EFFECTS OF *POST MORTEM* DEBONING TIME ON PHYSICAL, CHEMICAL, MORPHOLOGICAL AND ORGANOLEPTIC PROPERTIES OF CHICKEN BREAST MEAT DURING *POST MORTEM* AGING

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Background

It is often said that chicken beast meat is not favourite for lack of its juiciness and tenderness in Japan, although chicken is most cheap in meat. The improvement of chicken beast meat qualities is now being required. It is well known that rigor mortis happens immediately after slaughter and the muscles in an animal become tough. It was reported that rigor mortis reached to the maximum at 2 hours after slaughter, which leads to make chicken muscle the toughest (Negishi and Yoshikawa, 1994). This phenomenon not only hardens meat but also reduces juiciness of meat, resulting in decline in meat quality even if meat is stored for *post mortem* aging at low temperature.
In Japan, the production of broiler meat is expanded. The deboning process in a factory in Japan is immediately conducted after slaughter in order to save time for production of broiler meat from a living body, because freshness of chicken meat is required from a market. In general, boiler breast meat in Japan is evaluated non-juiciness. This problem is caused by rigor mortis after slaughter. In order to prevent such a decline in meat quality, it is important to make influence of rigor mortis as small as possible. It is reported to pass a time zone of rigor mortis in the state on the bone as one of the methods of making influence of rigor mortis small (McKee *et al.*, 1997). However, it has not clarified how deboning time after slaughter influences rigor mortis and meat quality after *post mortem* aging.

Objectives

The objective of this work was to clarify the effects of *post mortem* deboning time on physical, chemical, morphological and organoleptic properties of chicken breast meat after *post mortem* aging in order to the improvement of juiciness and tenderness.

Materials and methods

Preparation of chicken breast: In analysis and sensory evaluation, chicken breast meat obtained from male broiler (White Rock×White Cornish) deboned at 1, 2, 4, 6 or 24 h (hours) *post mortem* was aseptically put into polyvinylidene chloride bags, vacuum-sealed, and stored at 0 ˚C for 4 days. In morphological observation, one obtained from female broiler deboned at 1, 8 or 16 h *post mortem*. Each sample deboned at 1 h *post mortem* was observed after aging until 8 or 16 h at 0 ˚C.

Sensory evaluation: Samples for sensory evaluation were skinned and grilled at 140˚C until internal temperature became 70 ˚C. Tenderness, juiciness and palatability were evaluated by well-trained panels using Kramer ranking tests (1963).

Cooling loss and cooking loss: Amounts of drips separated from samples after storing at 4 ˚C for 4 days were measured and the cooling loss was expressed with the rate of drip to sample weight. Their samples were skinned and vacuum-sealed. Amounts of drips separated from samples during heating at 70 ˚C for 70 minutes in a water bath were measured and the cooking loss was expressed with the rate of drip to sample weight before heating.

Shear force values: Pectoral muscles separated from chicken breast used for measurement of cooking loss were cut into 4×1×1 cm. Their shear force values were determined by Tensipresser™ (TTP-50BX, Taketomo) with a cylindrical plunger of 5.5 mm in diameter (Ozutsumi *et al.*, 1988).

Morphological observation: Pectoral muscles of chicken breast deboned at 1, 8 or 16 h *post mortem* were immediately fixed with 0.5 % paraformaldehyde in K-phosphate buffer (pH 7.3) by standard method. The samples for observation with optical microscope (DX-50, Olympus) were stained with hematoxylin and eosin. The pre-fixed samples were fixed with 2% osmium tetroxide and dehydrate by standard method. They were embedded in epoxi resin and the blocks were cut with ultracut ultramicrotome. Their sections were stained with uranyl acetate and lead citrate for observation with transmission electron microscope (1200EX, Joel). The distance between Z lines of each sample was measured as arbitrary average value of ten points.

Myofibrillar fragmentation index (MFI): Myofibrils prepared from chicken breast meat were suspended, observed at 1,000 magnification under a phase-contrast microscope, and photographed. MFI (%) was measured as the ratio of myofibrillar fragments composed of 1-4 sarcomeres.

Results and discussion

Sensory evaluation: Table 1 shows the sensory properties after post-deboning aging for 4 days at 0℃. Chicken breast deboned at 4 h *post mortem* was the most tender and juicy among those deboned at 1, 2, 4, 6 h *post mortem*. Chicken breast deboned at 6 h *post mortem* was more palatable than that deboned at 4 h *post mortem*. It was shown that chicken breast deboned at 4-6 h *post mortem* were the most tender, juicy and palatable those after post-deboning aging.

