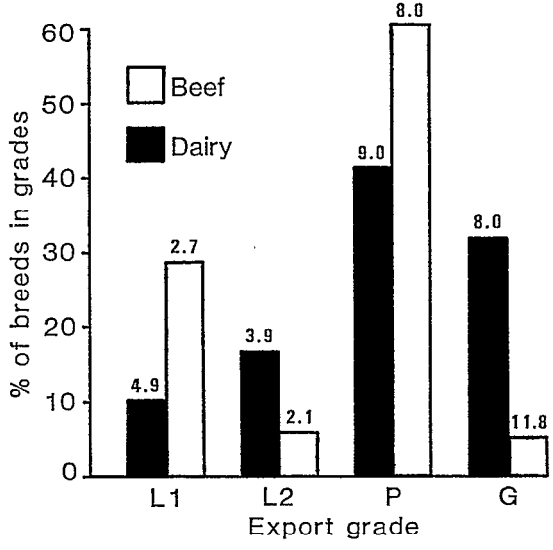

FIG. 3 Distribution of steers from dairy and beef sires within export grade and carcass fat depth.

The distribution of breed types (dairy or beef) in the L1, L2, P and G grades is shown in Fig. 1 together with the mean fat depth E for the steer carcasses. Within the predominantly beef breeds, fat depth E increased steadily from an average of 2.4mm in grade L to 11.8mm in grade G, while 60% of all the carcasses sampled within these grades fell into grade P, 34% in grade L (L1 and L2) and only 6% in grade G. Within the predominantly dairy breeds the same pattern of fat depths and distribution of carcasses between grades did not occur. There was less of the sample in grade L1 (approximately 10%, compared with 28% for beef breeds) though average fat depth E was greater than for the corresponding L1 beef carcass. In grade L2 the opposite occurred, with the dairy-type carcass occurring more frequently than the beef-type, while fat depth E was still greater for the dairy-type. In grade P, fat depths were similar for dairy and beef-type carcasses, but only 41% of the dairy-type were graded P. The greatest differences between breed type distribution and mean fat depth occurred in grade G. Contrary to expectation, in the G grade, fat depth of the dairy breed carcasses did not increase and remained within the expected levels of the P grade (8mm), which was 3.8mm less than for the beef breeds, whilst the proportion of dairy breed carcasses in the G grade was 5 times that of the beef type (31% *v* 6%).

DISCUSSION

A major criticism made of the New Zealand Export Grading System by some sectors of the beef industry was that it did not reflect the saleable meat yield of a carcass. Data from this study, based on 916 steers and heifers classified by grade, show quite clearly that the present system is essentially a yield grade system. As grade changes from M to G, the range into which 95% of carcasses fall, saleable meat yield changes at an increasing rate. The difference between M and L1 was, on average, 0.3% units saleable meat, while between grades P and G the difference was 3.9% units. This can be explained by the increasing fat content of the carcass associated with the greater average weights of carcasses in grades P and G compared with M. The dominant effect of weight on saleable meat yield was also evident within the bull data but there was a linear relationship between weights (kg) of saleable meat in the left side (Y) and of hot carcass (X), described by the equation;

$$Y = -2.87 (\pm 0.61) + 0.364 (\pm 0.003) X;$$
$$RSD = 2.65; r = 0.97$$

An unexpected result in this study was that heifers and steers had similar yields of saleable meat at the same adjusted hot carcass weight within a grade. However this conclusion is only valid over a specific weight range because the analyses have also, indirectly, included fatness, having been made within a grade. When the data are examined without regard to grade there is a linear decline in saleable meat yield with increasing fat depth and this relationship is almost identical for both sexes, the slopes of the 2 lines being parallel. However, within the data of this study heifers tended to have lighter carcasses for any given fat depth, and fat depth increased at a faster rate with increasing carcass weight in heifers than in steers. Thus at a given fat depth, steers will tend to have heavier carcasses. The importance of carcass weight in influencing fatness and meat yield, particularly at heavier carcass weights, has apparently been recognised by the freezing works. In a recent freezing works schedule (AFFCO 11/1/86) steers and heifers were valued at the same price (c/kg) within a grade at any particular weight, up to 270kg. However, given that the relationship between carcass yield and fat depth was the same in both heifers and steers the discount on heifers above 270kg does not appear justified.

