MEAT QUALITY AND CALPASTATIN QUANTIFICATION OF THAI NATIVE BOVINE MUSCLES

Tavitchasri P.[1*], Uaphattanaphong P.[2], Ngamyeesoon N.[3] and Sethakul J.[2]

[1] Program in Animal Science, Department of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Chumphon Campus, Chumphon, 86160, Thailand.

[2] Department of Animal Production Technology and Fisheries, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, 10520, Thailand.

[3] Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, 10520, Thailand.

Abstract – This study aimed to quantify differences in meat quality parameters and calpastatin (CAST) levels in 9 muscles from two Thai native cattle groups, Tak and Kanchanaburi. Muscles taken from the right side of five Kanchanaburi and four Tak crossbreeds at 5 days post mortem showed that overall Tak meat had higher ultimate pH and b* colour values, but lower L* colour, Warner-Bratzler shear force (WBSF) and CAST values than Kanchanaburi meat (P<0.05). Ultimate pH, meat colour, WBSF and CAST varied between different muscles in both groups. Across both groups, Psoas major (PM) muscle showed lowest WBSF and CAST values (P<0.05), followed in order by *Longissimus dorsi* (LD), *Biceps femoris* (BF), *Triceps brachii* (TB), *Semitendinosus* (ST), *Rectus femoris* (RF), *Supraspinatus* (SS), *Semimembranosus* (SM) and *Gluteus medius* (GM).

Key Words – tenderness, calpastatin protein, Thai native cattle

I. INTRODUCTION

Toughness was a major reason for unacceptability of Thai beef consumption [1]. Most of Thai native cattle, which have high percentage of *Bos indicus*, were raised under free range grazing, stall-fed with grass or retired cattle from farm work. Although their meat is less tender, Thai style cooking such as boiling or stew is suitable for them. In general, many factors affect the tenderness of the meat. The role of protease enzyme, calpains, appears to be an important cause of postmortem tenderization process of meat [2]. Calpastatin, the calpain inhibitor, is the primary factors that influence calpain activity in postmortem proteolysis. Increasing of its activity postmortem is highly related with reduce meat tenderness [3]. Decreased tenderness has been associated with the presence of the *Bos indicus* in the crossbreeding [4]. Tenderness are mainly related to a reduced level of calpain in *Bos indicus* and higher calpastatin. Tavitchasri *et al*. [5] reported that crossbred cattle (>62.5% Simmental) had higher beef tenderness, while higher values for calpastatin protein than Thai native cattle (>50% Brahman) due to higher marbling scores and older age. There had been a few studies on the variation in tenderness among different muscles in Thai beef, therefore this study was to determine the meat quality and distribution of calpastatin protein in various muscles from two Thai native cattle groups.

II. MATERIALS AND METHODS

This study involved the following cattle types: 1) five Thai native cattle (Kanchanaburi), naturally raised under free range grazing and 2) four Thai native crossbred (Tak; Brahman x at least 62.5% Thai native), raised with cultivated grass supplemented with pangola grass, ruzi grass and hamata bean in the stall. The beef samples were *Psoas major* (PM), *Longissimus dorsi* (LD), *Triceps brachii* (TB), *Supraspinatus* (SS), *Gluteus medius* (GM), *Semitendinosus* (ST), *Semimembranosus* (SM), *Biceps femoris* (BF) and *Rectus femoris* (RF) muscles, randomly collected from the right side of each carcass at 5 day postmortem ageing. In each muscle quality was determined measuring ultimate pH (pHu), meat color (L*, a*, b*), Warner-Bratzler shear force (WBSF) and calpastatin protein (CAST). Calpastatin protein was detected using the method of Geesink *et al*. [6]. Supernatant containing heat-stable proteins, including CAST, was use for

determination of CAST by indirect Enzyme Linked Immunosorbant assay. Polyclonal antibodies, used to assay the level of CAST protein, were raised in rabbit against recombinant bovine skeletal muscle calpastatin as previously reported by Tavitchasri *et al*. [7]. The statistical analysis of meat quality data was performed using PROC GLM of the Statistical Analysis System. When significance was determined ($p<0.05$), least square group means were compared using the PDIFF test of SAS (2000).

III. RESULTS AND DISCUSSION

The study indicated that the Kanchanaburi carcasses had lower pH value in meat but higher lightness (L*) than the Tak carcasses ($P<0.05$) (Table 1) resulted in lighter meat. There was a relationship between muscle pH and color measurement. Muscle pH value had negative correlations to lightness [8]. There were no significant in redness values (a*) of meat between cattle groups ($P>0.05$). While, yellowness value (b*) of Tak was higher than Kanchanaburi meat ($P<0.05$) as a result of the intramuscular fat content.

