Tenderness and Cooking Loss of Yearling Brahman Cross and Mature Ongole Cross Beef Treated Tenderizing Method

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Abstract

The application of tenderizing methods such as enzyme, internal endpoint temperature, and thawing method on beef from different age and breed of cattle are important to investigate. The objectives of this research were to study effect of papain enzymes, internal endpoint temperatures and thawing methods on Warner-Bratzler shear force (WBSF) and cooking loss of meat from yearling Brahman Cross and Ongole Cross 3-4 years old used as young and mature beef respectively. Young frozen beef was thawed for 24 hr in refrigerator or soaking in ambient temperature water for 30 min. Old beef was only thawed used first thawing method. Cooking loss and WBSF were evaluated after beef were treated with or without soaking in papain enzyme solution for 30 min and continued with boiling until internal endpoint temperature 80 ^{o}C, 90 ^{o}C or 100 ^{o}C. The result showed that papain could improve tenderness of mature beef if reach internal endpoint temperature 90 ^{o}C, but could not at young beef. Cooking loss of young and mature beef that were boiled until internal endpoint temperature 80 ^{o}C or 90 ^{o}C had no differences. Thawing for 24 hr in refrigerator with internal endpoint temperature 80oC resulted in the most tenderness and the lowest cooking loss in young beef. In conclusion; the use of papain enzyme to improve tenderness was effective for mature beef, and internal endpoint temperature 80 ^{o}C or 90 ^{o}C was better than 100 ^{o}C to get lowest cooking loss at young beef neither mature beef. In this research beef from mature Ongole Cross (Indonesian local breed) has lower WBSF value (more tender) than beef from young Brahman Cross (Australian Brahman Cross).

Key words: beef tenderness, cooking loss, tenderizing method

Introduction

Tenderness is the main factor that influences meat palatability and consumer decision for choosing the meat (Brooks *et al*., 2000). Beef tenderness was affected by breed (Huffman *et al*., 1967; Slanger *et al*., 1985), age (Shorthose and Harris, 1990; Huff-Lonergen *et al*., 1995), feed (Ponnampalam *et al*., 2002), aging (George-Evin *et al*., 2004), chilling and rate of cooking (King *et al*., 2003). Papain enzyme was proteolytic enzyme that could improve the meat tenderness (Huffman *et al*., 1967; Ionescu *et al*., 2008). Ionescu *et al*. (2008) reported that papain, besides bromelin, led to a limited hydrolysis of beef meat proteins, to a loss of physical integrity of muscle and connective tissue, accompanied by a high solubility of structural proteins, and to an improvement of the beef meat tenderness. Addition end point of internal temperature in cooking also plays a part in beef tenderizing (Parrish *et al*., 1973; Liu and Berry 1996; George-Evin *et al*., 2004). The other factor that could affect beef tenderness before cooking is thawing method.

Information about meat tenderizing method was necessary to produce beef tender. Besides that, cooking loss also to be concern as beef cooking characteristic that influence consumer acceptance. Tenderizing treatments such as enzyme, internal temperature, and thawing method on beef from different age and breed of cattle have to be investigated. The objectives of this research were to study the effect of papain enzymes, internal endpoint temperatures and thawing methods on Warner-Bratzler shear force (WBSF) and cooking loss of meat from yearling Brahman Cross and Ongole Cross 3-4 years old used as young and mature beef respectively.

Materials and Methods

Beef that used in this research were got from round of male yearling Brahman Cross as young beef, and Ongole Cross 3-4 years old as mature beef. Both of meats were frozen until evaluation procedures were held. Frozen young beef was thawed with different method. Beef that still covered in plastics packaging were thawed for 24 hr in *refrigerator* or soaked in ambient temperature water for 30 min. The mature beef was only thawed by first thawing method. After thawing, the packaging were removed from samples, and were treated with or without soaking in papain enzyme solution (2% crude extract; w/v) for 30 min that continued with boiling until reach internal endpoint temperature (IET) 80 ^oC, 90 ^oC or 100 ^oC.

Tenderness was measured by WBSF (kg/cm^2). Beef samples boiled according to each treatment, and then min of three 1.27 cm diameter and length 3-4 cm of samples cores were taken parallel to the muscles fiber. Then the cores were shared by Warner-Bratzler shear. Cooking loss represented weight losses after cooking that was measured as sample weight margin before and after boiled.

The effect of IET (80^{o}C, 90^{o}C dan 100^{o}C), papain enzyme (with and without), and thawing method (soaking 30 min in water and refrigerator for 24 hr) on WBSF and cooking loss of young beef from Brahman Cross were arranged in factorial design 3 x 2 x 2 with 3 replication and used randomize complete design as basic design. While effect of internal endpoint temperature (80 ^{o}C, 90 ^{o}C dan 100 ^{o}C), papain enzyme (with and without) on WBSF and cooking loss of Ongole Cross studies used factorial design 3 x 2 with 3 replication and randomize complete design as basic design. Analysis of variance was used to analyze effect of the treatment, and mean differences among treatment was analyzed using Tukey test.

Results and Discussion

Beef thawed at refrigerator (4-6 ^oC) for 24 hr was more tender (was indicated by lower WBSF at P<0.05) than beef soaked for 30 min at ambient temperature water (Table 1). This fact indicated that beef tenderness was caused by the damage of meat fiber as consequence of ice crystal formation, and the damage of meat fiber thawed at refrigerator was more intensive than that thawed in water. This explanation make reference to Linares *et al.* (2005) that reported that slow thawing as it happened in refrigerator causes more damage through ice crystallization in the meat.

