51st International Congress of Meat Science and Technology
August 7-12, 2005 – Baltimore, Maryland USA

SEASONAL VARIATION IN CARCASS QUALITY OF REINDEER (*RANGIFER TARANDUS TARANDUS*) FROM THE SEWARD PENINSULA, ALASKA

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Key Words: Reindeer, meat, venison, seasonal effects, carcass composition, yield, ultimate pH

Introduction

During much of its history in Alaska the reindeer industry has produced meat for subsistence and local use (Stern *et. al*., 1980). Today, reindeer producers wish to commercialize their reindeer operations by selling meat in upscale local markets and exporting a high quality product to both national and international markets. State regulation allows Alaskan Native producers to sell field slaughtered, non-inspected carcasses to local retail outlets (D.E.C., State of Alaska, 2003). Under these regulations reindeer can be field slaughtered if ambient air temperature is less than 32 F and there is snow on the ground. The market potential for this product is limited because field slaughtered meat cannot be added to other meat products *i.e*. sausage, cannot be sold to restaurants or exported out of the state and must remain frozen immediately after field slaughter through purchase by the consumer. Also, wholesale distributors, *i.e*. Fred Meyer and Safeway, are reluctant to market reindeer meat on a seasonal basis. They demand a nearly year round supply of premium quality meat before offering the product to the consumer (Krieg, 1991). Reindeer producers on the Seward Peninsula want to enhance their operations by reliably delivering a high quality product from animals slaughtered outside the mid-winter months. The steady supply of a high quality product over an extended period of time will be the key to successful commercialization and profitability of the reindeer industry in Alaska.

The reindeer (*Rangifer tarandus tarandus*) is a seasonal animal and, like other Nordic cervides, is known to have a low capacity to gain weight during winter vis-á-vis summer (White & Fancy, 1986). Reproductive status and season have been demonstrated to be important factors influencing carcass yield and composition in red deer (*Cervus elaphus*) (Drew, 1991). Seasonal changes in appetite (Ryg & Jacobsen, 1982), body condition (McEwan & Whitehead, 1970; Reimers, 1983) and thus carcass composition occur rapidly in reindeer, however these changes are asynchronous between sex and age classes (Finstad & Prichard, 2000). Supplemental feeding may help to improve the nutritional status of the reindeer, both by increasing body condition and thereby carcass conformation and by increasing the glycogen levels in the muscles, which is of critical importance for several meat quality attributes (Jacobsen, Bjarghov & Skjenneberg, 1977; Wiklund *et al*., 1996; Wiklund *et al*., 2000a).

The most important factor contributing to future stability and profitability of reindeer producers is the ability to consistently slaughter animals with a carcass type that will yield the greatest quantity of high quality product. There are no published studies that have systematically evaluated carcass yield and quality across animal categories of Alaskan reindeer slaughtered through an extended season.

Objectives

Determine reindeer body condition dynamics (weight gain and loss), carcass characteristics, composition and yield of adult reindeer bulls and steers (castrated bulls) through a nine -month slaughtering season, July through March. In addition, ultimate pH values of *M. longissimus* were recorded.

Methodology

A total of 42 reindeer were included in the study (19 bulls and 23 steers). All animals came from the same herd out in the Seward Peninsula, Alaska, and were slaughtered at three different times; mid July (group 1), late November (group 2) and mid March (group 3). Group 1 were gathered and herded with helicopter and snow machine before entering the corral, the animals were positioned in a squeeze chute and stunned with a captive bolt. Animals in groups 2 and 3 were gathered with snow machine and, while still free-ranging in the herd, they were shot with a rifle. All carcasses were gutted and dressed out in the field, and then transported as soon as possible to a meat processing facility for further sampling and boning. Carcass cutting followed a protocol developed for this study but based on earlier moose and reindeer carcass studies (Hansson & Malmfors, 1978; Wiklund *et al*., 2000b). Ultimate pH was recorded at boning in *M. longissimus* (at the last rib) using a portable pH meter (Knick Elektronische Messgeräte GmbH & Co, Germany) equipped with a Xerolyte electrode (InLab®427, Mettler Toledo, Switzerland).

