KRD2:12

VENISON RESEARCH AND DEVELOPMENT

K.R. Drew
MAFTech Invermay Agricultural Centre
Private Bag, Mosgiel, N.Z.

INTRODUCTION

The production of New Zealand venison to fit the market can be looked at in a number of ways.

1. To target as much production as possible at the point of high seasonal demand.

2. To consider slaughter technology and packaging in extending shelf life of chilled venison.

3. To focus quality management on the most important sensory parameter - tenderness.

4. To direct attention at the important feature of selling packaged product - colour.

SEASONALITY OF VENISON PRODUCTION

In 1988 74% of our export venison went to Europe and more than half of that to West Germany (G.I.B., 1989). The traditional period of high demand for venison in Europe is in the early winter before and up to Christmas. High prices to farmers for deer slaughtered in September/October and early November have reflected demand. The recent research/industry forum identified the highest research priority "to produce a 55-60 kg carcass in the period August to October to enable exporters to sea-freight chilled venison to the lucrative pre-Christmas market". To achieve a 55-60 kg carcass it is necessary to meet a liveweight target of about 100 kg. With red deer this is extremely difficult to do by 1 November (Table 1) whether you are in the North or the South Island. In fact Table 1 shows that less than half of the red deer can be expected to reach 100 kg even by 15 months of age.

Some people have suggested that improved winter feeding of weaners will provide the answer to achieving a 100 kg target at 10-11 months of age. But the facts of winter inappetence indicate that there is a "ceiling" growth potential indoors on concentrates of about 160 g/d (Corson & Suttie, pers. comm.) and that excellent traditional winter management is capable of achieving 110 g/d in weaners - a gap of about 50 g/d. Over a 100 day winter an extra 5 kg of expensive growth will not make much impact in shifting 1 November weight from 80 to 100 kg.

The use of an elk cross breeding programme over red deer is a much more likely system in reaching 100 kg stag at the end of October. Elk/red hybrid (F1 or ½ bred) stags can be expected to reach 116 kg at 11 months of age (Table 1) and at least 105 kg by 1 October. The use of F1 stags to generate ¼ elk progeny can be expected to produce stags that reach 95-100 kg at the end of October but more information will be available on that topic during the next year.

TABLE 1: Stag liveweight in spring and late summer (kg)

	Spring (1 November)	Late Summer (mid February-1 March)
Red deer		
South Island - pasture[1]	80	94-101
North Island - pasture[2]	79	99
Feedlot - concentrate feeding[3]	85	106-116
Elk/Red hybrid		
South Island - pasture	116	145

[1] Moore et al., 1988
[2] Adam & Asher 1986
[3] Fennessy 1982

F1 AND RED DEER CARCASS CHARACTERISTICS

Comparison between F1 and red deer of similar carcass weights have been made. The F1 animals were slaughtered at 11 months of age while the red stags were 26 months old. Table 2 shows that the young F1 stags had heavier carcasses than the red deer which were more than twice as old. The red deer weights are similar to national industry statistics and are from a large number of animals from many commercial farms (n=53). The F1 animals had an average GR of 4.7 mm compared with 10 in the red deer and had proportionately more saddle and less neck and ribs. The lean, fat and bone content of the primal cuts is shown in Table 3. All F1 cuts had more lean than the older red deer and that is particularly significant in the valuable saddle cut where the boneless cuts can be worth more than $30/kg. Although all the deer were low in fat content, the red stags had 40% more fat than the F1's. The difference was most marked in the rib section which would make the F1 boneless venison from this cut attractive for sale.

TABLE 2: Stag carcass composition

	26 month old red deer	11 month old elk/red deer
n =	53	8
liveweight (kg)	110	116
hot carcass weight (kg)	63	68
cold carcass weight (CW) (kg)	61	66
dressing %	57	59
	kg (% CW)	kg (% CW)
saddle	8.6 (15)	11.8 (18)
hind leg	23.5 (39)	26.6 (40)
shoulder	11.4 (19)	12.9 (20)
neck	9.7 (16)	9.3 (14)
ribs	6.8 (11)	5.5 (8)
GR (mm)	10	4.7

It might be expected that the F1 carcasses coming from animals with a high mature body weight expectation would have proportionately more bone at a young age than the red deer. Table 3 shows that all primal cuts from the F1 carcasses were lower in bone content than those from red deer.