Meat from Kanchanaburi was less tender than meat from Tak ($P<0.05$). This result was consistent with the higher content of CAST compared to Tak muscles. The crossbreeding of Tak cattle with Brahman breed and feeding high quality grass in the stall resulting in higher marbling content may explain this difference in tenderness.

In the present study, there was positive correlation between WBSF and CAST ($r = 0.14$). Shackelford *et al*. [4] and Wolf *et al*. [9] reported that there were relationships between shear force and calpastatin activity ($r = 0.27$ and $r = 0.09$, respectively).

Table 1 Effect of cattle type on meat quality variation (LSM±SE)

Parameters	Cattle	
	Tak	Kanchanaburi
pH	5.56±0.03[a]	5.48±0.02[b]
L* (lightness)	42.49±0.36[b]	44.98±0.33[a]
a* (redness)	18.23±0.28[a]	18.29±0.25[a]
b* (yellowness)	8.62±0.21[a]	4.27±0.21[b]
WBSF (kg)	6.70±0.22[b]	7.83±0.19[a]
CAST (µg/µl)	1.20±0.02[b]	1.42±0.02[a]

[a-b] Means with a row without a common superscript letter differ ($P<0.05$)

Ultimate pH, meat color, WBSF and CAST were affected by different muscles (Table 2). Thai native muscles were in the range 5.32 to 5.61, a range considered as the normal ultimate pH for beef muscle. *Gluteus medius* muscles had lower pH than the other ($P<0.05$). Meat color of ST was lighter and lower in redness value ($P<0.05$) resulted in pale meat color. In addition, b* value was higher in PM while, lower in GM ($P<0.05$).

Differences in tenderness ratings among muscles were consistent with CAST. *Psoas major* muscle was the most tender and presented the lowest CAST content followed by LD, BF, TB, ST, RF,

Table 2 Effect of muscle type on meat quality variation (LSM±SE)

Muscles	Parameters					
	pH	L* (lightness)	a* (redness)	b* (yellowness)	WBSF	CAST
Psoas major (PM)	5.58±0.05[a]	42.16±0.73[c]	21.89±0.57[a]	9.34±0.43[a]	5.60±0.44[f]	1.13±0.04[d]
Longissimus dorsi (LD)	5.59±0.05[a]	46.36±0.73[b]	16.67±0.57[bcd]	5.35±0.43[de]	6.24±0.44[ef]	1.16±0.04[cd]
Triceps brachii (TB)	5.57±0.05[a]	44.70±0.73[b]	21.15±0.57[a]	7.94±0.4[ab]	6.36±0.44[def]	1.26±0.04[bc]
Supraspinatus (SS)	5.45±0.05[ab]	38.90±0.73[d]	18.11±0.57[bc]	5.92±0.43[cd]	8.04±0.44[bc]	1.38±0.04[a]
Gluteus medius (GM)	5.32±0.05[b]	41.13±0.73[c]	15.22±0.57[de]	4.20±0.43[e]	9.80±0.44[a]	1.42±0.04[a]
Semitendinosus (ST)	5.54±0.05[a]	50.43±0.73[a]	14.89±0.57[e]	6.77±0.43[bc]	7.01±0.44[cde]	1.33±0.04[ab]
Semimembranosus (SM)	5.44±0.05[ab]	40.60±0.73[cd]	18.39±0.57[b]	6.30±0.43[cd]	8.42±0.44[b]	1.40±0.04[a]
Biceps femoris (BF)	5.61±0.05[a]	44.54±0.73[b]	21.62±0.57[a]	7.11±0.43[bc]	6.36±0.44[def]	1.22±0.04[cd]
Rectus femoris (RF)	5.56±0.05[a]	44.80±0.73[b]	16.40±0.57[cde]	5.07±0.43[de]	7.54±0.44[bcd]	1.36±0.04[a]

[a-f] Means with a column without a common superscript letter differ ($P<0.05$)

SS, SM and GM muscles ($P<0.05$). Although GM muscles were tougher and higher CAST corresponded to the lowest in pH level resulted in high free water, therefore, high cooking loss lead to tougher meat. Furthermore, GM had lower b* value associated with less intramuscular fat. A previous study reported that tenderloin (PM) steaks were consistently rated extremely tender, while top sirloin (GM) was rated as tougher beef [10]. Moreover, there was no significant effect of the interaction between cattle groups and different muscles on beef quality.

IV. CONCLUSION

Meat from Tak was more tender than Kanchanaburi with average lower shear force values of all muscles tested, although meat color was darker. Ultimate pH, meat color, tenderness and calpastatin protein were different in each muscle type. PM was the most tender muscle, while the GM muscle was the toughest.

ACKNOWLEDGEMENTS

The author would like to thanks
- Meat Technology Research Network Center of King Mongkut's Institute of Technology Ladkrabang
- Thailand Research Fund

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