EFFECTS OF CALCIUM ACETATE ON PROTEOLYSIS AND TENDERIZATION OF SPENT DUCK MEAT

Ya-Shiou Chang*

Department of Animal Science, Chinese Culture University, Taiwan

*Corresponding author email: zyx21@ulive.pccu.edu.tw

I. INTRODUCTION

Duck meat continuously gains interests globally. To utilize spent duck meats, calcium chloride has been widely applied as a meat tenderizer, and its application for increasing the tenderness of spent hen is conceivable [1]. Calcium acetate is thought to be as a potential candidate to meet the requirement of clean label because it is a natural agent with high solubility and gastrointestinal absorbability compared to other calcium salts [2]. While calcium acetate is used primarily for baking and pharmaceutical industries, study of its application in duck meat tenderization is still limited. Therefore, the purpose of this study was to determine the effects of calcium acetate on spent duck tenderness.

II. MATERIALS AND METHODS

Thirty spent laying duck (24 months old) carcasses chilled immediately in a water bath at 12 °C for 1 h (the 0-d sample). The pectoralis major (BM) muscles were taken from each carcass after chilling and incubated in a 400 ml of pre-cold 30 mM calcium acetate (ACA sample) at 5 °C. Control BM samples (CON sample, without 30mM calcium acetate incubation) were incubated in a 400 ml of pre-cold distilled water at 5 °C. The left-side BM sample was sampled at 0 (1-h postmortem prior to incubation), 1, 2, and 3 d of incubation at 5 °C. Upon sampling, the specimens were finely minced by a scalpel, quickly snap-frozen in liquid nitrogen and stored at -80 °C until needed for pH measurement [3], myofibril preparations and SDS-PAGE [4]. The right-side BM sample was divided into two equal parts and sampled in 1- and 3-d postmortem for shear force measurements [5]. All data were analyzed using SAS 9.3 using split plot, mixed model procedure, $P < 0.05$ considered as significant.

III. RESULTS AND DISCUSSION

Figure 1 shows the pH in 0-d CON (6.46) and ACA (6.48) samples decreased significantly ($P < 0.05$) in 1-d CON (5.99) and ACA (5.93) samples. However, the pH remained nearly unchanged through 3-d samples (5.96 CON vs. 5.92 ACA). Because the troponin-T degradation products (~30kDa) have been defined as one of the important indicators of postmortem proteolysis [6], the accumulation of the 26/32 kDa component in duck muscle may correlate with the improvement of postmortem meat tenderness [7]. SDS-PAGE gel shows that the 26/32 kDa bands appeared more clearly in ACA (Fig.1B) than in CON (Fig.1A) samples by day 1 and the band intensities increase in both samples during the entire 3-d experimental period. Image analysis (Fig.1C) shows that the content of 26/32 kDa components in 3-d ACA samples, which was taken as 100%, was the most abundant in all samples. The 26/32 kDa component content increased form 0-d (12% CON vs. 12% ACA) to 1-d (21% CON vs. 61% ACA) and to 3-d (32% CON vs. 100% ACA) samples, respectively. These results indicated that the total content of 30/32 kDa components were generated rapidly ($P < 0.05$) in ACA than in CON samples, showing the occurrence of extensive proteolysis. Moreover, shear force values (Table 1) were much lower ($P < 0.05$) in 3-d sample (9.63 kg CON vs 7.14 kg ACA) than in 1-d sample (12.29 kg CON vs 10.22 kg ACA).

Table.1 Postmortem changes of pH and shear force values in control (CON, without without 30mM calcium acetate incubation), calcium acetate-incubated (ACA) Tsaiya duck breast samples stored at 5°C.

Measurement	Postmortem time, day	CON sample	ACA sample
pH value	Day 0	6.46±0.09^{a}	6.48±0.07^{a}
	Day 1	5.99±0.02^{b}	5.93±0.05^{b}
	Day 2	5.96±0.03^{b}	5.94±0.03^{b}
	Day 3	5.96±0.05^{b}	5.92±0.04^{b}
Shear force (Kg)	Day 1	12.29±0.19^{by}	10.22±0.46^{bx}
	Day 3	9.63±0.15^{ay}	7.14±0.42^{ax}

*Within a row$^{x, y}$ or a column$^{a, b}$, means without a common superscript differ in the same measurement ($P < 0.05$).

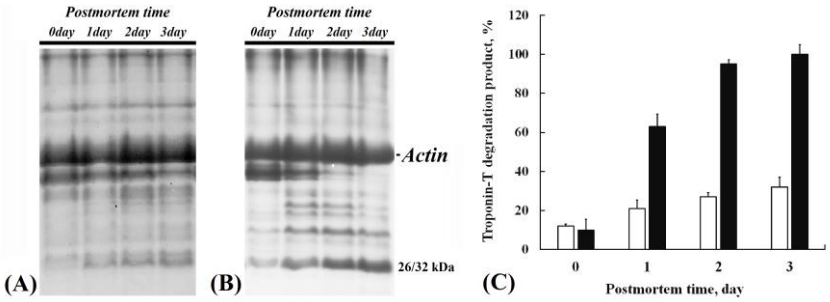

Figure 1. Twelve percent SDS-PAGE gel of myofibrils prepared from control (Fig 1A, CON, without 30 mM calcium acetate incubation) and 30 mM calcium acetate-incubated (Fig 1B, ACA) spent duck breast samples. Image analysis (C) shows changes in troponin-T degradation products (~32 to 26 kDa TN-T degradation products) of CON (open-bar) and ACA (filled-bar) samples stored at 5°C. The relative troponin-T degradation content is expressed as a percent of the total ~32 to 26 kDa content in the 3-d ACA samples, which was taken as 100%. Each point is the average of 15 replications. Bar = Standard error.

IV. CONCLUSION

The results suggest that by enhancing the proteolysis and tenderization, calcium acetate could be used as a tenderizer for postmortem breast muscles of spent duck.

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