BRIEF COMMUNICATION: Seasonal variation in venison drip loss and tenderness

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INTRODUCTION

Venison is a high quality product with several attributes attractive to consumers. It is tender, has low fat content, has a favourable fat composition and has high levels of minerals (Hoffman & Wiklund, 2006). However, New Zealand venison processors have indicated a seasonal variation in the amount of drip. Poor colour stability can also be a problem, sometimes even in vacuum bags when it can occur after extended storage of chilled product. The purpose of this study was to determine seasonal variation in drip loss and tenderness in venison.

MATERIALS AND METHODS

Animals

Sixty-four red deer (*Cervus elaphus*) stags that were less than two years old, were slaughtered at four different times of the year (Group 1, December, n = 17; Group 2, March, n = 8; Group 3, June, n = 20 and Group 4, September n = 19). Animal group was thus confounded with animal age. The animals were slaughtered at the Silver Fern Farms and Duncan Venison plants in Rotorua, according to normal slaughter practices. The loin muscles (*M. longissimus*) from the left side of the carcasses were collected at 1 day post slaughter, divided in four parts and randomly allocated to storage times of either one day, three weeks, nine weeks or 14 weeks at -1.5°C. Each sample was vacuum packaged and transported to AgResearch Ruakura for meat quality measurements and storage. Drip loss and tenderness were measured for the treated group at the end of its allocated storage period.

Drip loss and purge

Drip loss/water-holding capacity was measured using different methods. In the case of samples of fresh meat one day post slaughter, the Honikel bag method (Honikel, 1998) was used. Drip loss from samples exposed to a storage treatment was measured using a centrifuge method (Kristensen & Purslow, 2001). Purge in the vacuum bags was measured after three, nine and 14 weeks of storage. Loins were removed from their packages, dabbed dry with a paper towel and then weighed. Purge loss was calculated as the difference in the weight of the loins before and after vacuum packaging and storage, expressed as a percentage of the original weight of the loins.

Tenderness

Loins were cooked in bags submerged in boiling water until the internal temperature of the sample, measured by a thermocouple, reached 75°C. After cooking the samples were immediately cooled on ice. Ten 1 x 1 cm cross-section slices, equivalent to a human bite, were prepared from the cooked sample with the muscle fibres running longitudinally along the slice. Each sample was then sheared with the long axis of the fibres running perpendicular to the blade, using a MIRINZ tenderometer. The results were expressed as shear force (kgF).

Statistical analysis

Each variable at each observation time was analysed by analysis of variance, with month as the treatment term using the statistical package Genstat (Payne *et al*, 2008).

RESULTS AND DISCUSSION

Drip loss, purge and cooking loss

Drip loss in loin samples measured using the Honikel bag method at one day post slaughter was higher on average for Groups 1 and 3 than for the other groups (Table 1). At the subsequent storage times (3, 9 and 14 weeks) drip loss was measured as purge in the vacuum bags. At 3 weeks of storage Group 1 had the highest mean purge loss (Table 1). After 9 and 14 weeks of storage the mean purge for all groups was highest for Group 4 and lowest for Group 3. In all groups the mean purge was significantly greater than the values after three weeks of storage (Table 1). A clear trend of increasing average drip/purge over the storage period was shown for all four groups. Centrifuge drip was highest in meat from Group 1 at all storage times, except after 3 weeks of storage when Group 2 samples had the highest amount of centrifuge drip (Table 1). Over the storage period the amount of centrifuge drip tended to decrease in the loin samples from all four groups.

Purge in vacuum bags during long term chilled storage has been reported previously for venison, showing both lower (Wiklund *et al*., 2001) and similar (Wiklund *et al*., 2006) levels of purge loss compared with the present study. The increasing amount of purge loss over the storage period observed in this study agrees well with the earlier

TABLE 1: Mean value and standard error of difference (SED) for meat quality characteristics for red deer stags in the study.

Trait	Time from slaughter	Slaughter treatment				
		Group 1 (December)	Group 2 (March)	Group 3 (July)	Group 4 (September)	SED
Drip (%)						
	1 day	3.32^{a}	0.97^{c}	3.21^{a}	2.28^{b}	0.31
	3 week	3.76^{a}	2.46^{b}	2.69^{b}	2.74^{b}	0.40
	9 week	5.07^{ab}	4.20^{bc}	3.80^{c}	5.87^{a}	0.46
	14 week	4.93^{b}	5.07^{ab}	4.18^{b}	6.18^{a}	0.46
Centrifuge drip (%)						
	1 day	10.62^{a}	3.78^{bc}	1.93^{c}	4.19^{b}	0.70
	3 week	5.47^{b}	7.95^{a}	1.15^{d}	2.41^{c}	0.46
	9 week	3.94^{a}	1.73^{b}	0.67^{c}	0.98^{c}	0.25
	14 week	4.60^{a}	0.47^{b}	0.99^{b}	0.96^{b}	0.45
Shear force (kgF)						
	1 day	6.18^{b}	11.28^{a}	9.44^{a}	9.60^{a}	0.76
	3 week	4.06^{b}	5.18^{a}	3.94^{b}	4.90^{a}	0.27
	9 week	3.29^{b}	4.22^{a}	4.13^{a}	4.44^{a}	0.25
	14 week	3.34^{b}	4.31^{a}	3.87^{ab}	4.21^{a}	0.23

