EFFECT OF FROZEN STORAGE DURATION ON TECHNOLOGICAL QUALITY CHARACTERISTICS OF HORSEMEAT MUSCLES

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Abstract –The study aimed at assessing the effects of frozen storage duration on quality characteristics, lipid oxidation and sensory quality of various horsemeat muscles. Five representative muscles: *longissimus dorsi* (LD), *gluteus medius* (GM), s*emimembranosus* (SM), *biceps femoris* (BF) and *triceps brachii* (TB) at 24 h post-mortem obtained from 28-mo-old Jeju female breed horses (*n*=8) were used in the present investigation. The muscles were vacuum-packaged and frozen at -20ºC for 120, 240 and 360 days. Results revealed that all the muscles significantly ($p<0.05$) increased in cooking losses after 120 days of frozen storage and did not increase thereafter. The thiobarbituric acid reactive substances (TBARS) and total volatile basic nitrogen (TVBN) contents did not increase after 240 days but significantly increased as increasing the frozen storage time up to 360 days ($p<0.05$). A significant decrease in WBSF values was observed for all the muscles with increased frozen storage time ($p<0.05$). It may be concluded that the frozen storage could be applied to increase the long-term shelf life of horsemeat.

Key Words – shear force, color, thawing loss.

I. INTRODUCTION

Horse meat for human consumption and trade activities is common in many countries; however, quite little attention has been paid to the factors affecting its quality. Furthermore, most studies have only focused on evaluating the effects of pre-harvest factors (e.g., breed, sex and feeding diets) on the horsemeat quality characteristics [1, 2]. In the meat industry, in order to keep meats fresh and safe for long periods, the meats are usually stored under refrigerated or freezing condition. Of which, freezing is one of the oldest and common preservation methods because it can increase the long-term shelf life while still retaining properties similar to those of fresh meat. In order to standardize the processing and storage as well as to promote the trade activities of horsemeat, more detailed studies on the factors affecting the quality of this meat type are required. The present research aimed at investigating the effects of frozen storage durations (0, 120, 240 and 360 days) at -20ºC on the quality characteristics of various horsemeat muscles.

II. MATERIALS AND METHODS

Jeju female breed horses (n = 8) with their live weight of about 280-350 kg obtained from a local farm in Jeju province, Korea, were used in the present study. After slaughter, the carcasses were transferred to a chilling room (2± 2 ºC) for 24 h. The following day, the carcass sides were transferred to a cutting room where five representative muscles including: *longissimus dorsi* (LD), *gluteus medius* (GM), s*emimembranosus* (SM), *biceps femoris* (BF) and *triceps brachii* (TB) muscles were taken from both sides (left and right) of each carcass. Each muscle was divided into two equal parts, so 4 parts (2 part/carcass side x 2 sides) per carcass were formed. After the initial weights were recorded, all the samples were placed in oxygen impermeable polyethylene bags, labelled and randomly assigned to 0 (non-frozen, fresh), 120, 240 and 360 days frozen storage groups. All the samples were analyzed for thawing loss, cooking loss, Warner–Bratzler shear force (WBSF), thiobarbituric acid reactive substances (TBARS) and total volatile basic nitrogen (TVBN) as described in our previous study [3]. The data were analyzed by using the General Linear Model (GLM) procedure of statistical analysis system (SAS) package considering muscle type and frozen storage period as the main effects. The differences between means were compared by using Duncan's Multiple Range Test, and significance was defined at $p<0.05$.

III. RESULTS AND DISCUSSION

Results on cooking loss and WBSF are presented in Table 1. Cooking loss is among the important quality traits which reflect the water holding capacity of muscle tissue. The results showed that all the muscles significantly ($p<0.05$) increased in cooking loss after 120 days, with an average increase of approximately 4.47 % and did not increase thereafter. The obtained results are in agreement with findings reported for other meat types in literature [4, 5].