TABLE 3: Lean, fat and bone content of primal cuts

Primal cuts	Tissues as % primal cut weight					
	Lean		Fat		Bone	
	red*	elk/red*	red	elk/red	red	elk/red
saddle	69	74	7.3	3.9	24	22
shoulder	74	76	6.2	4.6	16	16
hind leg	77	79	5.2	3.5	21	21
neck	67	70	6.8	5.7	26	24
ribs	68	75	12.3	5.5	20	19
TOTAL	72.7	76.0	7.0	4.7	20	19

* red = 26 month old red stags CW = 63 kg n = 53
elk/red = 11 months old elk/red stags CW = 68 kg n = 8

CARCASS BACTERIOLOGICAL QUALITY

It is obvious that contaminated carcasses, whatever the quality of packaging system, will produce poor quality venison for export. The development of an inverted dressing system for deer hide removal provides the technology to greatly improve carcass bacteriological quality. Seman et al. (1989) measured the bacteriological quality of venison carcasses produced from two traditional deer slaughter premises and one plant using inverted dressing technology. Table 4 shows that plant A using an inverted dressing machine is producing almost sterile venison. Plants B and C on average produced high quality venison but the range in bacteriological count was high compared with plant A. A small proportion of contaminated carcasses may have adverse effects on the rest and will certainly cause marketing problems.

TABLE 4: Mean and range of the aerobic plate count of deer carcasses slaughtered at three locations (Seman et al., 1989)

Slaughter location*	Carcass site: Shoulder	Mid-loin	Leg
		($\log_{10}$ CFU/cm²)	
(A)	0.05 (0-1.04)	0.07 (0-1.30)	0.12 (0-1.20)
(B)	1.52 (0-4.73)	1.48 (0-3.20)	nd
(C)	0.99 (0-4.00)	1.32 (0-5.20)	0.85 (0-3.18)

nd = not determined
* Plant A uses inverted dressing
Plants B & C use traditional processing procedures

TENDERNESS

Much of New Zealand's export venison goes to the "white table cloth" hotel and restaurant business and the final consumer judges the quality of the venison in the cooked form. The most important quality of cooked meat is clearly recognised as tenderness and post slaughter management of the meat has the biggest effect. Low voltage electrical stimulation of carcasses soon after skinning is essential and failure to carry out the step adequately will increase toughness in the saddle cut by nearly 50% (Drew et al., 1988). Venison pH levels fall rapidly to less than 6.0 within 2 hours of slaughter when electrical stimulation is used and Chrystall & Devine (1983) concluded that such carcasses could be rapidly chilled 2 hours after slaughter without the risk of cold shortening. Meat can be tenderised by holding it for extended periods above freezing point. The effect is much greater as the holding temperature increases. When venison was held chilled at -1°C for 18 weeks, tenderness increased with time but only marginally (Seman et al., 1988).

PACKAGING SYSTEMS

Chilled venison is most commonly vacuum packed to extend the shelf life. Controlled atmosphere packaging (CAP) in which the meat is held in a controlled gas environment such as CO_2 has been researched at Invermay. Europe leads the world in this technology and 35% of all Denmark's retail meat trade uses CAP (Bruce, 1988). The Invermay work showed that vacuum packed venison loins resulted in meat of acceptable quality after 12 and 18 weeks of chilled storage and that CAP contributed no additional benefit (Seman et al., 1989).

COLOUR IN VENISON

One of the features of venison is its dark colour. Venison is very high in iron content, being almost three times that of lamb (Drew & Seman, 1987) and while this is nutritionally very desirable the meat is quite dark. Consumers of red meat in western countries purchase product largely on colour and appearance. Preferred meat is bright red. As the export volume of venison increases by a factor of four or five in the next 5 years it is apparent that quantities will be marketed on display shelves. When this happens colour will be a major factor in sales.

