EFFECT OF SOUS VIDE ON THE QUALITY CHARACTERISTIC OF HORSE MEAT

Sangrok Lee[1], Hee-Jeong Lee[1], Dongwook Kim[1], Dong-Jin Shin[1] and Aera Jang[1*]

[1] Department of Applied Animal Science, Kangwon National University, Chuncheon, Republic of Korea

*Corresponding author email: ajang@kangwon.ac.kr

I. INTRODUCTION

Horse meat is known for its high protein content, iron, unsaturated fatty acids and low-fat content. Due to these characteristics, horse meat has a distinct texture compared to other types of meat. With many countries, such as those in Europe, projected to have a higher percentage of the population aged 65 and over by 2025 (from 17% to 30%) [2], there is an increasing demand for tender and more nutritious meat. Sous-vide cooking (SV) is a method that involves vacuum packing and immersing the meat at a low temperature for several hours, which depends on the thickness of the meat, the intramuscular connective tissue, and the myofibrillar protein components. SV has been shown to produce meat with better sensory properties and an extended shelf-life, as well as good textural properties like juiciness and tenderness [3]. However, there has been limited research on using sous-vide cooking for horse meat in Korea. Therefore, the aim of this study is to optimize the sous-vide cooking conditions for Jeju horse meat to obtain tender and more nutritious horse meat that is suitable for elderly consumption.

II. MATERIALS AND METHODS

Horse meat (*m.semitendinosus* [ST], n=3) was purchased from a local commercial meat supplier. Each muscle was cut into 2.5 cm thickness and 200±50 g, and then individually vacuum packed. The SV samples were immersed in selected temperature-time combinations (60°C-6 hours, 60°C-12 hours, 60°C-18 hours, 70°C-6 hours, 70°C-12 hours, 70°C-18 hours). The control (C) sample was boiled at 75°C for 40 minutes until the core temperature reached 72°C. Shear force (SF) was measured by the Texture Analyzer TA 1 (LLOYD instruments, Fareham, UK) on 3 cm x 1 cm x 2 cm cut samples. For sensory analysis, meat cubes of size 1 cm^3 were given to 15 panelists from Kangwon National University and each was asked to rate 7 textural attributes (color, aroma, taste, flavor, juiciness, tenderness, overall acceptability) using a 9-point scale system. The microstructure was observed using a FE-SEM(JSM-7900F). The cooked muscle samples were analysed for myofibrillar protein profile using SDS-PAGE on 8% running gels. The data was analysed using SAS software (version 9.4, SAS Institute Inc, Cray, NC, USA) with one-way analysis of variance and Turkey's test.

III. RESULTS AND DISCUSSION

The results of SF and sensory analysis are shown in Table 1. In terms of SF, the control samples had the highest value (65.79N), which is significantly higher than the 60°C-18 h, 70°C-12 h, and 70°C-18 h SV samples. On the other hand, among the cooked samples, the 70°C-18 h sample had the lowest value (38.57N), which had no significant difference with the raw sample. This means that the 70°C-18 h sample became as tender as the raw sample. In sensory analysis, there was no significant difference in color or aroma among the cooked samples. However, in terms of tenderness and overall acceptability, the 70°C-18 h sample received the highest score among the cooked samples, and there was a significant difference with the control sample. The microstructure of raw and cooked horse ST was shown in the SEM micrographs in figure 1. It can be observed that there were clear gaps between muscle fibers in the cooked samples, and the structure of the 70°C SV samples was more compact and denser than that of the 60°C SV samples. At 70°C, the connective tissue would have denatured and transformed into gel, which fills the gaps between muscle fibers [4]. The degradation of myofibrillar

protein contributes to the tenderness improvement of the meat [5]. The SDS-PAGE of raw and cooked horse ST was shown in figure 2. The 70°C-18 h SV sample had the most decreased intensity of the myosin heavy chain band among the samples.

