MYOFIBRILLAR PROTEIN DEGRADATION OVER AGEING PERIOD OF KAMPAENGSAEN BEEF

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Keywords: *Myofibrillar protein, Degradation, Beef, Ageing, SDS-PAGE*

Introduction

Meat tenderness is an important characteristic to indicate meat quality. Moreover, the tenderness also depends on breed, for instance the *Bos taurus* crossbred beef has been characterized as more tender than the *Bos indicus* crossbred beef (Wheeler et al., 1990). As the percentage of *Bos indicus* increased, the level of tenderness decreased (Whipple et al., 1990). Storage of carcasses at refrigerated temperatures has been reported to improve the tenderness by increasing postmortem protein degradation by Ca^{2+}-dependent proteases (CDP) and cathepsins (Koomaraie and Shackelford, 1991). The major groups of proteins degraded during the ageing storage are myofibrillar proteins, the proteins responsible for muscle contraction. The degradation of myofibrillar proteins in beef has been characterized by electrophoretic separation using sodium dodecyl sulphate-polyacrylamide (SDS-PAGE). Titin, nebulin desmin and troponin-T were found to decrease over the 28 day of ageing period whereas myosin, actin, actinin and tropomyosin were found not changed (Ho et al., 1997).

The research focused on the study of myofibrillar protein degradation in a Thailand developed crossbreed called Kampaengsaen breed (Prueksasri, 2001). The protein pattern was semi-quantitatively determined by SDS-PAGE. The relationship between the observed protein bands and the shear force values was analyzed.

Materials and Methods

Ten Kampaengsaen steers (25% Thai native x 25% Brahman x 50% Charolais), live weight 500–550 kg, were slaughtered. The *Longissimus dorsi* muscle from the 6th to the 12th ribs of the abdominal region was removed. Steaks of 2.5cm thickness were vacuum-packaged and aged at 2-4^{o}C for 0, 1, 3, 5, 7, 10, 14, 17 and 21 days. The shear force was measured at 1, 5, 7, 14 and 21 days postmortem using an Instron Warner–Bratzler Model 1011 with 50 kg compression load cell and speed 500 mm/min as described by (Devine et al., 1999). Myofibrillar protein extraction and SDS-PAGE analysis were performed using the method reported by Clayes et al. (1995). Protein bands were separated in vertical slab gels (14 cm X 16 cm X 0.15 cm) with 4% stacking gel and 8% separating gel in Tris-glycine buffer. SeeBlue® Plus2 Pre-Stained Standard (Invitrogen, US) was used as protein molecular weight marker. Bovine serum albumin (BSA) was used as an internal control for relative quantitative measurement of each protein band.

Results and Discussion

The myofibrillar proteins of Kampaengsaen beef were separated by the SDS-PAGE (Figure 1). From the electrophoretic profiles, the densities of myosin (210 kDa), α-actinin (148), desmin (67 kDa), actin (42 kDa), tropomyosin (34-36 kDa), myosin light chain 1 (MLC-1) (26 kDa), myosin light chain 2 (MLC-2) (18 kDa), and myosin light chain 3 (MLC-3) (16 kDa) bands did not change over the ageing period of 21 d postmortem (Figure 1). Four protein bands corresponding to troponin-T (37-39 kDa), troponin-I (24 kDa) and 113 kDa were decreased whereas troponin-T degraded product (30 kDa) and 27 kDa bands were increased as ageing time increased. The quantity of each protein was calculated using BSA band calibration (Table 1). As postmortem ageing time increased, the shear force value decreased from 7.39 kg at day 1 to 3.82 kg at day 21 (Table 1). The decline in shear force was strongly related to the decline in 113 kDa protein, troponin-T and troponin-I proteins as well as the increase in troponin-T degraded product and 27 kDa protein indicating the degradation of these proteins is related to Kampaengsaen beef tenderness.

Conclusions

The degradation of myofibrillar proteins is remarkably related to the shear force which is associated with tenderness of Kampaengsaen beef. Identification of the 27 kDa and 113 kDa bands would be the object of further investigation.

Figure 1. SDS-PAGE of myofibrillar proteins of Kampaengsaen beef after ageing for 0, 1, 3, 5, 7, 10, 14, 17 and 21 days postmortem. Bovine serum albumin (BSA) was an internal control. Standard molecular weight showed on the left. Relative molecular weight showed on the right.

Table 1. Mean of protein quantity* (μg BSA-equivalents/mg myofibrillar protein)**.**

Protein	Ageing									Trend
Band	0 d	1 d	3 d	5 d	7 d	10 d	14 d	17 d	21 d	
113 kDa	37.4	35.1	30.3	15.1	10.0	10.5	11.7	n.d	n.d.	↓
39 kDa	79.7	74.6	66.3	66.0	62.7	60.1	61.9	54.5	55.2	↓
37 kDa	75.7	70.9	63.0	62.7	59.5	57.1	58.8	51.8	52.5	↓
30 kDa	21.5	27.9	45.0	47.4	50.5	56.5	66.7	74.0	76.3	↑
27 kDa	n.d	n.d	40.9	43.5	45.3	47.4	57.8	65.0	67.5	↑
24 kDa	67.6	54.8	40.3	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	↓
Shear force (Kg)	n.a.	7.39±0.10	n.a.	5.99±0.07	4.99±0.1	n.a.	4.45±0.58	n.a.	3.82±0.4	↓

n.d. = not detectable n.a. = not available ↑ = increase, ↓ = decrease

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