Cooling loss and cooking loss: Figure 1 shows cooling loss and cooking loss after post-deboning aging. Cooling loss of chicken breast deboned at 1 or 2 h *post mortem* was higher than those of ones deboned at 4, 6 and 24 h *post mortem*. On the other hand, the cooking loss of chicken breast deboned at 1 h *post mortem* was also lager than those of meats deboned at 4, 6 and 24 h *post mortem*.

Shear force values: Shear force value of chicken breast meat after post-deboning aging was shown in Figure 2. Shear force value of breast meat deboned at 1 h *post mortem* was lager than those of meats deboned at 2, 4, 6 and 24 h *post mortem*, and shear force value of breast meat deboned at 2 h *post mortem* was also lager than those of meats deboned at 6 and 24 h *post mortem*. These results were consistent with those of the sensory evaluation for juiciness and tenderness.

Morphological observation: Optical micrographs of pectoral muscle deboned at 1, 8 and 16 h *post mortem* were shown in Fig. 3. Some crooked portions were observed in the myofibrils of pectoral muscle deboned at 1 h *post mortem*, while they were not observed in breast muscle deboned at 8, 16 h. The observation by transmission electron microscope showed that the distance between Z lines in myofibrils of chicken pectoral muscle deboned at 8 or 16 h *post mortem* was longer than that of muscles deboned at 1 h *post mortem* (Table 2). It was suggested that the latter myofibrils were observed to be wounded partially, because the rigor mortis was accelerated after deboning.

Myofibrillar fragmentation index (MFI): Figure 4 shows MFI after post-deboning aging. The MFI of chicken breast meat deboned at 1 or 2 h *post mortem* was smaller than those of meat deboned at 4, 6 and 24 h. It was also shown that weakening of Z lines of chicken pectoral muscle deboned after 4 h *post mortem* was significantly increased, and its tenderization was also accelerated.

Conclusions

From these results of this work, it was concluded that deboning of chicken breast after 4 h *post mortem* improved meat qualities such as tenderness, juiciness, cooling loss, cooking loss and shear force value.

References

Kramer, A. 1963. A rapid method for determining significance of difference from rank sums. Food Technol., 14: 576-581.

McKee, S.R., Hirschler, E.M. and Sams, A.R. 1997. Physical and biochemical effect of broiler breast tenderization by aging after pre-rigor deboning. J. Food Sci., 62: 959-962.

Negishi, H. and Yoshikawa, S. 1994. Changes in physical and chemical properties of breast meat during processing of broiler at a chicken factory after slaughter. Anim. Sci. Technol. (Jpn.) 65: 738-745.

Ozutsumi, K., Ozawa, S., Chikuni, K., Koishikawa, T., Kato, S. and Yoshitake M. 1988. The hardness measurement of various muscles in beef cattle via a Tensipresser. Anim. Sci. Technol. (Jpn.) 59: 590-595.

Table 1. Effect of *post mortem* deboning time on the tenderness, juiciness and palatability of chicken breast meat aged at 0 ˚C for 4 days

1. Deboning time at 1, 2, 4 h postmortem

	Ranking		
	1 hour	2 hours	4 hours
Tenderness	3 **	2	1 **
Juiciness	3 *	2	1 **
Palatability	3 *	2	1 *

2. Deboning time at 1, 4, 6 h postmortem

	Ranking		
	1 hour	4 hours	6 hours
Tenderness	3 **	1 **	2
Juiciness	3 **	1 **	2 *
Palatability	3 **	2	1 **

****p<0.01 ; *p<0.05 (ranking test, Kramer method).**

Fig. 1. Effect of *post mortem* deboning time on the cooling loss and cooking loss of chicken breast meat aged at 0 ˚C for 4 days

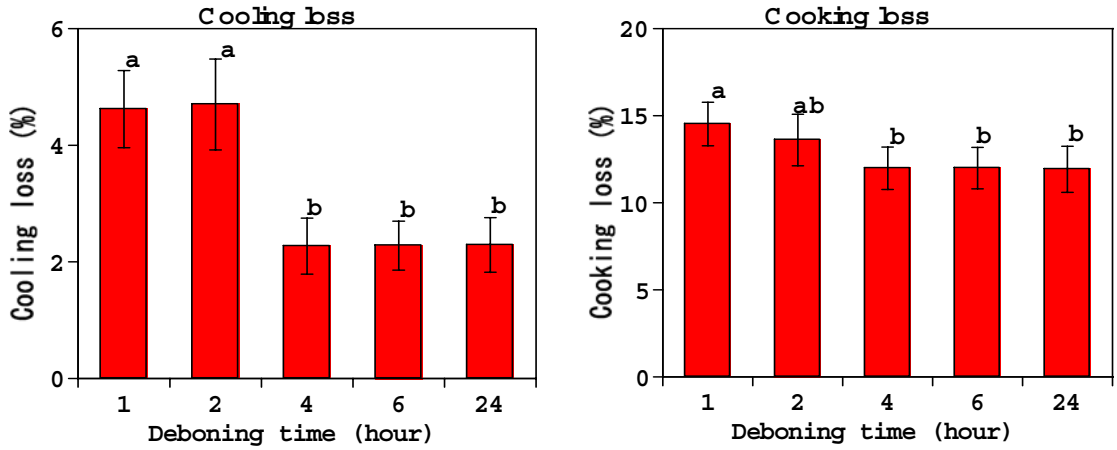

Fig. 2. Effect of *post mortem* deboning time on the shear force value of chicken breast meat aged at 0 ˚C for 4 days

