EFFECTS OF ELECTRICAL STIMULATION ON SENSORY QUALITY OF REINDEER MEAT

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Introduction

The majority of field slaughtering of reindeer in Alaska is conducted during the winter months on snow to reduce the risk of contamination and to eliminate the need for refrigeration and freezing facilities. Ambient air temperatures during field slaughtering are usually very low and immediate chilling and freezing of the carcass occurs. This un-inspected reindeer meat can be sold within the state of Alaska if the carcasses are field dressed in the winter and the carcasses are kept frozen until they reach the consumer. Rapid chilling and freezing of carcasses can result in meat tenderness problems due to cold shortening of the muscles. Electrical stimulation accelerates post-mortem glycolysis and rigor onset, so that rapid cooling or freezing of carcasses may be carried out soon after slaughter, reducing the risk of muscles cold shortening. Electrical stimulation has been widely adopted as a meat tenderisation method for beef, lamb and goat carcasses, and also for deer carcasses in New Zealand.

In this study the effect of electrical stimulation on meat tenderness of reindeer loin (*M. longissimus*) and shoulder muscles (*Mm. triceps brachii, supra spinatus* and *infra spinatus*) was evaluated by a trained sensory panel and consumer preference tests. In addition, the study included a comparison of carcasses and meat from an uninspected field-slaughter situation and slaughter at an inspected processing facility.

Materials and Methods

A total of 26 castrated reindeer bulls (>3 years old) were used to investigate the effects of low voltage stimulation on sensory attributes of the meat. Reindeer were gathered and herded just outside Nome in the Seward Peninsula, Alaska, and shot in the field. After bleeding carcasses were randomly allocated to either an electrical stimulation treatment (ES) or a no electrical stimulation treatment (NES). Electrical stimulation was applied immediately, followed by removal of the viscera and hide. Shoulder meat was boned out from the warm carcasses in the field, packed in plastic-lined cardboard boxes and left to freeze at ambient temperature (to simulate the quality of un-inspected meat). The remaining carcasses were transported by truck to a meat processing facility in Nome were they were hung in the chilling room (+3°C). At 2 days post slaughter (simulating an inspected slaughter) carcasses were boned and both the right and left loins (*M. longissimus*) were removed, loins from each side were randomly allotted for either proximate analysis or sensory evaluation. All samples were vacuum-packaged and frozen at –20°C until analysis.

The frozen and boxed shoulder meat was shipped to SFOS Fishery Industrial Technology Center located at Kodiak Island, Alaska. The frozen meat was removed from the boxes and either ground, sliced or cubed while still frozen. The meat samples were then vacuum-packaged and transported to Fairbanks and kept frozen until analysis. The cubed meat was cooked in the vacuum-bags in a water bath to an end temperature of 74°C. The slices and ground meat were roasted on an oven tray until well done (74°C).Three paired-comparison consumer tests (cubed meat, sliced meat and ground meat from ES vs. NES carcasses) were performed in collaboration with the Cooperative Extension Service (CES) at UAF in Fairbanks using a total of 212 consumers to evaluate the cubed, sliced and ground meat.

At the CES Research Kitchen the loin samples were thawed overnight in a refrigerator, thermocouples inserted and cooked in a conventional oven at 150°C to a core temperature of 70°C. A selected and trained sensory panel consisting of 7 members performed a descriptive test on the reindeer loin samples. All assessments were done in a sensory laboratory with separate booths and under standard white light. At every session, the panel members were served meat samples from 7-9 animals at the same time, each sample consisting of one slice of meat. Samples were placed in plastic cups coded with three-digit numbers and were served to the panel members in randomised order, at room temperature and in two replicates. The following attributes were selected and unanimously agreed upon during panel training; tenderness, juiciness, bloody flavour, gamey flavour and sweet flavour. An unstructured continuous line scale from 0 (low intensity) to 10 (high intensity) was used.

Results and Discussion

When consumers tasted the cubed and sliced meat from the shoulder they judged the meat from the electrically stimulated carcasses to be more tender for both products ($P \leq 0.05$ and $P \leq 0.001$ respectively). No significant difference ($P \geq 0.05$) was found between the two treatments for ground meat. However, there was a trend ($p=0.01$) towards

increased tenderness in meat from electrically stimulated carcasses. While primal cuts like tenderloin (*M. psoas major*), strip loin (*M. longissimus dorsi*) and topside (*M. semimembranosus*) are easily marketed, less valuable cuts like meat from the shoulders have a reduced market share because of a high percentage of connective tissue (lack of tenderness). Hot-boning of less valuable carcass cuts in the field combined with the treatment of electrical stimulation could be a way for value-added processing. Frozen, boneless meat can be further processed at regional processing facilities to increase the value of a typically low quality product.

The trained panel did not find significant differences in any of the measured attributes when comparing loin samples from the electrically stimulated and non-stimulated carcasses that had been conditioned in a cooler for 48 hours prior to removing and freezing the loin samples. These results agree with previously reported Warner-Bratzler tenderness measurements for the same reindeer loin samples and with other studies on tenderness in reindeer meat, where it was concluded that reindeer meat from high quality meat cuts were very tender, especially in comparison with beef (Wiklund *et al.*, 1997; Barnier *et al.*, 1999;Wiklund *et al.*, 2004). The loins evaluated by the trained panel simulated the treatment of reindeer carcasses and meat from an inspected slaughter where the carcass was chilled to + 3°C before boning. In this situation the electrical stimulation did not have any effect on tenderness. However, the effect of electrical stimulation on tenderness in other less valuable cuts than the loin needs to be determined under the conditions of an inspected slaughter.

Conclusions

Results from this study demonstrate that ES increased tenderness in the cubed and sliced products made from field slaughtered reindeer shoulder meat. Loins from carcasses conditioned in a cooler for 48 hours prior to removing and freezing the loin samples were very tender regardless of treatment. The ES techniques can be used in field slaughter systems for reindeer to significantly increase the quality and potential value of meat. It is possible ES will also have a role in enhancing reindeer meat quality in conventional USDA slaughter operations; however, this remains to be further investigated.

References

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