Weights of some body organs from cattle selected for high and low susceptibility to bloat

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ABSTRACT

Selection for and against susceptibility to bloat in herds of Fresian-Jersey crossbred cattle at Ruakura has resulted in cattle of high (HS) and low (LS) susceptibility. Forty one HS and 41 LS animals including 44 cows and 38 bulls were slaughtered between 1985 and 1987 and weights of carcass components and some body organs measured.

LS animals had a significantly higher proportion of bone weight and lower eye muscle area, proportions of hind-quarter weight and saleable meat in the carcass than did HS animals. This was offset by a 14% heavier hot carcass weight (HCW) in LS animals. Weights of heart and kidney, adjusted for HCW, were higher and those of mandibular glands were lower, for LS than HS animals. There were no differences between HS and LS herds in adjusted weights of liver, lungs and parotid glands.

Keywords Cattle; bloat; carcass; body organs.

INTRODUCTION

Selection for and against susceptibility to bloat in 2 herds of Friesan-Jersey crossbred cattle since 1972 has resulted in animals of high (HS) and low (LS) susceptibility. LS cows are heavier than HS cows and tend to be taller with smaller ratios of rib girth to heart grith (C.A. Morris and V.R. Carruthers, unpublished). LS cows may produce more saliva than HS cows (Mendel and Boda, 1961) or produce saliva at a higher flow rate (McIntosh and Cockrem, 1977), suggesting differences in activity and/or size of salivary glands. To assess whether the selection programme has resulted in any anatomical characteristics that differ between HS and LS cattle, cows and bulls culled from the 2 herds from 1985 to 1987 were slaughtered at Ruakura and the weights of some body organs and carcass components measured.

MATERIALS AND METHODS

Forty one HS and 41 LS animals, comprising 44 cows and 38 bulls, were slaughtered over 7 kill days between June 1985 and May 1987. The susceptibility herd, sex, age and pregnancy status of animals are summarised in Table 1. The proportions of Friesian genes in the HS and LS groups were 0.38 and 0.42 respectively. Prior to slaughter each animal was weighed off-pasture (full live weight) and after 12 to 16 h fasting (pre-slaughter live weight, PSW). The difference between these weights was taken as the fasting weight loss. At slaughter the hot carcass weight (HCW), heart, lungs, liver, kidneys, full and empty reticulo-rumen and abosmasum, and foetus plus membranes if pregnant were weighed. The PSW of pregnant animals was adjusted by subtracting the weight of foetus plus membranes, to give a PSW comparable to non-pregnant animals for use in subsequent calculations. The eye muscle area at the 12-13th rib was measured and the left hind quarter was weighed. The weights of saleable meat, bone and trimmed fat were measured in the left side of each carcass according to the New Zealand commercial system (Everitt and Jury, 1964) after removal of perinephric and retroperitoneal fat. The parotid and mandibular salivary glands were dissected and weighed from the right side of the head in 33 cows and from both sides in the remaining 49 animals.

Dressing out percent was calculated as HCW/PSW x 100. The data were analysed using least squares analysis of variance with the susceptibility herd, age and sex as fixed effects. Sex was confounded with kill day. Pregnancy status was included in analyses of organs for cows. Organ weight data, fasting weight loss, weight of digesta and eye muscle area were adjusted by covariance for HCW. In the absence of interactions the data were combined for all animals per susceptibility herd.

RESULTS

Full live weight, pre-slaughter live weight and hot carcass weight were 11, 12 and 14%, respectively,

TABLE 1 The number of animals of high (SH) and low (LS) susceptibility to bloat in each sex and age group.

Sex	Age (years)	Herd HS	Herd LS
Cows	2	3	4
	3+	20[1]	17[2]
Bulls	1	14	15
	2	4	5

[1] Includes 14 pregnant cows.
[2] Includes 12 pregnant cows.

higher in LS than HS animals (Table 2). There were no differences between susceptibility herds in dressing out percentage, in change in weight during fasting or in the weight of the contents of reticulo-rumen and abomasum at slaughter when these were adjusted for HCW (Table 2). Compared with HS animals, LS animals had significantly lower weight of left hind quarter and saleable meat, and a higher weight of bone, when expressed either as a percentage of left side weight (LSW) or by regression with HCW. There was no difference between susceptibility herds in weight of trimmed fat as a percentage of LSW. Eye muscle area adjusted for HCW was smaller for LS than HS animals (Table 2).

