EFFECT OF LEVEL OF HANDLING ON MEAT QUALITY OF CATTLE OF TWO BREED TYPES

B.L. McINTYRE* and W.J. RYAN**

SUMMARY

In Phase I of this experiment, Kimberley Shorthorn steers approximately six months of age were subjected to either Experimental (intensive) or Commercial (minimal) handling treatments for a period of six months. One side of each carcase was electrically stimulated while the other remained unstimulated. In Phase II, a sample of 12 months old Kimberley Shorthorn steers remaining from Phase I and 9 months old Angus steers were subject to the same handling treatments for the next 12 months. Both sides of these carcases were electrically stimulated. Handling treatment had no significant ($P < 0.05$) effect on meat quality in either breed or in either Phase. In Phase I electrical stimulation had no beneficial effect on meat quality. An unusually high incidence of dark cutting meat of high ultimate pH was found in these animals. In Phase II Angus were significantly ($P < 0.05$) more tender than Kimberledy Shorthorns, but, after adjustment by covariance for fat thickness, this advantage was removed. (Keywords: cattle handling, muscle pH, meat quality).

INTRODUCTION

Procedures leading to the slaughter of cattle inevitably impose stress on the animal, the severity of which depends on factors such as the distance travelled, temperature, mixing of strange groups and temperament. (See reviews by Grandin 1980 and Lister et al. 1981). The stressors can be physical (e.g. exhaustion, illness) and psychological (fear, aggression) and can lead to a depletion in muscular energy reserves which results in high ultimate pH and dark cutting meat. In studying the effect of pH on tenderness, Bouton et al. (1983) reported a curvelinear relationship with maximum toughness in the pH range of 5.8 to 6.0.

To our knowledge no information is available on the effect that previous handling may have on such stress. It is possible that animals which have been handled frequently could be less prone to stress prior to slauqhter. Our own results (Ryan and McIntyre unpublished) have shown that meat was touqher from animals raised under extensive pastoral conditions than that from animals transferred to the more intensive agricultural areas. In addition there was a trend for tenderness to improve with increasing time spent by animals grazing in agricultural areas.

We therefore hypothesized that an increase in the level of handlinq improves meat quality throuqh a reduction of susceptibility to stress during the marketinq process.

MATERIALS AND METHODS

In Phase I, 72 Kimberley Shorthorn weaner steers of approximately six months of aqe were transferred in June 1982 by road transport from the East Kimberley pastoral area to the agricultural areas of the South-West of Western Australia. These animals were allocated randomly from within weight strata

* W.A. Department of Agriculture, Baron-Hay Court, South Perth, W.A. 6151.
** Department of Animal Science, University of Western Australia, Nedlands, W.A.

to three replicates of each of two handlinq treatments. Each group of 12 animals grazed a 10 ha paddock of improved pastures of subterranean clover (*T.* subterraneum) and ryeqrass (*L. rigidum*). The handlinq treatments were Experimental handling (EX); intensive handlinq, monthly yarding for weighing and ultrasonic backfat testing, weekly inspection of stock usinq a motor vehicle and Commercial handlinq (COM); minimal handlinq, weekly inspection of stock as above, yarding only when necessary for animal husbandry procedures.

Six animals from each replicate were slauqhtered in December 1982. Animals were yarded and weiqhed in the afternoon of day 1 loaded and transported by truck (approx. 140 km) on day 2, and slauqhtered on day 3. One side of each carcase was electrically stimulated (800 volts RMS; 14.3 pulses per sec for 90 seconds).

In Phase II, 36 weaner Angus steers (approximately nine months old) from the agricultural areas were included in the experiment in December 1982. These animals were allocated from within weight strata to two replicates of each handling treatment. The 36 remaining Kimberley Shorthorn steers were reallocated similarly to treatments corresponding with their previous handlinq treatment. These animals grazed until slauqhter in December 1983 and the same preslauqhter procedures applied. Both sides of these carcases were electrically stimulated.

Hot carcase weight (fats out, tail off) and fat thickness at the 12th rib were measured. Carcases were hunq in a chiller for three days at 2-3°C. Meat colour was visually assessed 45 minutes after quartering between the 10th and 11th ribs using reference colour photoqraphs. A sample of M. lonqissimus thoracis et lumborum posterior to the 11th rib was removed from each side of the carcase in the case of the cattle slauqhtered in December 1982 and from one side of each carcase in the followinq year. Samples were frozen at -18°C prior to quality assessments. Instron shear force and adhesion, taste panel evaluation, meat colour and pH were measured as described by McIntyre and Ryan (1984).

For Phase I the data were analysed as a split plot structure with handling treatment as the main effect and post-slaughter treatment as the sub-treatment . For Phase II, handling treatment and breed were treated as main effects. Paddock effects were removed and treatment effects tested aqainst between animal variation. Hot carcase weiqht and fat thickness were included as covariates in the analysis for Phase II.

RESULTS

In Phase I there was no difference in performance of the animals due to handling treatment with both qroups gaining approximately 120 kg in 150 days (see Table 1). Animals were very lean at the time of slauqhter. Neither handlinq treatment nor electrical stimulation had any siqnificant ($P < 0.05$) effect on meat quality assessments of shear force, adhesion and taste panel. There was a high incidence of dark meat of hiqh ultimate pH (71 and 46 per cent above pH 5.8 and 6.0 respectively). This was not affected by handling treatment or by electrical stimulation.

