SOUS VIDE COOKING IMPROVED THE PHYSICOCHEMICAL PARAMETERS OF HOT-BONED BOVINE *SEMIMEMBRANOSUS* MUSCLE

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I. INTRODUCTION

Hot-boned muscle is defined as the removal of muscles from the carcass pre-rigor, but the poor tenderness has limited its wide application, especially for hindquarters cuts of beef that are considered as low value, such as *semimembranosus*. *Sous vide* (SV) has been developed and widely used to improve the tenderness of value-add low-value beef [1]. However, most of the samples used in these SV studies were post-rigor or aged meat, while there are limited studies using hot-boned muscles as material. Therefore, this study evaluated the ability of SV to improve the physicochemical and sensory parameters of hot-boned *semimembranosus*, aimed to provide a value-added processing technology for hot-boned muscles from low-value beef cuts.

II. MATERIALS AND METHODS

A total of 6 carcasses of Simmental bull (in two batches) were selected for the experiment. The *semimembranosus* muscles were removed from both left and right sides of the carcasses within 45 minutes after slaughter. The right muscles were further wet-aged at 0 - 4 ℃ for 7 days, and the left were cut into steaks of 2.54 cm and randomly assigned to: *Sous vide* group (SV), Grilled group (GR) or the Boiling group (BO). After cooking, the cooking loss, tenderness, microstructure and sensory were evaluated. After 7 days, the aged right muscles were cut, cooked and evaluated in the same way. The SV steak was cooked in a vacuum packaged plastic bag in a water bath set at 57 ℃ for 11 hours. The GR steaks were cooked using a griller at 177 ℃ until their central temperature reached 72 ℃. Each BO steak was cooked in a food grade plastic bag in a boiling water bath at 100 ℃ for 2 hours to simulate traditional Chinese cooking methods.

Statistical analyses were executed using the MIXED procedure of SAS. The figure was made by SigmaPlot 14.0. Least squares means were considered significantly different at $P < 0.05$.

III. RESULTS AND DISCUSSION

Table 1. Effects of cooking methods and muscle states on the cooking loss and WBSF of beef steaks.

Traits	Cooking method	Muscle states		SE	*P*-value		
		Hot-boned	Aged		Cooking	State	Cooking ×State
Cooking loss (%)	BO	42.3^{bx}	51.4^{ax}	1.0	< 0.05	< 0.05	< 0.05
	GR	28.6^{by}	33.0^{ay}				
	SV	25.3^{bz}	28.6^{az}				
WBSF (N)	BO	116.5^{ax}	79.5^{bx}	1.4	< 0.05	< 0.05	< 0.05
	GR	86.2^{ay}	63.7^{by}				
	SV	43.3^{az}	36.2^{bz}				

$^{a-b}$ Means within the same cooking method with different letters differ at $P < 0.05$.

$^{x-z}$ Means within the same muscle state with different letters differ at $P < 0.05$.

There was an interaction effect of muscle state and cooking method on the cooking loss and shear force ($P < 0.05$). For hot-boned or aged steaks, the cooking loss of SV significantly lower than both BO and GR. The cooking loss in hot-boned steaks was significantly reduced compared to those of aged steaks under all cooking methods. So, meat cooked with SV under a hot-boned state will have a better water holding capability than after aging. The WBSF was significantly decreased after 7 days wet-aging. For both hot-boned and aged steaks, the SV cooking had significantly lowest WBSF values.

Although the WBSF of hot-boned steaks was still significantly higher than that of aged steaks under SV cooking, it had been reduced to 43.3 N and can fully meet the tenderness requirements of Chinese consumers [2]. So, the hot-boned *semimembranosus* muscles with poor tenderness can be processed to ideal tenderness by SV.

The Microstructure were observed in this research in Figure 1. The arrangement of muscle fibers in SV was much looser and the number of muscle fibers with larger diameter was much less than other two cooking groups. This indicated that less contraction in SV steaks happened during cooking which was in accordance with the WBSF results. Meanwhile, SV showed the biggest extra-myofibrillar mass area which helped hold more moisture during cooking. Additionally, the steaks cooked under aged state showed smaller fiber diameter and compact arrangement, which would lead to decreased WHC in aged steaks.

The results of the sensory evaluation were shown in Figure 1. SV had significantly improved the scores of sensory tenderness and overall acceptability compared to those of GR and BO steaks. The sensory tenderness results here were consistent with the shear force results which further illustrated that *semimembranosus* muscles can achieve consumer's acceptable tenderness by SV cooking. Interestingly, SV can obtain the similar flavor to GR, which showed that had overcome the mild flavor defect [1]. Many researchers are concerned that the lack of Maillard reaction in SV may lead to consumer's rejection due to its "under-cooked" color [1]. Satisfactorily, our study showed no significant difference in sensory cooked color in the center between SV steaks and GR steaks with hot-boned muscles. Overall, the combination of SV and hot-boned state improved the organoleptic properties of hot-boned *semimembranosus* and achieved better overall acceptability than other combinations.

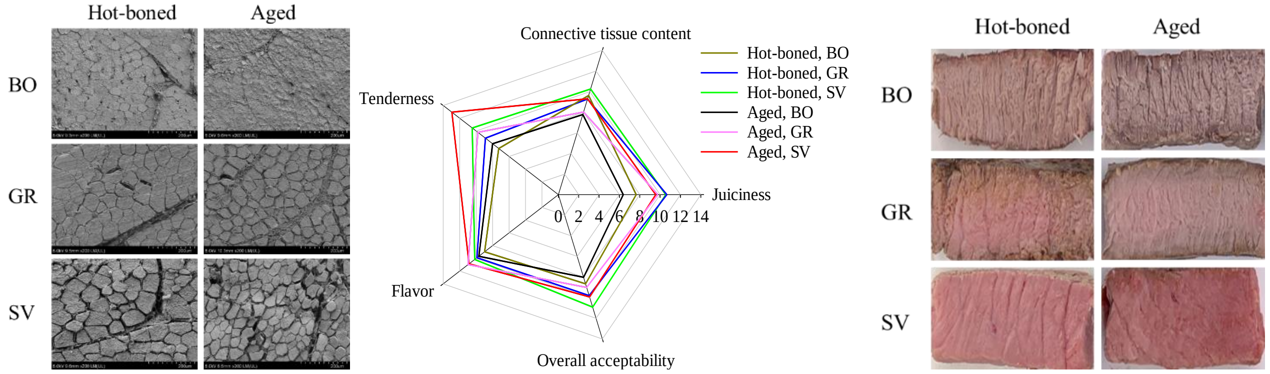

Figure 1. The sensory evaluation, cooked color and microstructure of beef steaks.

IV. CONCLUSION

The SV cooking achieved less cooking loss, lower WBSF, higher sensory scores and acceptable sensory color. The hot-boned steaks also improved the WHC and sensory scores. Therefore, it is a good choice to cook the hot-boned *semimembranosus* muscles directly under hot-boned state using SV to improve the eating quality, which can eliminate the need for aging, benefiting the beef industry.

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