

A SURVEY OF THE INCIDENCE OF HIGH pH BEEF MEAT IN VICTORIAN ABATTOIRS

R.D. Warner, T.G. Truscott, G.A. Eldridge and P.R. Franz,
Department of Agriculture and Rural Affairs, Animal Research
Institute, Werribee, Victoria, Australia, 3030.

SUMMARY

A survey of 8 Victorian abattoirs was conducted to determine the incidence of dark-cutting (DC) in prime carcasses. Each abattoir was visited at 2-3 month intervals over 1 year. Data on 3,850 beef carcasses weighing 120-270 kg with up to 20 mm of fat (12/13th rib) and up to 4 permanent incisors was analysed. A 1-2g sample of the muscle Longissimus dorsi was taken from the hot carcass and used to estimate ultimate pH (pHu) and the incidence of DC (pHu 5.8). The mean incidence of DC was 9.6% and varied significantly (1-16%; $P < .05$) between abattoirs; no "seasonal" effect was observed. The incidence of DC was significantly lower amongst consignments of cattle from feedlots ($P < .001$) and those that spent less than 2 days in lairage ($P < .01$). Provision of feed in lairage and transport distance had no appreciable influence. The ultimate pH of muscle was influenced by age ($P < .08$), sex ($P < .01$) and fat depth ($P < .001$) but not by breed or carcass weight.

INTRODUCTION

The quality of beef meat deteriorates if the ultimate pH (pHu) is above 5.8 (Tarrant 1981) and is often discriminated against by the retail trade because of its unacceptably dark colour. It is often described as dark cutting (DC) meat. The precise pHu value at which a carcass is deemed DC depends on marketing and processing factors and is in the range 5.8 - 6.3. Victorian buyers of beef carcasses tend to discriminate against meat with pHu 5.8 (T.Truscott unpublished data), so this value was used to identify DC carcasses in the survey.

The occurrence of DC is recognised as a problem by the meat industry in many countries and is generally associated with the many stressors which are applied to the animal between leaving the farm and slaughter at the meatworks. The incidence of DC beef carcasses has been subjectively estimated as 7% in Victoria (Hudson and Warner 1985) and 8% in Australia (Tarrant 1981). This survey was designed to quantify the incidence of DC (pHu 5.8) in prime beef carcasses in Victorian abattoirs and to examine the pre-slaughter management factors which may contribute to its incidence.

EXPERIMENTAL METHODS

Eight Victorian abattoirs were visited at 2-3 month intervals over 1 year and data was collected on 3850 beef carcasses with hot weights of 120 - 270 kg from prime quality beef cattle which had mandibular molars and no more than 4 permanent incisors. One days kill was sampled at each visit which except for the larger abattoirs (1, 3 and 7; Table 1), represented all carcasses that fitted the above criteria. A pre-rigor sample of meat (1-2 g) from the M. Longissimus dorsi of each carcass was stored in liquid nitrogen and later used in a freeze-thaw

technique to estimate the ultimate pH (Warner et al. 1986).

Data collected on the cattle and their carcasses included breed, dentition, hot carcass weight, fat depth at 12/13 rib, sex, origin (feedlot, farm, saleyard or other), distance transported, time in lairage and access to feed in lairage. All abattoirs were not represented in each 3 month period of the study, thus the year was split into 4 "seasons" for statistical analysis; viz. September 1985 to early January 1986, late January to March 1986, April to early June 1986 and late June to September 1986. All abattoirs were visited in each of these "seasons".

Data from 3,850 animals, 180 consignments and 40 abattoir visits was analysed in an unbalanced nested design of animal effects within consignment effects within abattoir visit effects. One abattoir was excluded at the animal and consignment level due to missing data. A generalised linear model was used to investigate the proportion of DC carcasses within each consignment and visit. Least squares analysis was used at the animal level to examine the effect of variables on the estimated pHu. The effect of higher level variables were absorbed at the animal level and removed at the consignment level.

RESULTS

The median hot carcass weight category was 180-189 kg within the overall range of 120-270 kg. The median fat depth was 6 mm over the range of 0-20 mm. The mean pHu was 5.470,25 with 9.6% of carcasses having a pHu 5.8 (dark cutting). Most cattle (90%) had less than 2 permanent incisors, 68% were steers and 32% were heifers. The predominant breeds were Hereford (44%) and Angus (18%) with the balance consisting of other British breeds and British cross-breds. There was less than 1% of animals of European breed.

Visit Level Analysis: The number of carcasses sampled at each abattoir ranged from 203 to 1576 (Table 1). Abattoir had a significant influence on the incidence of DC ($P < .05$). "Season" and its interaction with abattoir effects had no significant influence on the incidence of DC.

Consignment Level Analysis: There were significant effects of origin of the cattle ($P < .001$) and time cattle spend in lairage ($P < .01$) on the incidence of DC. Provision of feed in lairage (22% were fed) and distance transported (91% transported 500 km) did not influence the incidence of DC and there were no significant interactions between these effects.

