EFFECTS OF STORAGE TEMPERATURE ON MEAT QUALITY OF HOT-BONED DUCK BREAST MUSCLE

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Abstract – In this study, the effects of storage temperature on meat quality of hot-boned duck breast muscle were evaluated. The hot-boned duck breast muscle stored at three different temperatures (0, 15, and 30 ºC) for 24 h. The 30 ºC treatment showed the lower ultimate pH value and poor water holding capacity (WHC). Also, the muscle which had the shortest sarcomere length resulted in increased shear force. The high storage temperature led to decline meat quality. However, there were no significant differences in WHC, sarcomere length, and shear force between 0 and 15 ºC despite different in ultimate pH. Thus, further studies are needed to determine optimal storage temperature ranged from 0 to 15 ºC.

Key Words – hot-boned meat, hot-boning, pre-rigor muscle

I. INTRODUCTION

Various biochemical changes are occurred at muscle after slaughter, these changes in initial slaughter influence greatly meat quality. During conversion of muscle to meat, glycolysis and deletion of adenosine tri-phosphate (ATP) are more important factor. These breakdowns are mainly affected by chilling temperature which is associated with enzymatic activities [1]. Thus, many researchers have attempted to evaluate meat quality stored at several chilling temperatures.

Hot-boning technology has been recognized to have many advantages, including a reduction in cooler space, decreased energy cost and an increase in final yield as well as an improvement in meat quality [2].

However, very few studies have evaluated the effect of hot-boning on meat quality of duck muscle. To develop of various duck meat product and improve duck meat quality, therefore, the objective of this study was to evaluate the meat characteristics of hot-boned duck breast muscle chilled at 0, 15, and 30 ºC.

II. MATERIALS AND METHODS

1. Hot-boned duck breast preparation

A total of 48 Pekin ducks (*Anas platyrhynchos*, 42±2 d of age and approximately 3.2-3.4 kg live weight) were obtained from a local poultry processor and transported to the Konkuk University Meat Science Laboratory. To minimize the effects of catching and handling, the birds were removed from cages. Feed was removed 12 h prior to processing, but they were allowed access to water until 2 h prior to processing [3]. The birds were stunned electrically at 50 V for 10 s and killed by bleeding from a single unilateral neck cut for approximately 3 min. The duck carcasses (2.2-2.3 kg average carcass weight) were obtained within 15 min after slaughter, and then the breast muscle was immediately removed. A total of 96 duck breasts (*pectoralis major*) were obtained, each duck breast muscle was weighed (142.14±8.52 g average weight) and individually vacuum-packaged into polyethylene bags. The packaged bags were immersed in a constant-temperature water bath set to 0, 15, and 30 ºC, respectively.

2. Physicochemical analysis

2.1. Sampling

The intact left breast muscle were used to determine pH value, color measurement, and drip loss. To evaluate sarcomere length, water holding capacity, and shear force, the right breast are cut about two centimeters from top

part of muscle at each individual measuring times (Figure 1).

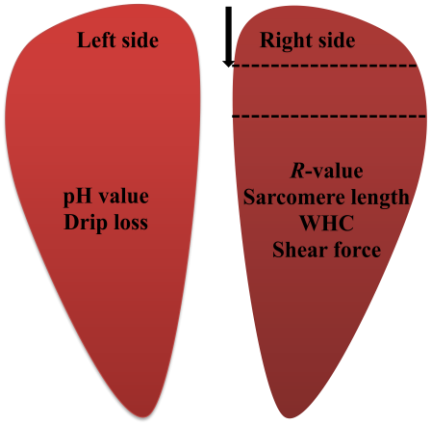

Figure 1. Simple diagram of sampling locations for evaluating the meat characteristics of pre-rigor duck breast muscle. WHC, water holding capacity.

2.2. pH value

The pH values of duck breast were determined using portable pH meter (Model D-50, HORIBA Ltd., Kyoto, Japan) at individual measuring times.

2.3. R-value

The *R*-value was determined using a modification of a method initially described Koh et al [4].

2.4. Drip loss

Drip loss was determined by calculation of weight loss percentage between before and after storage.

2.5. Water holding capacity (WHC)

The water holding capacity (WHC) was determined using the filter paper pressed method [5].

2.6. Sarcomere length

The sarcomere length of sample was determined using the neon laser diffraction method [6].

2.7. Shear force

Samples cooked at 75 ºC for 30 min were cooled to room temperature for 3 h. The cooked samples were cut into a rectangular parallelepiped shape (4.0×1.0×2.0 cm). Shear force values were determined based on Warner-Bratzler hear attachment (V-type blade set) on a texture analyzer (TA-XT2i, Stable Micro Systems Ltd., England).

2.8 Statistical analysis

An analysis of variance were performed on all the variables measured using the General Linear Model (GLM) procedure of the SAS statistical package. Duncan's multiple range test was used to determine differences between treatment means for drip loss, water holding capacity, sarcomere length, and shear force [7].

