QUALITY IN FARMED VENISON

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Tenderness in farmed venison is dramatically improved by electrical stimulation of carcasses shortly after slaughter. Holding carcasses at 10°C overnight before chilling or freezing, also have very beneficial effects on meat tenderness. These are two important conclusions drawn from recent work at Invermay.

It was said of sheep meats that the first shipment of frozen meat from Port Chalmers in 1882 would have provided better eating meat than that produced in 1960 when carcasses were being rapidly blast frozen. The reason is that meat which is chilled rapidly after slaughter is inevitably tough when cooked.

So what has this got to do with one of our exciting new growth industries - farmed venison? Since we are looking at placing farmed venison at the very high priced end of the meat market in those countries where we do not have an established venison trade it is essential that the consumer likes it as well as the product being hygenic. Meat tenderness is by far the most important consideration in eating quality and this is where the farmed venison industry needs to take advantage of the most modern technology and the best information on how to use it to advantage.

We have carried out a comprehensive set of experiments which were designed to investigate factors which might be important in relation to venison tenderness in one and two year old red deer stags.

Factors

* The effect of low voltage electrical stimulation.
* The effect of holding venison cuts at various temperatures and times.
* The shelf life of chilled venison held at -1°C.
* The effect of freezing and thawing.

Slaughter and processing conditions

Although the Invermay abattoir is not a licensed plant, it provides facilities which are equal to export standards. Deer were weighed off the farm, held overnight in covered yards and stunned at slaughter with a captive bolt pistol. Immediately after stunning the animals were hoisted, stuck and bled in a similar way to cattle. Carcass dressing was done on the rail with great care being taken to minimise dirt and hair contamination where the hide was opened up from the back legs. A mechanical hide puller removed the hide downwards from the back legs to the head. For reasons of hygiene, the knife was used as little as possible round the back legs, tail and flanks and the skin peeled off with the hide puller. After evisceration the carcasses from these experiments were weighed and then cut into primal cuts of leg and saddle for the various treatments. The saddles or loins were divided into several portions to provide product for ageing treatments. Tests were done on inner and outer portions of loin and these established that results derived from small loin pieces would likely apply to the uncut carcass. The time period between slaughter and carcass cutting was approximately 30 minutes.

Tenderness measurement

Tenderness was measured with a Warner-Bratzler machine which records the force in kg required to shear through a slice of meat cooked for 60 minutes at 80°C. Typical values range from 14 or 15 for very tough meat and 3 or 4 for very tender meat.

Carcass treatment

The danger of producing tough meat by chilling the carcass before the process of rigor mortis is completed is well known. In recent years it has been possible to use electrical current to accelerate the rigor process and avoid cold induced toughening. In the present experiments electrical stimulation (ES) with low voltage (80 v peak) was applied through a nose clip and one leg. Stimulation was done 30-60 seconds after sticking. Results are shown in table 1.

Table 1

The effect of electrical stimulation on meat tenderness (kg) in Red deer stags *

Age (months)	15		26	
Carcass treatment	Non-Stimulated	Stimulated	Non-Stimulated	Stimulated
Loin	10.6	5.3	11.7	6.0
Leg	6.2	4.1	4.8	4.2

* All carcasses held at 10°C for 2 hours post-slaughter and then 22 hours at 0°C.

Comments

* Stimulation was very effective in improving tenderness especially in the loin section.

* The loin pieces were generally tougher than the leg, possibly because the small pieces cooled more rapidly than whole legs.

* There were no detectable differences between age groups.

Significant improvements in meat tenderness can also be made by holding carcasses at about 10°C for 24 hours (conditioning) and further improvements are possible if carcasses are held at 2-4°C after conditioning (ageing). The following conditioning and ageing treatments were used on Red stag carcasses.

Designation	Treatment after slaughter
CA1	2 hours at 10°C, 22 hours at 0°C
CA2	24 hours at 10°C
CA3	24 hours at 10°C, 24 hours at 4°C
CA4	24 hours at 10°C, 72 hours at 4°C

The combined results of electrical stimulation and ageing and conditioning from 15 month old stags are shown in figure 1.

Comments

* Conditioning and ageing (CA) treatments progressively improved meat tenderness.

* CA effects were more marked in non-stimulated rather than stimulated carcasses.

* Similar results were obtained with 26 month old stags. There was a suggestion that CA4 produced more tender meat than CA3 in 26 month old stags and this was not apparent in 15 month old animals.

Effect of freezing and thawing on tenderness

Portions of venison cuts were frozen, stored at -18°C for 3 months, thawed at 4°C and then tested for tenderness. The results in table 2 show that freezing and thawing significantly improved tenderness.

Table 2

The effects of freezing and thawing on meat tenderness (kg) *

	Unfrozen	Frozen and thawed
15 months (leg)	5.1	3.7
26 months (leg)	4.4	3.8
26 months (loin)	5.7	4.9

* Data is averaged across all CA treatments and both non-stimulated and stimulated carcasses.

Comments

* Freezing and thawing improved tenderness by 14-27% compared with unfrozen meat.

* The effect was greatest in yearling deer, non-stimulated carcasses and in carcasses exposed to low temperature soon after slaughter.

