EFFECTS OF CHILLING AND AGEING PERIOD ON HORSE MEAT QUALITY

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Abstract: Suitable chilling and ageing methods to ensure the superior quality of horse meat were developed using 36 equine *Semimembranosus* (SM) muscles from carcasses subjected to three chilling periods (17, 26 and 30 hours). Portions of each muscle were subjected to four ageing periods (3, 30, 60 and 90 days) and effects on horse meat quality were measured. *L decreased ($p<0.05$) and *b** increased ($p<0.05$) with increased length of chilling and ageing. Purge loss increased and Warner- Bratzler shear force decreased ($p<0.05$) with length of ageing only. Warner-Bratzler shear force was negatively correlated with intramuscular fat content ($r=-0.20$, $p<0.02$). Chilling horse carcasses for 26 hours and ageing removed SM muscles for 30 days ageing period optimized horse meat quality.**

Key Words – Meat quality, color, shear force

I. INTRODUCTION

Canada is one of the largest exporters of horse meat in the world and Alberta contributes significantly to this export supply. To remain competitive, Canada must ensure the highest quality of horse meat. Currently, in Canada, horse meat is harvested either through hot boning (after 2 hours post mortem) or after complete carcass chilling (40 hours post mortem). In the hot boning method, there is a chance of cold shortening, which would result in tough meat. Contrarily, complete carcass chilling requires significant energy for chilling. Therefore, the objectives of the study were to investigate different chilling and ageing periods and identify those that produced the highest technological quality of horse meat.

II. MATERIALS AND METHODS

Thirty-six *Semimembranosus (SM)* muscles were collected from a horse slaughter facility in Alberta over four consecutive weeks (visits), with 9 muscles collected at each visit. The *SM* muscles were removed from the right side of randomly selected carcasses after 17, 26 and 30 hours of chilling post mortem. Three muscles were included in each chilling period at every visit. After three days of ageing at 0 ± 0.5 °C, muscles were sliced into five portions with two steaks in each portion. Portions were randomly distributed to 3, 30, 60 and 90 days ageing with the exception of the middle portion, which was frozen and stored at -18 °C for intramuscular connective tissue analysis. The steaks within each portion were packaged under vacuum for ageing. After each ageing period, purge loss, Warner-Bratzler shear force (WBSF), luminosity (*L**), redness (*a**), yellowness (*b**), chroma, hue, and pH were measured according to Girard et al. (1). Cooking loss was measured according to Franco et al. (2) and intramuscular fat (IMF) content was analyzed according to Girard et al. (3). Data were analyzed by R (version 3.3.1) using the package nlme as a mixed model, where ageing and chilling period and the interaction were fixed effects, visit was a random effect, and the carcass weight was included as covariate. Differences between means ($P<0.05$) were determined by least square mean differences.

III. RESULTS AND DISCUSSION

Meat color (Table 1), particularly *L** and *b** values, decreased with prolonged carcass chilling, indicating that the color of the muscle darkened after 26 hours post mortem, as the lowest values of *L** and *b** were observed at 30 hours of chilling. Purge loss (Table 1) decreased ($p<0.05$) as the length of chilling period increased, with the maximum mean purge loss observed at 17 hours, and the lowest at 26 and 30 hours of chilling. In the early post mortem, the lateral and longitudinal shrinkage of myofibrillar filaments (4) accelerates the rate of water movement from myofibrillar lattice to extra myofibrillar space, which may enhance the purge losses in the early chilling period. *L**, *a**, *b** chroma and hue changed ($P<0.05$) with extended ageing (Table 1) and *L** and *a** gradually decreased as length of ageing period increased although, the changes in *b**, chroma and hue fluctuated with ageing. Similar fluctuation was observed for pH value with prolonged ageing. The values *b** and pH changed similarly and this was substantiated by their positive correlation ($r=0.37$, $P<0.01$).

Table 1. Effects of chilling and ageing on color, purge loss (%), pH, cooking loss (%), Warner-Bratzler Shear force (WBSF) and intramuscular fat (IMF) content (dry basis) of horse meat

	Chilling (hours)			P value	SEM[2]	Ageing (days)				P value	SEM[2]
	17	26	30			3	30	60	90		
Color[1]											
*L**	28.95[a]	28.44[a]	27.48[b]	<0.01	0.33	29.80[a]	29.62[a]	27.65[b]	26.09[c]	<0.01	0.35
*a**	19.91	19.94	20.02	0.99	0.31	20.04[ab]	20.82[a]	20.02[ab]	18.95[b]	<0.01	0.34
*b**	3.89[a]	3.79[ab]	3.62[b]	0.04	0.21	3.22[a]	4.74[b]	4.21[b]	2.89[a]	<0.01	0.22
Chroma	20.38	20.34	20.40	0.96	0.32	20.34[ab]	21.37[a]	20.51[ab]	19.27[b]	<0.01	0.36
Hue	10.73	10.42	10.08	0.99	0.55	8.77[a]	12.71[b]	11.79[b]	8.38[a]	<0.01	0.58
P. loss%[3]	3.87[a]	2.87[b]	2.64[b]	<0.01	0.42	0.51[a]	2.99[b]	4.33[c]	4.68[c]	<0.01	0.44
C. loss%[4]	5.48	5.49	5.52	0.44	0.03	5.43[a]	5.57[b]	5.62[b]	5.35[a]	<0.01	0.03
pH	26.59	26.20	25.76	0.46	0.45	26.19	26.34	26.13	26.05	0.95	0.48
WBSF (N)	47.34	45.61	43.91	0.21	2.02	57.53[a]	47.99[b]	40.24[c]	36.73[c]	<0.01	2.14
IMF (%)	3.85	4.32	4.71	0.34	0.42	4.18	4.36	4.10	4.50	0.87	0.40

[1] *L**, luminosity; *a**, redness; *b**, yellowness; [2]SEM, standard error mean, [3]purge loss (%); [4]Cooking loss (%); a, b, c Different superscript in the same row indicate means are significantly different ($p \leq 0.05$).

Purge loss gradually increased ($P<0.05$) with the length of ageing (Table 1). In early ageing, purge losses may have been reduced by limited translocation of free water from the myofibrillar proteins to the extra myofibrillar spaces. However, the amount of purge loss increased with extended ageing, most likely as a consequence of enzymatic degradation of myofibrillar proteins like desmin, titin and nebulin, (5), which simultaneously causes weakening and tenderization of muscle (6). Supporting this hypothesis are the WBSF results (Table 1), which showed that WBSF gradually decreased ($p<0.05$) with the length of the ageing period. The negative correlation between WBSF and purge loss ($r=-0.45$, $P<0.01$) indicated that changes in these measurements were concurrent. The negative correlation between WBSF and Intramuscular fat (IMF, $r=-0.20$, $p=0.02$) revealed that IMF content contributed to decreased WBSF value and improved meat tenderness.

IV. CONCLUSION

Results indicated the length of time for which the muscle remained on the carcass early post mortem had a limited effect on horse meat quality. Results suggested that ageing horse meat for 30 days will minimize purge loss and allow fresh meat color to be maintained while achieving additional tenderization regardless of carcass chilling time. Acceptability of the product should be assessed with sensory testing; therefore, further research is required.

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