EFFECT OF CARCASS SUSPENSION METHOD ON WATER HOLDING CAPACITY OF *M. LONGISSIMUS* FROM FALLOW DEER (*DAMA DAMA*) AND LAMB

Wiklund, E.[1, 2], Mulley, R. C.[2], Hutchison, C. L.[3] and Littlejohn, R. P.[4]

[1]Swedish University of Agricultural Sciences, Department of Food Science, P.O. Box 7051, 750 07 Uppsala, Sweden
[2]University of Western Sydney, School of Environment & Agriculture, Hawkesbury Campus, Penrith South DC NSW 1797, Australia
[3]University of Western Sydney, School of Science, Food & Horticulture, Hawkesbury Campus, Penrith South DC NSW 1797 Australia
[4]AgResearch, Invermay Agricultural Centre, Puddle Alley, Private Bag 50034, Mosgiel, New Zealand

Background

Quality assurance of deer meat (venison) is essential to long-term product marketability and has been identified as a key challenge for the Australian deer industry. Consumer attitudes and preferences are increasingly important for all meat industries, and pasture based production systems (as used for deer and lamb) are often valued by consumers as more animal friendly and ethical compared with the intensive production of beef in feed-lots, pork and chicken. Technological meat quality attributes like pH and water holding capacity are related to the functional properties of meat during storage and processing. These quality parameters also have an indirect influence on the sensory quality of meat, such as tenderness, juiciness and flavour, valued by consumers as the most important in relation to the eating quality of meat.

Techniques for hanging carcasses (Achilles tendon suspension and pelvic suspension) have been studied for beef (Hostetler *et al*., 1970; Lundesjö Ahnström *et al*., 2003) where the variation in tenderness is considered to be the main reason for consumer dissatisfaction (Koohmaraie, 1996). The tenderness in meat from bulls was more improved as an effect of pelvic suspension compared with meat from heifers (Fisher, 1994; Lundesjö Ahnström *et al*., 2003). Similar results have also been reported for fallow deer (*Dama dama*), where pelvic suspension of the carcasses had the greatest impact on meat tenderness in venison from young male fallow deer (Sims *et al*., 2004). In addition, previous and recent research has demonstrated quality differences in meat from ruminants (beef, reindeer (*Rangifer tarandus tarandus*) and red deer (*Cervus elaphus*) that have been grazing pasture or fed grain-based feed mixtures (Daly *et al*., 1999; Wiklund *et al*., 2001a; 2003a; 2003b; Wood *et al*., 2003; Bruce *et al*., 2004). However, research in the area of venison quality has been very limited and further studies of the relationship between production system, slaughter handling techniques and consumer acceptance of the final products are essential.

Objectives

The objective of this study was to compare the effects of two different techniques for hanging carcasses (Achilles tendon suspension and pelvic suspension) on the water-holding properties of deer and lamb meat. In addition, the water holding capacity of long term chilled (up to 6 weeks post slaughter) deer and lamb meat was measured.

Materials and methods

Ten female lambs (F1 Merino/Border Leicester x Texel, 5½ months old) and 10 female fallow deer (15 months old) raised at the University of Western Sydney, were included in the study. The animals were fasted for 16 h prior to slaughter, stunned with a captive bolt and bled using thoracic stick exsanguination within 10 s of the stun (ethics approval UWS 04.01). The dressed carcasses were split along the mid ventral axis approx. 45 – 75 min post slaughter, and each carcass side was randomly assigned to either Achilles tendon suspension (control treatment) or pelvic suspension. At 1 day *post mortem* (*pm*), both *M. longissimus* (striploins) from each carcass were collected, cut in 5 pieces and randomly assigned to a treatment of 1, 3 or 6 weeks of refrigerated storage (+2° C), freezing (-20° C) or to be analysed as fresh meat. Drip loss was measured on the fresh meat samples after hanging meat samples in plastic bags for 2 days at + 2° C. All other samples were vacuum packaged. Purge (drip loss in the vacuum bags) was measured after 1, 3 and 6 weeks of refrigerated storage by the following procedure: (1) the weight of meat and vacuum bag was recorded before opening; (2) at opening, any surplus drip on the meat was removed using a paper towel and

the drip-free weight of the meat recorded. Thaw loss was measured using the same technique as described for the purge measurements after the meat samples had been removed from the freezer and thawed overnight at +2° C. Cooking loss was measured for all treatments (fresh, frozen/thawed and chilled-stored meat) after the vacuum packed meat samples had been heated to 70° C in a water bath. The samples were weighed in the same way as described for the purge measurements. The data was analysed statistically by analysis of variance, fitting species for the slaughter data, and species, hanging treatment and their interaction with animal as a blocking factor for the meat quality data, using the statistical package GenStat (2002).

