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Rumen digesta and other body measurements in relation to bloat susceptibility in cattle

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ABSTRACT

Two herds with high (HS) or low (LS) susceptibility to pasture bloat have been selected divergently at Ruakura since 1972 using field bloat scores. The present paper continues studies on weights of rumen digesta, in 92 HS and 81 LS cull cattle experimentally slaughtered from 1985 to 1990. Traits recorded included pre-slaughter weight (PSW), hot carcass weight (HCW), the fresh weight, dry matter percentage (DM%) and dry weight of rumen digesta, weight of full abomasum and omasum, carcass composition, and weights of heart, liver, kidney and omental fat. In addition, pre-feeding and post-feeding girths at the last rib were obtained on 61 2- to 8-year-old cows in mid-lactation, as a possible predictor of variation in rumen contents and in bloat susceptibility.

The LS herd had a 10% greater PSW than the HS herd ($P<0.001$), and adjustments for body size were therefore made below to all traits from the abattoir except HCW and DM%. The fresh weights of digesta were similar in the two herds, but the DM% of digesta was 17% greater in LS than HS cattle ($P<0.001$). The weight of abomasum and omasum was 15% greater in LS than HS cattle ($P<0.001$), but there was no significant herd effect on fasting weight loss. Heart and kidney weights were 8 to 9% greater in LS than HS cattle. Ratios of rib girth to chest girth, in the absence of bloat, were not significantly different between herds at 1.172 ± 0.005 to 1.169 ± 0.006 in HS and LS cows before feeding, and respectively 1.284 ± 0.006 and 1.269 ± 0.007 after feeding. Within herds, the correlation of mean bloat score with pre-feeding rib girth/chest girth was 0.11 and with post-feeding rib girth/chest girth 0.15. Corresponding correlations of girth ratios with breeding values for bloat score (pooled within herd) were 0.26 and 0.27. These results suggest that digesta weight and abomasal weight deserve further study but that girths were not useful predictors of susceptibility.

Keywords Cattle, bloat, carcass, body organs, rumen, digesta.

INTRODUCTION

Selection for high (HS) or low (LS) susceptibility to pasture bloat in Friesian-Jersey crossbred cattle was begun at Ruakura in 1972. By 1988 a divergence of 0.91 units in bloat grade had been achieved (Morris *et al.*, 1991), equivalent to 1.86 genetic standard deviations. Various studies have described the search for indicators of susceptibility or for physiological traits correlated with bloat (e.g. Carruthers *et al.*, 1988, McIntosh *et al.*, 1988) from small numbers of intensively-monitored cattle. A larger study based on 82 animals at slaughter (Carruthers and Morris, 1988) suggested a difference between herds in the fresh weight of rumen digesta (after adjustment for herd differences in body size). The present analysis compared the herds for rumen digesta (fresh and dry weights) from 173 animals and included measurement of digesta dry weight and the weight of abomasum plus omasum plus contents. The weights of some body organs are reported, and an update on the carcass composition data from Carruthers and Morris (1988) is given.

In addition, following preliminary findings of McIntosh *et al.* (1988), pre-feeding and post-feeding girths at the last rib were tested as a predictor of bloat susceptibility and the weight of rumen contents.

MATERIALS AND METHODS

Live Weight and Abattoir Data

Cull bulls and cows from the HS and LS selection herds were slaughtered at the Ruakura experimental abattoir from June 1985 to April 1990, over 19 slaughter days. Overall, 173 cattle comprising 82 one- and two-year-old bulls and 91 mixed-age cull cows (92 HS and 81 LS) were slaughtered. This total included 75 of the 82 described by Carruthers and Morris (1988), the

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remaining 7 now being discarded for small numbers in a slaughter group.