Means in the same row with different superscript letters are significantly different ($P \leq 0.05$).

mentioned venison studies. Drip loss measured with the Honikel bag method or as purge in vacuum bags represents water dripping out from the meat structure with minimum force applied to the meat sample, while the centrifugation method applies force to release water from the sample. The reason that centrifuge drip levels decreased over the storage period when the purge loss increased was probably related to the fact that after water already had been released as purge there was less water left to be released in the centrifuge test.

Tenderness

The loin samples from deer in Group 1 were tender at one day post slaughter and had consistently the lowest mean shear force values throughout the storage period (Table 1). Meat samples from the other groups tenderised significantly during the first three weeks of storage (Table 1). After three weeks there were only small improvements in tenderness for loin samples from all four groups. The final shear force values measured at 14 weeks post slaughter, which ranged from 3.3 to 4.3 kgF, all represent very tender meat. Shear force values similar to those found in the present venison loin samples have been reported previously (Wiklund *et al*., 2001; Farouk *et al*., 2007). Comparative studies have clearly shown that venison is very tender compared with beef one to three days post slaughter (Barnier *et al*., 1999; Farouk *et al*., 2007), as was also demonstrated at one day post slaughter in loin samples from deer in Group 1 in the present study. After three weeks of chilled storage and ageing time, loin samples from the deer in Group 2 were significantly tougher than all other samples. However, when the meat would reach the market in Europe or the USA at around six to seven weeks post slaughter, the difference in tenderness between samples from the different groups would be negligible.

The drip loss and shear force results recorded at one day post slaughter demonstrated that the very tender samples from deer in Group 1 also had the highest drip loss values. In addition, for loin samples from all groups, tenderness improved over the storage period to reach very low shear force values after 14 weeks of storage and was accompanied by a significant increase in purge loss. This suggests that there is a strong relationship between meat tenderness and drip loss.

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REFERENCES

Barnier, V. M. H.; Wiklund, E.; van Dijk, A.; Smulders, F. J. M.; Malmfors, G. 1999: Proteolytic enzyme and inhibitor levels in reindeer (*Rangifer tarandus tarandus* L) vs. bovine longissimus muscle, as they relate to ageing rate and response. *Rangifer* **19**: 13-18.

Farouk, M. M.; Beggan, M.; Hurst, S.; Stuart, A.; Dobbie, P.;Bekhit, A.E.D. 2007: Meat quality attributes of chilled venison and beef. *Journal of food quality* **30**: 1023-1039.

Payne, R.W.; Harding, S.A.; Murray, D.A.; Soutar, D.M.; Baird, D.B.; Welham, S.J.; Kane, A.F.; Gilmour, A.R.; Thompson, R.; Webster, R.; Tunnicliffe Wilson, G. (2008). GenStat Release 11 Reference Manual, Part 1 Summary. VSN International Ltd., Hemel Hempstead, Hertfordshire, UK.

Hoffman, L.C.; Wiklund, E. 2006: Game and venison – meat for the modern consumer. *Meat science* **74**: 197-208.

Honikel, K.O. 1998: Reference methods for assessment of physical characteristics of meat. *Meat science* **49**: 447-457.

Kristensen, L.; Purslow, P. 2001: The effect of ageing on the water-holding capacity of pork: role of the cytoskeletal proteins. *Meat science* **58**: 17-23.

Wiklund, E.; Sampels, S.; Manley, T. R.; Pickova, J.; Littlejohn, R. P. 2006: Effects of feeding regimen and chilled storage on water holding capacity, colour stability, pigment content and oxidation in red deer (*Cervus elaphus*) meat. *Journal of the science of food and agriculture* **86**: 98-106.

Wiklund, E.; Stevenson-Barry, J.M.; Duncan, S.J.; Littlejohn, R. P. 2001: Electrical stimulation of red deer (*Cervus elaphus*) carcasses – effects on rate of pH-decline, meat tenderness, colour stability and water holding capacity. *Meat science* **59**: 211-220.