As shown in Table 2, the Anqus qained approximately 25 kg more than the Kimberley Shorthorns and also had greater carcase weiqht and fat thickness. There were no siqnificant ($P < 0.05$) differences in any of the meat quality characteristics due to handling treatment nor any siqnificant ($P < 0.05$) interactions. However, breed had a significant ($P < 0.05$) effect, with Angus having lower adhesion, hiqher taste panel score and liqhter meat colour than the Kimberley Shorthorns. When fat thickness was included as a covariate, only adhesion and meat colour remained significantly ($P < 0.05$) different between breeds.

Table 1 Live animal performance, carcase characteristics and meat quality of Kimberley Shorthorn steers slaughtered after Experimental (EX) or Commercial (COM) handling for six months

Handling treatment	EX (n = 18)		COM (n = 18)		LSD
Post-slaughter treatment	Stim	Not Stim	Stim	Not Stim	
Initial full liveweight (kg)	131		130		
Final full liveweight (kg)	248		246		
Hot carcase weight (kg)	120		118		
Fat thickness (mm)	1.0		1.2		
Shear force (kg)	3.78	3.70	3.28	3.52	0.630
Adhesion (kg)	0.35	0.34	0.34	0.31	0.052
Taste panel score (1)	4.33	4.41	4.62	4.30	0.502
Muscle pH	6.00	6.04	6.01	6.07	0.247
Meat colour score (2)	4.9	4.9	4.6	4.8	0.61

(1) Taste panel scores range from 1 = very tough to 6 = very tender
(2) Meat colour scores ranged from 1 = very light red to 6 = very dark

Table 2 Live animal performance, carcase characteristics and meat quality of Kimberley Shorthorn (KSH) and Angus (ANG) steers slaughtered after Experimental (EX) or Commercial (COM) handling for 18 and 12 months respectively

Handling treatment	EX		COM			Significance
Breed	KSH (n=18)	ANG (n=18)	KSH (n=18)	ANG (n=18)	LSD	(breed effect)
Initial full live weight (kg)	243	247	245	247		
Final full live weight (kg)	399	429	395	420		
Hot carcase weight (kg)	207	221	207	210	12.5	N.S.
Fat thickness (mm)	2.9	7.2	3.8	8.2	1.16	*
Shear force (kg)	4.60	4.36	4.28	4.12	0.562	N.S.
Adhesion (kg)	0.65	0.54	0.69	0.51	0.094	*
Taste panel score (1)	4.01	4.73	4.09	4.55	0.380	*
Muscle pH	5.65	5.62	5.66	5.65	0.086	N.S.
Meat colour score (2)	3.6	3.1	3.7	3.2	0.37	*
Means adjusted by covariance for fat thickness						
Shear force (kg)	4.51	4.42	4.21	4.22	0.712	N.S.
Adhesion (kg)	0.65	0.54	0.69	0.51	0.120	*
Taste panel score (1)	4.26	4.57	4.25	4.30	0.461	N.S.
Muscle pH	5.66	5.61	5.66	5.64	0.109	N.S.
Meat colour score (2)	3.6	3.1	3.7	3.1	0.47	*

* $P < 0.05$ (1), (2) See Table 1.

DISCUSSION

The results of this investigation have shown that an increased level of handling of cattle on farm did not result in improvements in meat quality. Also no reduction in level of susceptibility to stress was indicated from the ultimate pH levels in the meat from the two handling treatments. These findings were contrary to the hypothesis. The results do suggest that the kind of handling carried out in experiments does not effect quality and that results can be extrapolated to the commercial situation.

A notable feature of the results for the Kimberley Shorthorns in Phase I was the exceptionally high incidence of dark meat with high ultimate pH. This was well above the level we have experienced in cattle of similar age from the agricultural areas. However it was consistent with results of other studies with animals of that type from the pastoral areas (Ryan and McIntyre unpublished). It seems unlikely that the low levels of muscle glycogen necessary to produce such pH levels could have been due to physical stress. Even though the animals had very low levels of fatness, both groups had gained substantial amounts of weight during the experiment and the EX group at least were still growing during the period immediately before slaughter.

Although it cannot be determined from this study we suggest that the effect was due to psychological stress during the processes leading to slaughter arising as a consequence of the animal's environment in their first six months of life. Cattle raised under extensive pastoral conditions in the Kimberley have almost no contact with man so that they do not have the opportunity to lose their fear of man, his facilities and procedures, and are therefore highly sensitive in stressful situations. Even intensive handling in the initial six months in the agricultural areas was not sufficient to reduce this sensitivity to the extent that it no longer affected muscle pH. The normal pH values in the second year may indicate that the susceptibility to stress declined over time even with minimal handling.

The superior meat quality of the Angus compared with the Kimberley Shorthorns in Phase II was largely accounted for by their greater fatness. It is probable that the lower connective tissue strength of the slightly younger Angus cattle (indicated by adhesion values) was also a contributing factor.

The lower shear force and adhesion values of animals in Phase I compared to those in Phase II were consistent with younger animals having less connective tissue strength. The high pH in Phase I did not appear to have had a major effect on this general trend.

REFERENCES

BOUTON, P.E., CARROL, F.D., FISHER, A.L., HARRIS, P.V. and SHORTHOSE, W.R. (1973). J. Food Sci. **38**: 816.

GRANDIN, T. (1980). Int. J. Stud. Anim. Prob. **1**: 313.

LISTER, D., GREGORY, N.G. and WARRIS, P.D. (1981). In "Developments in Meat Science - 2", p. 61, editor R. Lawrie (Applied Science Publishers: London).

McINTYRE, B.L. and RYAN, W.J. (1984). Proc. Aust. Soc. Anim. Prod. **15**: 468.