Actually, enzyme papain and IET treatment didn't affect the tenderness of young beef from yearling Brahman Cross (Table 1). That case was different with WBSF value of beef from mature Ongole Cross. WBSF value of beef from mature Ongole Cross significantly affected (P<0.05) by interaction of IET and papain enzyme treatment. Non-papain treatment resulted in the lowest WBSF (the most tender) at endpoint internal temperature 100 ^oC, while if use papain treatment, the lowest WBSF (the most tender) reached at IET 90 ^oC (Table 2).

Table 1. Warner-Bratzler sheared force of young beef treated by papain enzyme, different thawing method, and internal endpoint temperature (kg/cm2)

Thawing/Enzyme	Internal Temperature		
	80 ^oC	90 ^oC	100 ^oC
Soaking, 30 min			
Non-papain	5.32 ± 0.98	4.19 ± 0.36	6.40 ± 2.07
Papain	6.89 ± 1.28	4.83 ± 0.76	5.07 ± 0.38
Mean		5.42 ± 1.33[a]	
Refrigerator, 24 hr			
Non-papain	4.09 ± 1.12	4.36 ± 0.15	4.47 ± 0.22
Papain	4.71 ± 0.40	5.40 ± 0.81	4.84 ± 1.13
Mean		4.62 ± 0.80[b]	
Mean of internal temperature	5.17 ± 1.40	4.65 ± 0.71	5.19 ± 1.27
Mean of Papain			
Non-papain		4.77 ± 1.23	
Papain		5.27 ± 1.05	

Note: Different superscript in the same column indicate significant different (P<0.05).

This study indicated that papain application to improve tenderness was effective for mature beef. The result could be explained according to report of Ionescu *et al.* (2008) that papain showed hydrolytic activity on the connective tissue, leading to a better tenderization of the adult beef meat. Another fact from this research showed that beef from mature Ongole Cross (Indonesian local breed) has lower WBSF value (more tender) than beef from young Brahman Cross (Australian Brahman Cross) (Tabel 1 and 2).

Cooking loss of young beef from Brahman Cross was affected by interaction among IET, thawing method and use of papain enzyme (P<0.05). The lowest cooking loss reached by IET 80^{o}C for both of papain and thawing treatment, and 90 ^{o}C for all the treatment, except thawing by soaking for 30 min in ambient temperature water and without papain using (Table 3). Cooking loss of mature beef from Ongole Cross significantly affected (P<0.05) by interaction between papain enzyme and IET of cooking (Table 4). Internal endpoint temperature 80^{o}C with or without papain enzyme treatment resulted lower percentage of cooking loss, and no difference with IET 90^{o}C with or without enzyme. This research showed that increasing of IET

Table 2. Warner-Bratzler sheared force of mature beef treated by papain enzyme and internal endpoint temperature (kg/cm2)

Enzyme	Internal Temperature		
	80 ^{o}C	90 ^{o}C	100 ^{o}C
Non-papain	3.91 ± 0.15^a	3.82 ± 0.50^a	2.64 ± 0.42^{ab}
Papain	3.02 ± 0.48^{ab}	2.22 ± 0.52^b	3.73 ± 0.64^a

Note: Different superscript in the same raw and column indicate significant different (P<0.05).

Table 3. Cooking loss of young beef treated by papain enzyme, different thawing method, and internal endpoint temperature (%)

Thawing/Enzyme	Internal Temperature		
	80 ^{o}C	90 ^{o}C	100 ^{o}C
Soaking, 30 min			
Non-papain	37.90 ± 3.75^{bcd}	42.70 ± 4.10^{abc}	47.49 ± 6.21^{ab}
Papain	35.24 ± 6.93^{bcd}	39.35 ± 6.41^{abcd}	46.80 ± 5.87^{ab}
Refrigerator, 24 hr			
Non-papain	29.16 ± 4.95^d	37.84 ± 4.63^{bcd}	43.59 ± 6.16^{ab}
Papain	28.68 ± 3.49^d	39.07 ± 2.84^{abcd}	50.96 ± 7.23^a

Note: Different superscript in the same raw and column indicate significant different (P<0.05).

Table 4. Cooking loss of mature beef treated by papain enzyme and internal temperature (%)

Enzyme	Internal Temperature		
	80 °C	90 °C	100 °C
Non-papain	23.86 ± 5.09[d]	32.33 ± 3.87[bcd]	42.38 ± 7.21[a]
Papain	28.51 ± 2.31[cd]	35.95 ± 3.63[abc]	41.03 ± 4.57[ab]

Note: Different superscript in the same raw and column indicate significant different (P<0.05).

increased percentage of cooking loss both of young and mature beef. The result accord with George-Evan *et al*. (2005) reported that the increasing of IET increased cooking time and cooking losses.

Conclusions

The use of papain enzyme to improve tenderness was effective for mature beef, and internal endpoint temperature 80°C or 90 °C were better than 100 °C to get lowest cooking loss at young beef neither mature beef. In this research beef from mature Ongole Cross (Indonesian local breed) has lower WBSF value (more tender) than beef from young Brahman Cross (Australian Brahman Cross).

Acknowledgement

This research was funded by Young Lecturer Research Grant Program, Bogor Agricultural University. Great thank to Diah Retno Sulistiyowati, S.Pt. and Kamto Subagyo, S.Pt. as technical assistance in this research.

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