Results and discussion

The lambs had higher live weights compared with the deer ($p \leq 0.01$), but lower carcass weights and dressing percentages ($p \leq 0.001$) (Table 1). pH decline registered 1-24 hours *pm* did not differ ($p > 0.05$) between the two carcass treatments or between species (Fig. 1), and the mean ultimate pH values recorded at 24 h *pm* in *M. longissimus* (LD) were 5.69 (lamb) and 5.68 (deer). However, after 1 week of refrigerated storage pH dropped below 5.60, and was significantly lower in the lamb than in the deer samples (Table 1). After 3 and 6 weeks of storage pH was not significantly different from ultimate pH (Table 1). These results are in good agreement with an earlier study of red deer meat, where the same pattern for pH variation over storage time was observed (Wiklund *et al*., 2001b). Mean temperature was higher in lamb than in deer LD at 1 hour ($p \leq 0.05$) and lower at 24 hours ($p \leq 0.05$) *pm*, but was not significantly different between species during the main intermediate period of decline.

Among the measured water-holding traits, the carcass suspension technique had an effect on drip loss and purge. Drip loss in fresh meat was significantly lower with Achilles tendon suspension, while purge in the vacuum bags during storage was lower with pelvic suspension, significantly so for 3 weeks storage (Fig. 2). The only significant difference between species was found in drip loss where the deer meat had better water-holding capacity than the lamb meat (1.67% versus 2.24% of drip loss). Cooking loss and freeze/thaw loss was not affected by carcass treatment ($p \geq 0.05$), although a significantly higher cooking loss in the deer samples compared with the lamb samples was registered in fresh meat (Fig. 3). The present results on the positive effects of pelvic suspension on purge in deer and lamb support earlier findings in beef (Lundesjö Ahnström *et al*., 2003), though in the beef study positive effects of pelvic suspension on cooking loss and freeze/thaw loss were also reported. The present values measured for drip loss and cooking loss in lamb samples were in good agreement with previously reported values for lamb LD (Hoffman *et al*., 2003).

Conclusions

Knowledge about the quality attributes of fresh chilled venison is of strategic importance to the Australian deer industry. Today most of the venison produced is sold frozen, but the demand for fresh meat is expected to increase in the future. Pelvic suspension of carcasses has been demonstrated to improve tenderness in meat from young fallow deer bucks, the type of animals most likely to be supplied for commercial slaughter in Australia. The present results indicate that pelvic suspension also could be positive for water-holding properties of fresh chill-stored fallow deer venison. Pelvic suspension is suggested to be a method that can be used to enhance consumer important quality attributes of venison. Sensory analysis (using a trained expert panel and consumer preference tests) of venison from the two different carcass treatments as well as similar studies on red deer venison are subjects recommended for further investigation.

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Table 1. Mean live weight, carcass parameters and pH values in *M. longissimus* after 1, 3 and 6 weeks of refrigerated storage (+2° C) of the fallow deer and lamb included in the study, with standard errors of the difference (S.E.D.)

Trait	Deer (*n*=10)	Lamb (*n*=10)	S.E.D.	Degree of sign.[1]
Live weight, kg	36.7	39.9	1.08	**
Carcass weight, kg	21.2	19.1	0.58	***
Dressing percentage	57.9	47.8	0.72	***
pH values in *M. longissimus*				
1 week	5.59	5.55	0.010	***
3 weeks	5.67	5.67	0.015	n.s.
6 weeks	5.68	5.66	0.009	*

[1] n.s. = p>0.05; * = p≤0.05; ** = p≤0.01; *** = p≤0.001.