A major problem associated with payment in the New Zealand grading system is its stepwise nature, particularly as there are large price differentials between grades and between weight ranges within grades. Individual producers may be concerned about the accuracy of such a system when the boundary between 2 grades is not strictly defined. Given the usefulness of fat depth in describing saleable meat yield, it may be possible to devise a continuous grading system based on fat depths, carcass weight and possibly shape. Premiums could be set by individual purchasers to suit their own particular market requirements. It is highly likely that such systems will become an integral on-line part of a freezing works operation given the rapid development of data-handling systems and the need to reduce operating costs.

Although the New Zealand export grading system is essentially a yield-grade system there is an anomaly brought about by the use of a conformation grade within the L and P fatness grades. Within grade P, carcasses of poor conformation (class 2) are placed in grade G and this causes a distortion in the expected distribution pattern between classes based on fat depths. It may partly explain the big drop in saleable meat yield in grade G compared with P although fatness and conformation are confounded.

The major concern at present is to clearly define grades in terms of saleable meat yields, and this appears to be well described by changes in fatness. However, carcass shape does appear to have an influence. This is in line with other data in New Zealand (Bass *et al.*, 1981, 1982) and the United Kingdom (Kempster *et al.*, 1980) and implies that a more accurate grading system in the future may include a shape descriptor which is not confined to one fat grade.

This study has shown that the New Zealand export carcass grading system does describe carcasses in terms of saleable meat largely on the basis of a visual assessment of fat. The distribution of carcasses across grades, particularly in the steer sample (which account for 84.5% of the beef kill; NZMPB, 1985) was similar to that of the national kill. This suggests that the Ruakura data reflect the meat yields of animals slaughtered in commercial abattoirs. Setting aside the anomaly introduced by a limited assessment of conformation shape, saleable meat yield declines in a curvilinear fashion with increasing fatness. Because visual assessment is the basis of decision making there is probably some degree of overlap between grades. Although fatness is the major determinant of grade there are no implied differences in meat quality between carcasses of different grades within the New Zealand system.

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REFERENCES

Bass J. J.; Johnson D.L.; Colomer-Rocher F; Binks G. 1981. Prediction of carcass composition from carcass conformation in cattle. *Journal of agricultural science, Cambridge* **97:** 37-44.

Bass J. J.; Johnson D.L.; Woods E.G.; Moore R.W. 1982. Relationships of carcass conformation of cattle and sheep with carcass composition. *Proceedings of the New Zealand Society of Animal Production* **42:** 125-126.

Brannang E. 1976. Carcass scores, measurements and indices. *EEC seminar on criteria and methods for assessment of carcass and meat characteristics in beef production experiments.* Eds A.V. Fisher Commission of the European Communities Directorate General, Luxembourg: 121-132.

Kempster A.J.; Harrington G. 1980. The value of "fat corrected" conformation as an indicator of beef carcass composition within and between breeds. *Livestock production science* **7:** 367-372.

Nicol A.M. 1976. Beef grading in New Zealand. Proceedings of the Carcass Classification Symposium. Pub. Australian Meat Board, Sydney.

New Zealand Meat Producers Board. 1975. New Zealand Export meat grades. New Zealand Meat Producers Board, Wellington.

New Zealand Meat Producers Board, 1985. Annual report of the New Zealand Meat Producers Board, Wellington.

Recommended Procedures, 1965. Recommended Procedures for use in the measurement of beef cattle and carcasses. Agricultural Research Council, London, 18pp.