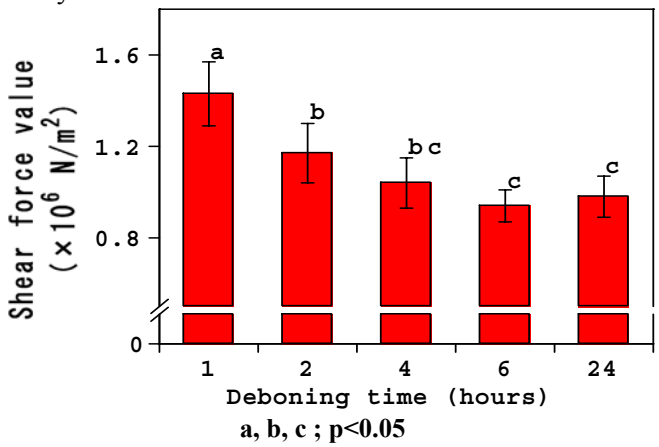

Fig. 3. Optical micrographs of pectoral muscle deboned at 1, 8 and 16h *post mortem*
(Vertical section ; ×800)

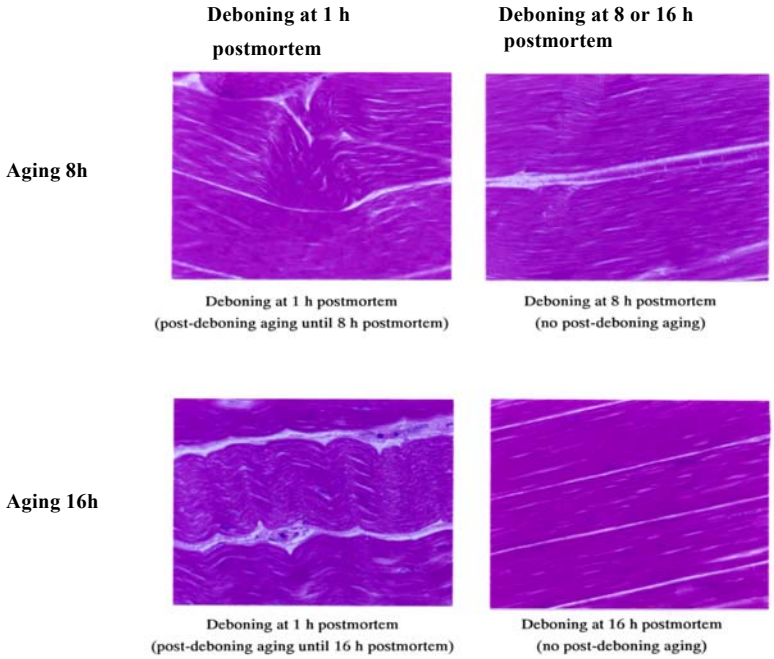

Table 2. Effect of *post mortem* deboning time on the distance between Z-lines in myofibrils of pectoral muscle of chicken breast meat

Postmortem time (hours)	Deboning time after postmortem (hours)			
	1		8	16
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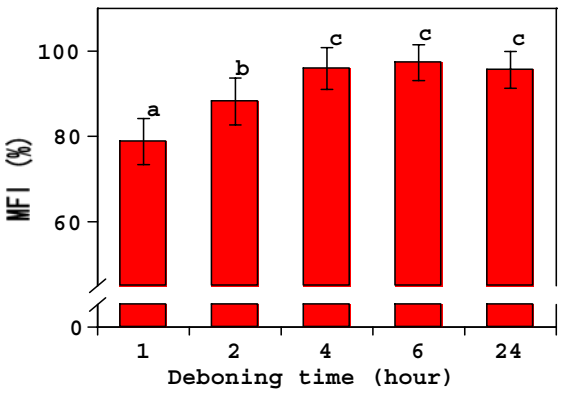
8	2.24 ß 0.12**		2.57 ß 0.07	
16	2.41 ß 0.07**			2.63 ß 0.08

** Values within the same horizontal line are significantly different (p<0.01).

Fig. 4. Effect of *post mortem* deboning time on the MFI of chicken breast meat aged for 4 days at 0 ˚C



a, b, c ; p<0.05