Table 1 Shear force and sensory analysis of raw and cooked horse *m.semitendinosus*

Traits	Raw	Con	60°C			70°C			SEM	P-value
			6H	12H	18H	6H	12H	18H		
Shear force (N)	31.33^{d}	65.79^{a}	58.10^{ab}	61.36^{ab}	50.08^{bc}	57.01^{ab}	50.97^{bc}	38.57^{cd}	3.038	<.0001
Sensory analysis										
Color	-	6.69^{abc}	6.08^{c}	5.85^{c}	6.23^{bc}	6.77^{abc}	7.08^{ab}	7.23^{a}	0.233	<.0001
Aroma	-	6.62	6.23	6.23	6.38	6.69	6.54	6.54	0.205	<.0001
Taste	-	6.46^{ab}	6.23^{ab}	6.15^{ab}	5.77^{b}	6.08^{ab}	6.31^{ab}	7.00^{a}	0.276	<.0001
Flavor	-	6.38^{ab}	6.23^{ab}	6.31^{ab}	5.69^{b}	6.31^{ab}	6.46^{ab}	6.85^{a}	0.243	<.0001
Juiciness	-	5.54^{ab}	6.62^{a}	5.77^{ab}	6.15^{a}	4.69^{b}	5.62^{ab}	5.62^{ab}	0.322	<.0001
Tenderness	-	4.23^{c}	6.00^{ab}	6.23^{ab}	6.62^{a}	4.92^{bc}	6.77^{a}	7.15^{a}	0.356	<.0001
Overall acceptability	-	5.62^{b}	6.15^{ab}	6.23^{ab}	6.00^{b}	5.31^{b}	6.23^{ab}	7.08^{a}	0.252	<.0001

Con, Control (core temperature to reach 72°C in water bath for 40 min).
$^{a-d}$ Means within same row with different superscript letters differ significantly (P<0.05).
SEM, standard error of means.

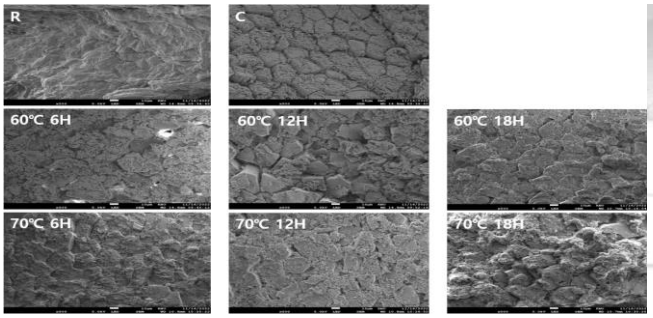

Figure 1. Microstructure of raw and cooked horse *m.semitendinosus* (500x magnification)

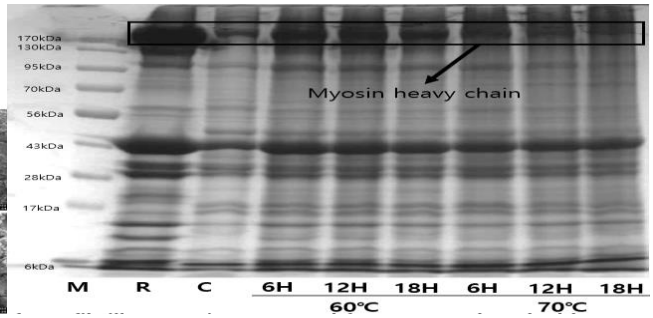

Figure 2. SDS-PAGE of raw and cooked horse *m.semitendinosus*

IV. CONCLUSION

From the result of SF, sensory analysis and SDS-PAGE, 70°C-18 h SV sample seems to improve the tenderness most effectively. The microstructure of the horse ST was affected by sous-vide cooking.

ACKNOWLEDGEMENTS

This work was supported by “Cooperative Research Program for Agriculture Science and Technology Development” of the Rural Development Administration, Republic of Korea (PJ016207).

REFERENCES

1. Botinestean, C., Keenan, D. F., Kerry, J. P., & Hamill, R. M. (2016). The effect of thermal treatments including sous-vide, blast freezing and their combinations on beef tenderness of *M. semitendinosus* steaks targeted at elderly consumers. LWT 74: 154-159.
2. Ismail, I., Hwang, Y. H., & Joo, S. T. (2019). Interventions of two-stage thermal sous-vide cooking on the toughness of beef semitendinosus. Meat Science 157: 107882.
3. Roldán, M., Antequera, T., Martín, A., Mayoral, A. I., & Ruiz, J. (2013). Effect of different temperature–time combinations on physicochemical, microbiological, textural and structural features of sous-vide cooked lamb loins. Meat Science 93: 572-578.
4. Yin, Y., Pereira, J., Zhou, L., Lorenzo, J. M., Tian, X., & Zhang, W. (2020). Insight into the effects of sous vide on cathepsin B and L activities, protein degradation and the ultrastructure of beef. Foods 9: 1441.