EFFECT OF HOT BONING AND CUTS VARIATION ON TENDERNESS OF SAUCED BEEF

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I. INTRODUCTION

Sauced beef is one of Chinese traditional meat products, which requires long stew time to prepare. This popular delicacy was traditionally produced by using hot boned beef cuts. Although hot boning is a time and cost saving processing procedure, it usually leads to a shortened sarcomere length, and decreased beef tenderness. It is reported that cooking methods can affect meat tenderness [1], however, not much information is available on the tenderness of sauced beef from different beef cuts. Tenderness is one of the most important attributes that affect consumers' satisfaction to meat quality, with shear force as an objective indicator. Therefore, in this study, the shear force of sauced beef from 4 different muscle cuts were investigated, and the sarcomere length were also measured to explain the variation.

II. MATERIALS AND METHODS

Nine Chinese crossbred yellow cattle carcasses were randomly selected on the slaughter line at a beef abattoir. The Knuckle, Shank, Striploin, and Topside were removed from both sides at 1 h postmortem and then transferred to the lab in foam box with ice in 2 hours. The four beef cuts were trimmed to about 500g sub-cuts and 2.54 cm thick beef steaks, those sub-cuts and steaks then vacuum packaged and stored in the chiller (3±1^{o}C), with those sub-cuts without package and cooked directly were regarded as pre-rigor samples, and sub-cuts at 10 to 12 h postmortem were marked as samples at rigor mortis. Other sub-cuts and steaks were aged for 2d and 7d, respectively. The processing procedure of sauced beef is as follows: the sub-cuts were put into a water bath (70^{o}C) and then heated to 100^{o}C and kept for 15min. After that, all the beef were transferred to another cooker with 70^{o}C water. After the spices were added, the cuts were heated to boiling and kept 30min, and then kept at 92^{o}C for 4.5h. The meat was following cooled down in a refrigerator (3±1^{o}C). The shear force was either measured using the steaks (internal temperature reached to 70^{o}C) as described in [2] or using the sauced beef with the same testing method. Sarcomere length (3g for each sample) was measured according to the previous method [3]. ANOVA was conducted by using SPSS software (Version 18). Tests of differences were considered significantly different at $P < 0.05$.

III. RESULTS AND DISCUSSION

The two kinds of samples (Beef 70 ^{o}C and sauced beef) used for shear force determination were regarded as two cooking methods. Aging and cooking methods showed significantly effects on the shear force (Table 1). The long time cooking (sauced beef) significantly ($p < 0.05$) decreased the shear force values, compared the beef steaks cooked to 70 ^{o}C. The pre-rigor and rigor mortis samples cooked to 70 ^{o}C exhibited a higher shear force values than aged samples, while the highest shear force values of sauced beef was the rigor mortis samples. As for the cuts variation, unexpected, the shear force values of Shank was lowest on each sampling time and with either of the cooking method, and the long time stew (sauced) also resulted in an even lower values.

Cooking procedure significantly shortened the sarcomere length (Table 2), and long-time cooked sauced beef had the shortest sarcomere, compared with raw beef and 70°C cooked meat. This was contrary to the shear force results that longer time cooking resulted in the lower shear force. This indicated increased tenderness of long time cooked sauced beef is not contributed by a longer sarcomere length, the gelatinization of the collagen might be a factor.

Table1 Shear force (N) of sauced beef from four beef cuts and at four sampling times

	Pre-rigor		Rigor mortis		Postmortem 2d		Postmortem 7d	
	Beef 70 °C	sauced beef	Beef 70 °C	Sauced beef	Beef 70 °C	sauced beef	Beef 70 °C	sauced beef
Striploin	107.6 ± 4.3^{ax}	75.4 ± 4.7^{bxy}	116.5 ± 10.4^{ax}	94.5 ± 11.7^{ax}	92.6 ± 4.3^{ax}	84.0 ± 6.0^{ax}	72.6 ± 15.9^{ax}	60.3 ± 12.4^{ax}
Knuckle	115.2 ± 8.9^{ax}	69.0 ± 12.0^{by}	112.8 ± 14.3^{ax}	89.1 ± 6.0^{bxy}	83.6 ± 6.3^{ax}	67.3 ± 5.7^{ax}	64.6 ± 6.1^{ax}	50.1 ± 6.2^{bxy}
Topside	126.5 ± 8.4^{ax}	85.0 ± 6.7^{bx}	118.6 ± 13.2^{ax}	102.0 ± 16.3^{ax}	93.5 ± 6.6^{ax}	73.4 ± 10.1^{bx}	71.8 ± 7.6^{ax}	54.1 ± 2.5^{bx}
Shank	98 ± 9.3^{ax}	61.7 ± 9.8^{by}	93.2 ± 17.9^{ax}	76.5 ± 8.8^{ay}	66.8 ± 4.3^{ay}	41.5 ± 4.2^{by}	54.8 ± 9.8^{ax}	40.7 ± 2.5^{by}

a, b means significant difference are within rows; x, y means significant differences are within columns; ($P < 0.05$)

Table 2 Sarcomere length (μm) of sauced beef produced by four muscle cuts at three sampling times

		Pre-rigor beef	Beef cooked to 70°C	Sauced beef
Pre-rigor	Striploin	2.01 ± 0.16^{ax}	1.22 ± 0.36^{bx}	1.13 ± 0.81^{by}
	Knuckle	2.06 ± 0.37^{ax}	1.27 ± 0.78^{bx}	1.12 ± 0.58^{by}
	Topside	2.03 ± 0.11^{ax}	1.21 ± 0.72^{bx}	1.14 ± 0.15^{by}
	Shank	2.07 ± 0.34^{ax}	1.41 ± 0.15^{bx}	1.36 ± 0.31^{bx}
Postmortem 2d	Striploin	1.51 ± 0.18^{az}	1.43 ± 0.09^{ay}	1.33 ± 0.14^{ay}
	Knuckle	1.89 ± 0.14^{ay}	1.65 ± 0.08^{abxy}	1.47 ± 0.07^{bxy}
	Topside	1.56 ± 0.14^{az}	1.48 ± 0.12^{ay}	1.40 ± 0.04^{by}
	Shank	2.30 ± 0.34^{ax}	1.87 ± 0.16^{bx}	1.67 ± 0.11^{bx}
Postmortem 7d	Striploin	1.58 ± 0.80^{ay}	1.48 ± 0.26^{ay}	1.36 ± 0.79^{ax}
	Knuckle	1.79 ± 1.23^{by}	1.55 ± 0.39^{abxt}	1.48 ± 0.84^{bx}
	Topside	1.55 ± 1.44^{ay}	1.54 ± 0.79^{axy}	1.42 ± 0.34^{ax}
	Shank	2.06 ± 0.32^{ax}	1.77 ± 0.02^{bx}	1.63 ± 0.02^{cx}

Means with different letter of a, b are significant difference at the 0.05 level ($P < 0.05$) within rows. Means with different letter of x, y, z are significant difference at the 0.05 level ($P < 0.05$) within columns at the same time point.

IV. CONCLUSION

The shear force of pre-rigor sauced beef is at the same level of 7 day aged beef cooked to 70°C, it means the hot-boned cuts can be used to make sauced beef. However, cautions should be paid, as the rigor mortis can increase the toughness. Sauced shank exhibited the best tenderness compared striploin, knuckle and topside, indicating this beef cuts are the best material to prepare sauced beef.

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