The use of CAP technology and the effect on colour acceptability and discoloration is shown in Table 5. Two packaging materials were compared with vacuum packing. Surface colour acceptability and discoloration scores at the point of opening were lower ($p<0.05$) in loins packaged in CO_2-UHB film than for meat packaged in either VP or CO_2-MPET. Once the packages are open and the venison displayed for sale, colour assessment of loin pieces decreased after only 6 weeks storage at -1°C from a value of 4.7 (on a scale where 5 = bright fresh red and 1 = extremely dark or brown) to 1.8 after 5 days of display (Seman et al., 1989). Similar trends were apparent after 12 weeks of storage and after 18 weeks colour scores were down to 2.3 after only 2 days of display. It was observed that venison slices stored 18 weeks had acceptable colour when sliced, but that the desirability of the colour deteriorated between the time of cutting and wrapping until the panel observed them 3 hours later having been held at 0-2°C in the interim. Unless marketing people can persuade venison consumers that dark colour = good quality rather than "dark cutter" beef much research effort will be needed to understand how to manipulate colour in chilled venison which has been stored for an extended period.

TABLE 5: Means of panel surface colour and colour acceptability scores by packaging method and storage time (Seman *et al.*, 1989)

	Packaging method			
	Vacuum (VP)	CO_2-UHB[1]	CO_2-MPET[2]	SED
Colour acceptability[3]				
Week 12	3.00	1.85	2.96	0.051*
Week 18	3.00	1.76	3.00	
Discoloration[4]				
Week 12	4.33	2.76	3.97	0.106*
Week 18	4.01	2.06	4.29	

1 100% CO_2 using ultra-high barrier outer film
2 100% CO_2 using dual aluminised polyethylene outer film
3 Scored using a 3 point scale (3 = purchase without reservation; 2 = purchase with reservation; 1 = would not purchase)
4 Scored using a 5 point scale (5 = bright fresh red venison colour; 4 = bright red venison colour; 3 = slightly dark or brown; 2 = moderately dark or brown; 1 = extremely dark or brown).
* $P<0.05$

CONCLUSIONS

* It is possible to achieve a target liveweight in stags of 100 kg in late October by using elk or elk hybrid sires.

* Elk/red (F1) carcasses at 68 kg (11 months old) are much leaner than comparable sized red deer carcasses (2 years of age) and with similar bone content.

* Inverted dressing procedures in deer significantly improve bacteriological quality when compared with traditional procedures.

* Venison tenderness is profoundly affected by post-slaughter treatment.

* Controlled atmosphere packaging of chilled venison is no better than vacuum packaging.

* Venison is a dark meat and the colour deteriorates very rapidly when exposed to the air after a long period of chilled storage.

REFERENCES

Adam, J.L. and G.W. Asher 1986. Proceedings of deer course for veterinarians 3:8-16.

Bruce, J.H. 1988. Proceedings 34th International Congress of Meat Science and Technology. p 670-672.

Chrystall, B.B. and C.E. Devine 1983. New Zealand Journal Agricultural Research 26:89-92.

Drew, K.R. and D.L. Seman 1987. Proceedings of the Nutrition Society of New Zealand 12:49-55.

Drew, K.R., S.F. Crosbie, D.A. Forss, T.R. Manley and A.J. Pearse 1988. Journal of Science Food and Agriculture 43:245-259.

Fennessy, P.F. 1982. In "The farming of deer", ed. David Yerex, Agricultural Promotion Associates Ltd p 105-114.

Game Industry Board Report 1989. p 6.

Moore, G.H., R.P. Littlejohn and G.M. Cowie 1988. New Zealand Journal Agricultural Research 31:285-291.

Seman, D.L., K.R. Drew, P.A. Clarken and R.P. Littlejohn 1988. Meat Science 22:267-282.

Seman, D.L., K.R. Drew and R.P. Littlejohn 1989. Journal Food Protection (in press).