Each animal was weighed off pasture (full live weight, FW), transported to the abattoir, and then weighed after a 12 to 16 h fast (pre-slaughter, fasted weight, PSW). A fasting weight loss was obtained as the difference between these weights. For pregnant cows, adjustments to FW and PSW were made before final analysis by subtracting the weight of foetus plus membranes. After slaughter, the hot carcass weight (HCW) and the weights of heart, liver, one kidney and omental fat were recorded, and meat, fat and bone weights were obtained from the dissected left side, as described by Carruthers and Morris (1988). A sample of digesta was collected from the reticulo-rumen for estimation of its dry-matter percentage (DM%), and the weight of all digesta in the reticulo-rumen was obtained by weighing it full, then empty. The weight of the full abomasum and omasum was also recorded.

Breeding values for bloat, obtained from repeated scoring on a scale of 0 to 4 units (range 1 to 10 scores per animal), were calculated for each animal assuming a heritability of 0.12 and a repeatability of 0.13, as described by Morris *et al.* (1991).

Girth Data

The girths of 61 cows aged 2 to 8 years from the HS and LS herds were measured on two occasions in mid-lactation in December 1984. Cows were taken off pasture at about 1600 h, fasted overnight, and chest girths (immediately behind the front legs) and rib girths (at the position of the last rib) were recorded at 0800 h and again at 1300 h after feeding on ryegrass-white clover pasture from 1000 h to 1300 h.

Statistical Analyses

Data were analysed using Genstat (1988). The live weight and abattoir data were from cattle allocated to slaughter groups such that slaughter date, age and sex were confounded, but cattle of both selection herds were represented in each group. Herd effects were therefore estimated from a fixed-effects model including herd and slaughter group, with or without hot carcass weight as a covariate. Effects for herd and age of cow were fitted in the analysis of the ratio of mean rib girth/ mean chest girth.

RESULTS

Live Weight and Abattoir Data

The mean breeding values for bloat in slaughtered animals were 0.48 and -0.28 in the HS and LS herds, respectively (s.e.d. 0.06, $P<0.001$).

Mean live and carcass weights, reticulo-rumen digesta weights and some body organ weights are summarised in Table 1. The FW, PSW and HCW were about 10% greater in the LS than the HS herd. The fasting weight loss (adjusted for HCW) tended to be larger for LS than HS animals, but the difference was not significant as this trait had a high (66%) coefficient of variation, compared with that for say PSW at 13%.

Weights of reticulo-rumen digesta were similar in both herds on a fresh weight basis, but there was a significantly higher DM content of digesta in the LS herd ($P<0.001$). The weight of the full abomasum plus omasum was 15% greater in LS than HS cattle.

The weights of heart and kidney (but not liver and omental fat) were greater in the LS than HS herds. Not shown are the weights and percentages of meat, bone and trimmed fat in the carcass. The herd effects were similar to those previously reported in a 47% subsample of these data (Carruthers and Morris, 1988), i.e. compared with HS cattle, the LS cattle had relatively less saleable meat (-1.6 percentage points), more bone (+1.3%), similar trimmed fat (+0.3%) and a smaller eye muscle area adjusted for HCW (-4.5 cm^2 or -8.9%).

Girth Data

Ratios of rib girth to chest girth averaged 1.172±0.005 and 1.169±0.006 for HS and LS cows before feeding, and 1.284±0.006 and 1.269±0.007 after feeding, respectively (neither herd difference significant), although there was no bloat observed on measurement days. Within herds, correlations of bloat score (means from 5 days when severe bloat was recorded) with girth ratios were 0.11 and 0.15 for pre-feeding ratio and post-feeding ratio, respectively. Corresponding correlations of girth ratios with breeding values for bloat score (pooled within herd) were 0.26 and 0.27.

TABLE 1 Live weights, carcass weight, reticulo-rumen digesta weights and some body organ weights from animals of high (HS) and low (LS) susceptibility to bloat.