The weights of the heart and kidneys (adjusted for HCW) were higher for LS animals than HS animals (Table 3). There were no differences between susceptibility herds in adjusted weights of liver and lungs.

The left and right mandibular glands (adjusted for HCW) were heavier in HS animals than in LS animals (Table 4), but there were no differences between susceptibility herds in adjusted weight of parotid glands. In animals where glands from both sides were weighed, the right mandibular gland was significantly heavier than the left mandibular, but there was no difference between sides in the weight of parotid gland.

TABLE 2 The pre-slaughter live weight, hot carcass weight, dressing out percentage, digesta weight and carcass composition of animals of high (HS) and low (LS) susceptibility to bloat.

Trait	Herd		Difference		
	HS	LS	LS-HS	SE	Signif.
Pre-slaughter weight (kg)	317.8	357.1	39.3	9.1	***
Hot carcass weight (kg)	167.7	191.6	23.9	5.9	***
Dressing out percentage	52.3	53.1	0.8	0.6	NS
Fasting weight loss (kg)[1]	19.4	20.0	0.6	1.1	NS
Digesta weight (kg)[1]	20.6	24.0	3.4	1.8	†
Weight of left side (LSW)(kg)	83.6	95.6	12.0	2.9	***
Weight of left hind quarter (% of LSW)	48.9	48.2	-0.7	0.3	*
Weight of saleable meat (% of LSW)	70.5	68.7	-1.8	0.5	**
Weight of bone (% of LSW)	20.2	21.0	0.8	0.4	*
Weight of trimmed fat (% of LSW)	8.8	9.8	1.0	0.7	NS
Eye muscle area (cm^2)[1]	60.4	54.2	-6.2	3.2	†

[1] Adjusted for HCW

TABLE 3 Weight (kg) of some body organs from animals of high (HS) and low (LS) susceptibility to bloat adjusted for hot carcass weight.

Organ	Herd		Difference		
	HS	LS	LS-HS	SE	Signif.
Heart	1.51	1.62	0.11	0.05	*
Liver	5.01	5.06	0.05	0.13	NS
Kidneys	0.93	0.98	0.05	0.03	†
Lungs	3.43	3.40	-0.03	0.14	NS

TABLE 4 The weight (g) of parotid and mandibular salivary glands from animals of high (HS) and low(LS) susceptibility to bloat adjusted for hot carcass weight.

Trait		Herd		Difference		
		HS	LS	LS-HS	SE	Signif.
Parotid	Left	115	109	-6	4	NS
	Right	113	114	1	5	NS
Mandibular	Left	110	94	-16	4	***
	Right	121	110	-11	5	*

DISCUSSION

The percentage difference in live weight and carcass weight measured between HS and LS animals is consistent with the difference in live weight observed throughout the breeding programme (Carruthers and Morris, 1987). This may be partly explained by differences between susceptibility herds in live weight of founder sires and dams, but may also reflect a correlation between weight and susceptibility. A negative relationship between live weight and susceptibility scores of individual animals exists within, as well as between, susceptibility herds (C.A. Morris, unpublished). The proportions of Friesian genes in the HS and LS animals were similar and therefore the differences in weight between herds were unlikely to have been due to breed effects.