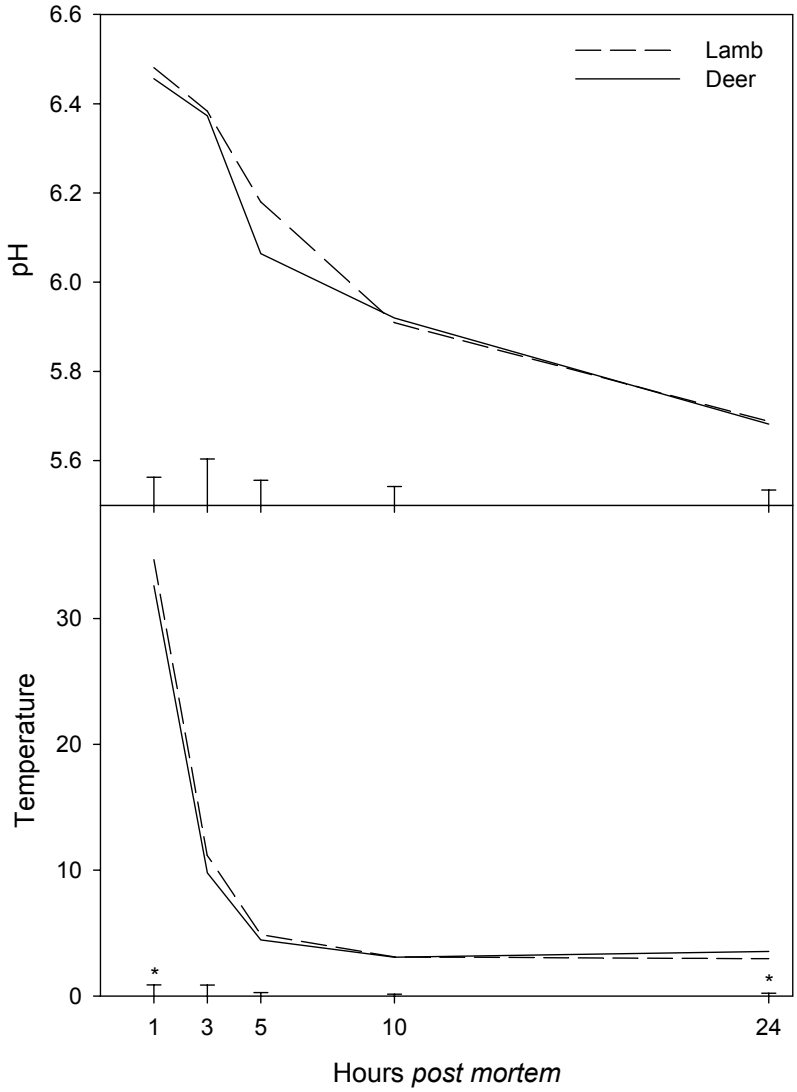

Figure 1. Mean temperature and pH (with standard errors of difference) measured at 1, 3, 5, 10 and 24 hours *post mortem* in *M. longissimus* from lamb (*n*=10) and fallow deer (*n*=10) included in the study.

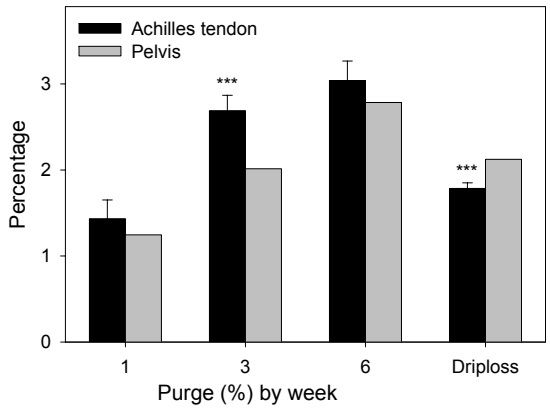

Figure 2. Purge (measured after 1, 3 and 6 weeks of refrigerated storage at +2° C) and drip loss in *M. longissimus* from lamb (*n*=10) and fallow deer (*n*=10) carcasses subjected to two different treatments; Achilles tendon suspension and pelvic suspension.

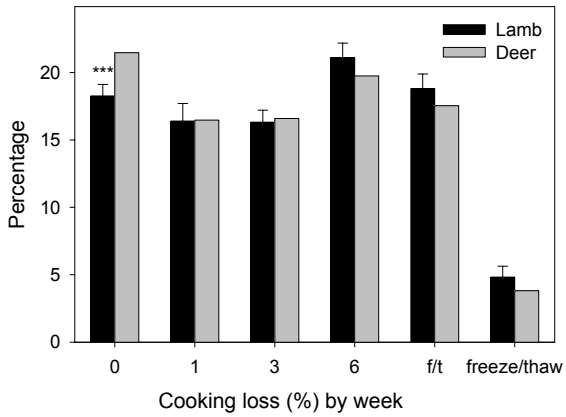

Figure 3. Cooking loss (in fresh meat (0), frozen/ thawed meat (f/t) and meat stored for 1, 3 and 6 weeks at +2° C) and freeze/thaw loss in *M. longissimus* from lamb (*n*=10) and fallow deer (*n*=10) included in the study.