III. RESULTS AND DISCUSSION

The effects of storage temperature on pH value of hot-boned duck breast muscle are shown in Figure 2. At post-mortem 15 min, the pH values of duck breast was 6.66. As storage time passed, the pH value decreased, especially, the treatments stored at 30 ºC showed a rapid decrease in pH value until post-mortem 3 h. The pH values at post-mortem 24 h were 6.08 (0 ºC), 5.89 (15 ºC), and 5.88 (30 ºC). The decreased pH during postmortem resulted in the accumulation of lactic acid, and our results are associated with increase in glycolysis rate due to high temperature [8].

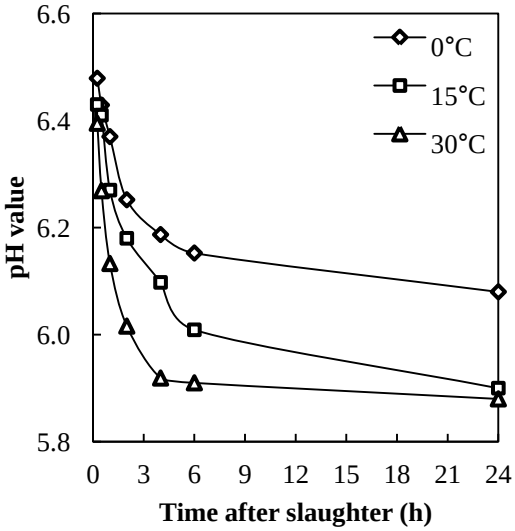

Figure 2. Changes in pH values of hot-boned duck breast muscle stored at three different temperatures.

R-value which is an indicator of adenosine tri-phosphate (ATP) was evaluated to determine the

degree to progress in rigor-mortis [9]. In our study, *R*-values of hot-boned duck breast muscle at 15 min after slaughter was 1.09, and were 1.17 (0 ºC), 1.18 (15 ºC), and 1.18 (30 ºC) at post-mortem 24 h, respectively (Figure 3).

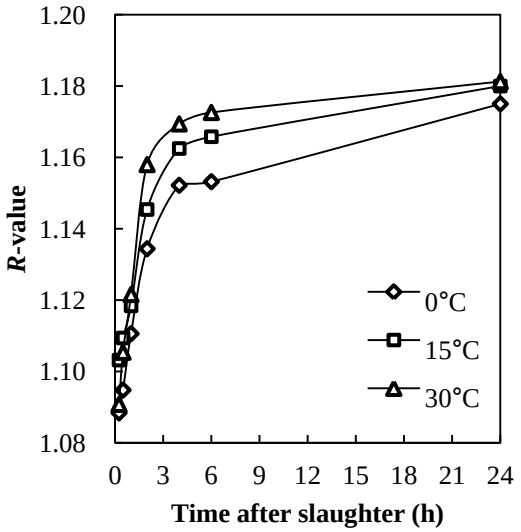

Figure 3. Changes in pH values of hot-boned duck breast muscle stored at three different temperatures.

Table 1. Effects of storage temperature on DL, WHC, SL, and SF[1)] of hot-boned duck breast muscle at post-mortem 24 h

Traits	Storage temperature (ºC)		
	0	15	30
DL (%)	3.66±0.32B	3.18±0.28B	7.42±0.43A
WHC (%)	44.31±2.58A	45.02±3.15A	39.32±2.84B
SL (μm)	1.27±0.04A	1.24±0.08A	1.16±0.05B
SF (N)	59.31±4.20B	61.71±5.42B	67.87±3.92A

All values are means±SE.
A,B Means in the same row with different letters are significantly different ($P < 0.05$).
[1)]DL, drip loss; WHC, water holding capacity; SL, sarcomere length; SF, shear force.

The effects of storage temperature on drip loss, water holding capacity, sarcomere length, and shear force of hot-boned duck breast muscle at post-mortem 24 h are shown in Table 1. The hot-boned muscle stored at 30 ºC showed the highest drip loss among the treatments ($P < 0.05$); however, there were no significant differences in 0 and 15 ºC treatments ($P > 0.05$). Also, the 30 ºC treatments had the poor properties in water holding capacity.

According to Huff-Lonergan and Lonergan [10], when the pH value is close to the isoelectric point of myofibrillar protein, which results in a lower water holding capacity. Thus, results of water holding capacity are associated with pH value. Sarcomere length in hot-boned breast stored at 30 ºC was shortest ($P < 0.05$). In our study, meat tenderness was determined using shear force of cooked duck breast muscle. The shear force increased with increasing storage temperature, even if there were no significant differences between 0 and 15 ºC treatments ($P > 0.05$). Many researchers reported that short sarcomere length affects the increased shear force in poultry breast muscle [11, 12].

IV. CONCLUSION

In conclusion, the high storage temperature (30 ºC) led to decrease ultimate pH value and to shrink sarcomere length of hot-boned duck breast. Although there was slightly difference in ultimate pH between 0 and 15 ºC, however, are little different in meat quality. Further studies are needed to determine optimal storage temperature ranged from 0 to 15 ºC.

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