Cattle from feedlots had a lower predicted proportion of DC ($P < .001$) than those from saleyard, farm or other sources (0.8%, $n = 415$; 8.3%, $n = 2714$; 12.2%, $n = 706$ and 21.9%, $n = 15$ respectively). Cattle which had spent the greatest time in lairage had the highest proportion of

Table 1: The predicted proportion (%) of dark-cutting (DC) beef carcasses for each abattoir.

Abattoir	1	2	3	4	5	6	7	8
DC Proportion(%)	16.0	8.0	11.2	1.1	5.2	8.3	7.8	3.8
No. visits	6	4	6	4	6	4	6	4
No. carcasses	1076	280	944	264	314	222	827	203

DC (day, 7.2%, n = 1281; 1-2 days, 7.4%, n = 2206; 2.5-3 days, 12%, n = 771; 3 days, 15.1%, n = 592).

Animal Level Analysis: Meat from heifers had lower pHu ($P < .01$) than meat from steers and young cattle (1 mandibular molar; 39% of total) tended ($P < .08$) to produce meat of a lower pHu. Fat depth at the 12/13 rib had a small but significant ($P < .001$) effect on pHu with each 1 mm decrease in fat depth increasing pHu by 0.007 pH units. The breed and carcass weight of the cattle had no significant effect on pHu.

DISCUSSION

The results presented provide an objective base for the comparison of the incidence of DC in Victoria with that in other countries and over time. The incidence of DC carcasses (9.6%, pHu 5.8; 6.3%, pHu 6.0; 4.0%, pHu 6.2) in this survey is higher than reported by Tarrant and Sherington (1980) in Ireland (3.2%, pHu 6.0) but similar to that reported by several other surveys eg. Fabiansson et al. (1984) in Sweden (3.4%, pHu 6.2) and confirms earlier subjective estimates (*viz.* 7%) by Hudson and Warner (1985).

Reasons for the large variation in the incidence of DC between abattoirs are not evident from the results of this survey, however there is a tendency for those abattoirs with higher throughputs to have higher incidences of DC (Table 1). The absence of an effect of "season" on DC contrasts with reports of Tarrant (1981) and Fabiansson et al. (1984). Our results indicate some factors that could be manipulated to reduce the incidence of DC in Victoria.

The low incidence of DC among carcasses from feedlot cattle agrees with the observations of Shorthose (1980) and is probably due to them being well-fed, more accustomed to handling and generally spending minimal time between loading and slaughter. On the other hand, the contrasting effects of origin of cattle (saleyard vs direct consignment) and time in lairage on the incidence of DC between the results of our survey and those and observations of Shorthose (1980) probably reflects the disparity in the meat industry between north and south-eastern Australia. Most cattle in Victoria are marketed through saleyards of which there are a large number located close to production areas. Thus in Victoria, both transport distances and time between mustering and slaughter for cattle are generally much shorter than in Queensland and consequently the effect of the additional time spent in the saleyard by cattle in Victoria is not reflected in an increased incidence of DC.

Similarly, extending the time spent in lairage under Victorian conditions would seem to result in an increase of the incidence of DC, this is contrary to the experience in Queensland where the incidence of DC is reduced by extending the time in lairage beyond 2 days (Shorthose 1980). The importance of limiting time in lairage has been demonstrated by others (Puolanne and Alto 1981).

Our results and those of Puolanne and Alto (1981) suggest that leaner cattle are more susceptible to DC and thus more care is required with these types of animals in the marketing process. We suspect that the low incidence of DC recorded in feedlot cattle and in young cattle may have resulted from these types being treated with additional care during lairage at the abattoir because of their relatively higher value.

It is concluded that the incidence of DC carcasses from prime beef cattle is sufficiently high to be of concern to the meat industry in Victoria and probably other parts of Australia. The large variation between abattoirs indicates that there is considerable scope to substantially reduce the overall incidence of DC amongst prime cattle.

ACKNOWLEDGEMENTS

Technical assistance provided by Mr D.J. Cahill and Mr M. Foote and advice from Mr C.G. Winfield is gratefully acknowledged. Funding was provided by the Australian Meat and Livestock Research and Development Corporation.

REFERENCES

- Fabiansson, S., Erichsen, I.E., Reutersward, A.L. and Malmfors, G. (1984) *Meat Science* 10:21
- Hudson, J.E. and Warner, R.D. (1985) Technical Series Report No.208, Victorian Department of Agriculture.
- Puolanne, E. and Aalto (1981) From "The Problem of Dark-cutting in Beef" (ed. D.E. Hood and P.V. Tarrant), Martinus Nijhoff Publishers, London. p.462.
- Shorthose, W.R. (1980) 3rd National Symposium on the Science and Technology of Meat, Buenos Aires, Argentina.
- Tarrant, P.V. (1981) From "The Problem of Dark-Cutting in Beef" (ed. D.E. Hood and P.V. Tarrant), Martinus Nijhoff Publishers, London. p.3.
- Tarrant, P.V. and Sherington (1980) *Meat Science* 4:289
- Warner, R.D., Eldridge, G.A., Truscott, T.G. and Cahill, D.J. (1986) *Proceedings of the Australian Society of Animal Production* 16:435.