Definitions of the cuts presented in Table 1 are as follows: semiboneless leg (major part of the hind-quarter of the carcass without shank, including the *M. gluteus medius, M. quadriceps femoris, M. biceps femoris, M. semitendinosus* and *M. semimembranosus*), saddle (*M. longissimus* with bone), striploin (*M. longissimus*), topside (*M. semimembranosus*) and shoulder (*M. triceps brachii*, *M. supra spinatus* and *M. infra spinatus* with bone and shank).

Results & Discussion

Reindeer slaughtered in July (group 1) had the highest body weights; however the carcass weights (Cw) did not differ much over the season (Table 1). The exception was the low weights of carcasses from bulls (47.2 kg) in group 2. This result could not only be related to the effects of the rutting season, but also to that these bulls were estimated to be younger (2 ½ years old) than the rest of the animals in the study. Overall, the carcass weights in the present study were much higher than those presented for Swedish reindeer bulls by Wiklund *et al* (2000b). This may be due to differences in animal age, slaughter strategies and herd composition between the two studies.

The present study provides important information on the yield of carcass cuts as a percentage of Cw from both bulls and steers over a 9 month season and comparisons within a time period between the two sexes (Table 1). As expected, the reindeer bulls showed a bigger seasonal variation in body composition than the steers. However, at the last slaughter occasion (group 3 in March) it was clear that both animal categories had started to regain the fat and protein reserves lost during the winter. The fat content (% of Cw) in bulls and steers in November was 1.6 and 6.4 respectively, while these figures had increased to 4.4 and 10.6 in March (Table 1). The proportion (% of Cw) and total weight (kg) of two of the most valuable cuts; striploin and topside, did not show a great variation between the sexes or over the season. Earlier studies have demonstrated the effects of pre-slaughter stress and nutritional status on muscle glycogen content and ultimate pH values in reindeer meat (Wiklund, 1996). The present results are in good agreement with previous studies, and we could conclude that the present high pH values recorded were clearly related to pre-slaughter stress (animals in group 1) and poor nutritional status (bulls in group 2) (Table 2).

Further studies within this project will relate the cutting data to the economical value of the carcasses. All together, this data could provide important information for the Alaskan reindeer industry and promote new management and slaughtering strategies focused on high animal productivity and optimal meat quality.

Conclusions

Seasonal effects in reindeer carcass composition were demonstrated in the present study, although the carcasses from the late slaughter occasion (March) had higher weights and better composition (proportion of valuable cuts) than expected. Reindeer bulls were more affected by the season than the steers, and showed the largest variation in carcass weights and fat content.

The present project will continue with evaluation of eating quality (trained sensory panel and consumer preference tests) of reindeer meat from bulls and steers as well as chemical analyses to give a complete sensory and nutritional profile of reindeer meat with the seasonal effects included. We expect that the results from the present study will generate information necessary for Alaskan reindeer producers to develop an operational plan that will increase the value and expand the delivery of reindeer products demanded and accepted by upscale markets and consumers.

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Table 1. Carcass characteristics and composition (least-squares means ± standard errors) in reindeer bulls and steers included in the study