Chilled venison

Modern sophisticated markets are more likely to respond to well packaged chilled venison than a frozen product when there is a high price tag. For this reason it is necessary to know how to prepare the highest quality product from the yards into the chiller and to know the shelf life. The two major factors in determining shelf life are bacteriological contamination and product tenderness. Both these factors were investigated at Invermay. Yearling stags were slaughtered without electrical stimulation and dressed under the strictest possible hygiene standards. After CA1 treatment (2 hours 10^{o}C/22 hours 0^{o}C) legs and loin portions were vacuum packed and held at -1^{o}C for up to 14 weeks. Every week samples of leg and loin were removed from the chiller, opened, bacteriologically tested and then cooked for tenderness measurement. Results showed that there were no significant amounts of Salmonella, Staphlococci or Clostridia bacteria during the 14 week period. The E. Coli organisms which are widely found in the environment increased a little during storage. Figure 2 shows the change in meat tenderness during the experiment.

Comments

* Both leg and loin pieces increased in tenderness during the first 7 weeks of chiller storage.

* In experiments not reported here non-stimulated loin portions from yearling stags given the CA1 treatment averaged a tenderness value of 10.4 one day after slaughtering; this figure in the present experiment has been reduced by half through 3 weeks of storage at -1^{o}C.

* Leg portions were generally more tender than loin pieces until about 10 weeks, when both cuts were of similar tenderness.

* It is possible that meat giving tenderness values below 3 is bordering on being over tender and "mushy". Investigations are needed to define this point.

* If overtenderness in chilled venison held for a long time in storage is a problem, it would be helpful to use a post-slaughter treatment which leaves the product in a relatively tough state going into storage (e.g. the CA1 treatment).

Conclusions and recommendations

Although much of this research work needs repetition and amplification results suggest that venison exporters have the tools to produce product to a tenderness specification. There will, however, always be variation between animals, particularly if some have shown more stress before slaughter than others so that meat quality will be somewhat variable whever the carcass treatment.

Unless product is to be held long term in a chiller, carcasses should be electrically stimulated and held overnight at about 10°C before cutting in order to produce tender meat. Ageing at 4°C for 24-72 hours will produce relatively tender meat from non-stimulated carcasses even when the latter has been chilled rapidly soon after slaughter. Previous work by Drs Chrystall and Devine from the Meat Industry Research Institute of New Zealand suggested that electrical stimulation of deer carcasses "enables hot cutting and boning of deer with minimal risk of toughening".

A surprise finding in our work was that frozen and thawed carcasses were more tender than those that were not frozen. Our results were complicated in that thawing was done slowly (18-48 hours) at 4°C and there may well have been some ageing occurring during thawing. Nevertheless, instructions to consumers to thaw venison slowly before cooking may be practical and will certainly improve tenderness. Advantage could be taken of these results as the exciting new development of portion cutting venison grows within the industry.

Where exporters have a market for chilled venison and provided that special care is taken during slaughter and carcass dressing to eliminate any dirt or hair contamination the product should have a life of at least 3 months. Long life chilled venison could be freighted by sea to anywhere in the Pacific basin and still have enough shelf life for ground transport and sale. It goes without saying that unless the meat remains continuously refrigerated during storage its useful life is limited. Perhaps the biggest problem with chilled venison is not the technology but the logistics of supplying widely separated hotels and restaurants with frequent orders for relatively small amounts of product.

The farmed venison industry has a unique opportunity to take up the most modern meat technology at the very start of its development and, if the concept of added value can be expanded, the New Zealand farmer and employment opportunities should both benefit.

Figure 2

TENDERNESS OF CHILLED VENISON DURING STORAGE

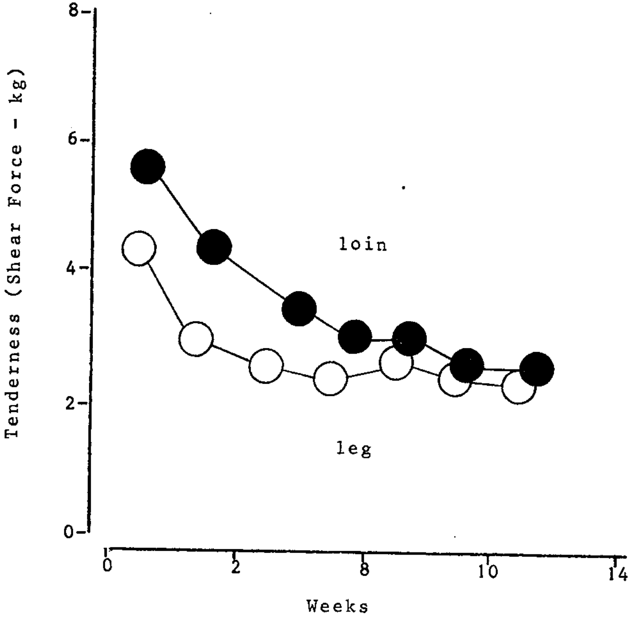

Figure 1

THE EFFECTS OF CONDITIONING AND AGEING ON MEAT TENDERNESS (LOINS)