Table 1 Effect of frozen storage on cooking loss and Warner–Bratzler shear force values (mean ± standard error)

Muscles	Cooking loss (%)				Warner–Bratzler shear force (kgf)			
	0 day (non-frozen)	120 day	240 day	360 day	0 day	120 day	240 day	360 day
LD	26.16±0.95bB	32.11±1.45aA	32.34±1.59aA	29.74.16aAB	5.39±0.04aA	2.68±0.2bB	2.74±0.1aB	2.79±0.2aB
GM	26.69±0.76abB	32.51±0.75aA	30.48±1.08aA	30.53±0.89aA	5.09±0.58abA	3.60±0.2aB	3.00±0.2aB	3.46±0.2aB
BF	25.99±0.62bB	32.46±1.12aA	31.53±1.17aA	30.95±0.81aA	3.62±0.10bA	2.84±0.2abB	3.23±0.2aAB	3.01±0.2aAB
TB	28.79±0.75aB	33.07±1.15aA	33.48±1.38aA	31.62±1.28aA	3.81±0.25abA	3.02±0.3abB	3.03±0.3aB	2.86±0.4aB
SM	28.83±0.72aB	33.52±0.71aA	31.84±0.99aAB	31.03±0.5aAB	4.57±0.21abA	3.03±0.3abB	3.01±0.2aB	2.74±0.1aB

Values with different letters (A-C) within each parameter in the same row differ significantly ($p<0.05$); Values with different letters (a-c) in the same column differ significantly ($p<0.05$).

The TVBN and TBARS contents of horsemeat muscles measured during frozen storage are presented in Table 2. Our results depict that the TVBN contents varied among the muscles throughout the frozen storage but not statistically different ($p>0.05$). Regarding the frozen storage effect, the TVBN content did not increase up to 240 days of frozen storage, but significantly increased in all muscles after 360 days in comparison to the non-frozen samples. Our results depict that the TBARS values in non-frozen muscles (0 day) were lower than those in the frozen samples, the content increased from 120 days of frozen storage, but statistical differences with respect to non-frozen samples only appeared after 360 days under frozen storage ($p<0.05$).

Table 2 Effect of frozen storage on TVBN and TBARS values (mean ± standard error)

Muscle	TVBN (mg %)				TBARS (mg MAD/kg fresh meat)			
	0 day (non-frozen)	120 day	240 day	360 day	0 day	120 day	240 day	360 day
LD	0.12±0.0bB	0.17±0.01aB	0.18±0.01aB	32.10±0.27aA	0.08±0.00abB	0.24±0.06aB	0.26±0.04aB	0.34±0.04aA
GM	0.16±0.0aC	0.18±0.01aBC	0.21±0.02aB	30.94±0.09aA	0.09±0.01abB	0.24±0.04aB	0.27±0.08aAB	0.46±0.22aA
BF	0.16±0.0aB	0.19±0.02aB	0.19±0.01aB	31.34±0.15aA	0.10±0.01aB	0.22±0.03aB	0.24±0.06aB	0.43±0.23aA
TB	0.16±0.0aB	0.17±0.01aB	0.19±0.01aB	31.05±0.11aA	0.07±0.01bB	0.22±0.07aAB	0.26±0.06aAB	0.45±0.12aA
SM	0.17±0.01aB	0.19±0.01aB	0.20±0.01aB	31.20±0.11aA	0.09±0.01abB	0.23±0.03aAB	0.31±0.08aAB	0.47±0.16aA

Values with different letters (A-C) within each parameter in the same row differ significantly ($p<0.05$); Values with different letters (a-c) in the same column differ significantly ($p<0.05$); TBARS: thiobarbituric acid reactive substances; TVBN: total volatile basic nitrogen.

IV. CONCLUSION

Based on the results obtained, it is concluded that the frozen storage could be applied to increase the long-term shelf-life by slowing the lipid oxidation and total volatile basic nitrogen formation of horsemeat. However, further study is needed to elucidate how the frozen storage affects the muscle ultrastructure or proteolytic activity and sensory quality of this meat type.

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