The mandibular glands from LS animals were lighter than those from HS animals, with no difference in parotid weights. Glands from the right side were heavier than those from the left side. In contrast, Gurnsey *et al.* (1977) reported that salivary glands were heavier for LS than for HS animals and suggested that this contributed to the higher flow rate observed in their LS animals, although it was not stated to which glands they referred. In sheep the weight of the parotid gland has not been shown to be correlated with 24 h production of saliva (Kay, 1960), but there is a lack of data on total saliva production or flow rate and gland size in cattle. Gurnsey *et al.* (1977) also found that the glands from the left side were heavier than those from the right, particularly for the parotid. Birtles (1981) found considerable variation in weight of gland between left and right sides both within and between cattle. The standard deviations for weights of parotid and mandibular glands in this study were 13 to 18 g and, after allowing for differences in live weight, were similar to those obtained by Birtles (1981). Higher

flow rates of saliva in LS cows were also observed by Mendel and Boda (1961) and McIntosh and Cockrem (1977), although the latter result was not consistent throughout the HS-LS breeding programme (Cockrem *et al.*, 1983). The importance to bloat of flow rate measured at specific times as opposed to total daily saliva production has not been investigated. Lack of saliva measurements on the slaughtered animals precludes clarification as to whether the amount of secretory tissue may contribute to a higher production of saliva in LS animals.

The weight of digesta in the reticulo-rumen and abomasum (adjusted for HCW) was greater for LS than HS animals. In contrast, previous studies with 8 rumen-fistulated cows found that LS cows had proportionately less digesta in the reticulo-rumen than did HS cows (Carruthers, 1986). The studies differed because the weight of abomasal contents was included for slaughtered animals, although this appears unlikely to be important as it is a relatively small proportion of digesta weight. In both studies the weight of digesta was estimated after a period of fasting, but the food intake prior to fasting was not measured in the slaughtered animals. Food intakes of fistulated cows were similar on a live weight basis.

The greater proportional content of saleable meat in HS animals compared with LS animals may be commercially significant in future, but is offset by the greater carcass weight of LS animals. At present the farmer is not paid fully for differences in carcass composition (Butler-Hogg *et al.*, 1988). The LS carcasses were 24 kg heavier and contained 11.2 kg (9.5%) more saleable meat than HS carcasses and were thus worth more in the present payment system.

The inconsistency between experiments involving HS and LS animals has highlighted the difficulties in identifying differences between HS and LS animals which could be used as markers to indicate susceptibility.

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REFERENCES

Birtles M.J. 1981. Histochemical studies of the secretory processes in bovine salivary glands. M.Sc. thesis. Massey University. .

Butler-Hogg B.W.; Morris C.A.; Baker R.L.; Bass J.J.; Mercer G.; Duganzich D.M. 1988. The influence of breed on the meat content of carcasses within each of the NZ beef export grades. *Proceedings of the New Zealand Society of Animal Production* **48**: 57-60.

Carruthers V.R. 1986. A study of the digestion and metabolism of dairy cows differing in susceptibility to bloat. D. Phil thesis, University of Waikato.

Carruthers V.R.; Morris C.A. 1987. Breeding for low susceptibility to bloat in cattle. *Proceedings of the 4th Animal Science Congress of the Asian-Australian Association of Animal Production Societies.* Hamilton. p.150.

Cockrem F.R.M.; McIntosh J.T.; McLaren R. 1983. Selection for and against susceptibility to bloat in dairy cows — a review. *Proceedings of the New Zealand Society of Animal Production* **43**: 101-106.

Everitt G.C.; Jury K.E. 1964. Implantation of oestrogenic hormones in beef cattle. IV. Effects of oestradiol benzoate plus progresterone on carcass composition and a comparison of methods of carcass evaluation. *New Zealand journal of agricultural research* **7**: 158-173.

Gurnsey M.P.; Reid C.S.W.; Jones W.T.; Birtles M.J. 1977. Salivary glands, total salivary flow rate and susceptibility to bloat. *New Zealand medical journal* **86**: 449 (Abstr.)

Kay R.N.B. 1960. The rate of flow and composition of various salivary secretions in sheep and calves. *Journal of physiology* **150**: 515-537.

Mendel V.E.; Boda J.M. 1961. Physiological studies of the rumen with emphasis on the animal factors associated with bloat. *Journal of dairy science* **44**: 1881-1898.

McIntosh J.T.; Cockrem F.R.M. 1977. Genetics of the susceptibility to bloat in cattle. II. Preliminary results from saliva samples from cows of high and low susceptibility. *New Zealand journal of agricultural research* **20**: 263-268.