Trait[a]		No.	HS mean	Difference LS-HS	SE	Signif.	RSD[b]
Full live weight		167	338	35.8	7.4	***	46.2
Pre-slaughter weight		167	325	33.0	7.2	***	45.0
Hot carcass weight		167	174	18.0	4.4	***	27.3
Fasting weight loss		167	12.7	2.4	1.5	NS	9.2
Digesta weight	: fresh	170	25.8	0.2	1.1	NS	6.4
	: dry	103	1.89	0.11	0.11	NS	0.51
Dry matter % of digesta		103	6.39	1.07	0.24	***	1.15
Weight of abomasum plus omasum		97	11.8	1.8	0.6	**	2.6
Weight of	: heart	170	1.52	0.12	0.03	***	0.19
	: liver	170	4.95	0.14	0.12	NS	0.67
	: kidney[c]	170	458	42	11	***	65
	: omental fat	121	2.18	-0.42	0.29	NS	1.44

*** $P<0.001$

[a] All variates except full weight, pre-slaughter weight and dry matter % were adjusted for hot carcass weight; all weights in kg (except kidney, in g)

[b] Residual standard deviation

[c] Single kidney

DISCUSSION

The herd differences in live and carcass weights of about 10% were consistent with previous findings (Carruthers and Morris, 1988). The remaining analyses therefore adjusted for the difference in body size. The fasting weight loss was similar in the HS and LS herds, as found earlier (Carruthers and Morris, 1988). The fresh weight of digesta did not differ between herds, although apparently LS cattle already had 3.4 kg more digesta than HS cattle ($P<0.10$) in the previous study. Dry digesta weights tended to be greater in the LS than HS herd, although not significantly so, but DM% for the LS herd was significantly greater than for the HS herd. Dry digesta weights were also greater in the LS herd in some previous experimental treatments (Carruthers *et al.*,1988). This indicated relatively more substrate for fermentation in the LS herd. Although the DM% of digesta was related to bloat susceptibility across herds, the correlation between breeding value for bloat and digesta DM% (using data adjusted for fixed effects including herd) was very small. Further study of the weight of full abomasum and omasum is also warranted because the adjusted herd difference was significant.

Cockrem *et al.* (1983, 1987) suggested that HS and LS cattle may differ in water metabolism. In several trials HS and LS cows have differed in the quantity of fluid in the reticulo-rumen and in digesta loss during fasting (Cockrem *et al.*, 1987; Carruthers *et al.*, 1988). The present results of a higher DM content and tendency for a greater fasting digesta loss in LS animals are consistent with earlier findings. This study also confirmed earlier results (Carruthers and Morris, 1988) that LS animals had greater heart and kidney weights than HS animals, but the physiological significance of this has not been established.

Although rib to chest girth ratios tended to be larger in HS than LS cows post-feeding, the within-herd correlations between girth ratio and breeding value for bloat were too small to be useful in the field.

In conclusion, digesta weight and abomasal weight deserve further study, but girth ratios were not useful as predictors of susceptibility to bloat.

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REFERENCES

Carruthers V.R.; Bryant A.M.; Cockrem F.R.M. ; McLeay L.M. 1988. Quantity of digesta in the reticulo-rumen of cows differing in susceptibility to bloat. *New Zealand Journal of Agricultural Research 31:* 111-119.

Carruthers V.R.; Morris C.A. 1988. Weights of some body organs from cattle selected for high and low susceptibility to bloat. *Proceedings of the New Zealand Society of Animal Production 48:* 147-149.

Cockrem F.R.M.; McIntosh J.T.; McLaren R.D. 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.

Cockrem F.R.M.; McIntosh J.T.; McLaren R.D.; Morris C.A. 1987. The relationship between volume of rumen contents and genetic susceptibility to pasture bloat in cattle. *Animal Production 45:* 43-47.

Genstat 1988. Statistical Package: Genstat 5, Release 1.3. Lawes Agricultural Trust (Rothamsted Experimental Station, U.K.).

McIntosh J.T.; Morris C.A.; Cockrem F.R.M.; McLaren R.D.; Gravett I.M. 1988. Genetics of susceptibility to bloat in cattle. IV. Girth measurements, bloat scores, saliva proteins, blood components, and milk production, liveweight, and intake data. *New Zealand Journal of Agricultural Research 31:* 133-144.

Morris C.A.; Cockrem F.R.M.; Carruthers V.R.; McIntosh J.T.; Cullen N.G. 1991. Response to divergent selection for bloat susceptibility in dairy cows. *New Zealand Journal of Agricultural Research 34:* 75-83.