Trait	Bulls July (*n*=7)	Steers July (*n*=7)	Bulls Nov (*n*=5)	Steers Nov (*n*=9)	Bulls March (*n*=7)	Steers March (*n*=7)	Degree of sign.[1]
Body weight, kg	137.7^{a} ±5.1	124.6^{ac} ±5.1	88.4^{b} ±6.1	101.3^{bc} ±4.5	113.2^{c} ±5.1	110.9^{c} ±5.1	***
Carcass weight (Cw), kg	61.0^{ac} ±2.7	60.0^{ac} ±2.7	47.2^{b} ±3.3	53.9^{ab} ±2.4	59.6^{c} ±2.8	62.3^{c} ±2.8	**
Semiboneless leg, kg	16.7^{a} ±0.8	15.8^{ac} ±0.7	12.5^{b} ±0.8	14.9^{a} ±0.7	15.0^{ac} ±0.7	14.5^{c} ±0.7	*
Semiboneless leg, % of Cw	27.7^{a} ±0.6	26.5^{ab} ±0.6	26.6^{ab} ±0.7	27.6^{a} ±0.5	25.2^{b} ±0.6	23.4^{c} ±0.6	***
Saddle, kg	7.9^{a} ±0.5	7.4^{a} ±0.5	5.6^{bc} ±0.6	7.2^{a} ±0.5	4.6^{c} ±0.5	5.1^{c} ±0.5	***
Saddle, % of Cw	12.8^{ab} ±0.4	12.3^{ab} ±0.4	11.8^{b} ±0.5	13.3^{a} ±0.4	7.7^{c} ±0.4	8.2^{c} ±0.4	***
Topside, kg	3.3^{ac} ±0.1	3.2^{a} ±0.1	2.8^{b} ±0.2	2.9^{ab} ±0.1	3.6^{c} ±0.1	3.3^{ac} ±0.1	***
Topside, % of Cw	5.4^{a} ±0.1	5.4^{a} ±0.1	6.0^{b} ±0.1	5.5^{a} ±0.1	6.1^{b} ±0.1	5.3^{a} ±0.1	***
Striploin, kg	1.9 ±0.1	1.8 ±0.1	1.7 ±0.1	1.8 ±0.1	1.7 ±0.1	1.8 ±0.1	n.s.
Striploin, % of Cw	3.1^{ac} ±0.1	3.1^{ab} ±0.1	3.5^{b} ±0.2	3.4^{ab} ±0.1	2.8^{c} ±0.1	2.9^{c} ±0.1	**
Shoulder, kg	11.0^{ab} ±0.4	10.7^{a} ±0.4	8.3^{c} ±0.5	8.9^{c} ±0.4	12.2^{b} ±0.4	11.7^{ab} ±0.4	***
Shoulder, % of Cw	15.2^{a} ±1.1	17.9^{abc} ±1.1	17.6^{abc} ±1.3	16.6^{ac} ±1.0	20.5^{bc} ±1.1	18.8^{c} ±1.1	*
Bone, kg	12.2 ±0.6	14.2 ±0.6	12.6 ±0.8	13.2 ±0.6	14.5 ±0.6	13.9 ±0.6	n.s.
Bone, % of Cw	20.0^{a} ±0.8	23.8^{b} ±0.8	26.7^{c} ±1.0	24.7^{bc} ±0.8	24.3^{bc} ±0.8	22.4^{ab} ±0.8	***
Fat, kg	4.1^{a} ±0.8	2.3^{ab} ±0.9	0.8^{b} ±0.9	3.7^{a} ±0.7	2.7^{ab} ±0.8	6.7^{c} ±0.8	***
Fat, % of Cw	6.5^{a} ±1.1	3.1^{b} ±1.1	1.6^{bc} ±1.3	6.4^{a} ±0.9	4.4^{ab} ±1.1	10.6^{d} ±1.1	***

1n.s. = p>0.05; * = p≤0.05; ** = p≤0.01; *** = p≤0.001. Means in the same row having the same superscript are not significantly different (p>0.05).

Table 2. Ultimate pH values (least-squares means ± standard errors) in *M. longissimus* from reindeer bulls and steers included in the study

Trait	Bulls July (*n*=7)	Steers July (*n*=7)	Bulls Nov (*n*=5)	Steers Nov (*n*=9)	Bulls March (*n*=7)	Steers March (*n*=7)	Degree of sign.[1]
Ultimate pH	$6.28^{a}\pm0.08$	$6.26^{a}\pm0.08$	$5.88^{b}\pm0.09$	$5.70^{bc}\pm0.07$	$5.61^{c}\pm0.08$	$5.68^{bc}\pm0.08$	***

1*** = p≤0.001. Means in the same row having the same superscript are not significantly different (p>0.05).