PHYSICOCHEMICAL AND TEXTURAL PROPERTIES OF GROUND CHICKEN BREAST MASSAGED WITH SUPERCOOLING SOLUTION

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Abstract – The aim of this paper was to study the changes of quality characteristics of ground chicken breast muscle which were massaged with curing solution temperature levels on. The massaged meat were formulated with 75% ground chicken breast muscle and 25% curing solution, based on total weight. The massaging processing were carried out at 3 ˚C and -3 ˚C for 1-5 h. As the massaging time was increased, the cooking yield of ground chicken breast muscle was increased. And after 4 h massaging, there were differences in the cooking yields, depending on temperature (*P* < 0.05). The water holding capacity and myofibrillar protein solubility were improved as the massaging time was increased. And the water holding capacity and myofibrillar protein solubility massaged at -3˚C were higher values than those massaged at 3˚C. In conclusion, quality characteristics of ground chicken breast muscle produced by low-temperature massaging processing for 4 h can be improved.

Key Words – Massaging, Chicken meat product, Water holding capacity

I. INTRODUCTION

Basically, the ability to water retention of meat has been explained as water holding capacity (WHC). In addition, various characteristics of meat product are greatly associated with remaining water in final products after processing. For these reasons, in meat industry, several methods including tumbling and massaging has been used to improve WHC, with accelerated diffusion of curing solution [1]. Especially, massaging is extensively used to manufacture restructured meat products. In previous studies, the effect of this physical process is affected by additives, time, and temperature. Seigel *et al*. [2] reported that the massaging with presence phosphate has greater effects. Gellett *et al*. [3] indicated that massaging at relatively high temperature resulted in the decreased binding ability of massaged hams. According to Gurikar *et al*. [4], meat chunk size, massaging time and cooking time influence quality of restructured pork blocks.

Recently, beneficial effects of low-temperature tumbling (-3 ºC) to prepare restructured chicken breast ham are reported by Kim *et al*. [5]. However, there is little information about effects of low-temperature massaging with supercooling curing solution. Therefore, the objectives of this study were to evaluate effect of low-temperature massaging by using supercooling curing solution (-3 ºC) on physicochemical and textural properties of ground chicken breast without equipment to maintain temperature.

II. MATERIALS AND METHODS

1. Massaging processing

A commercial sample of chicken breast muscle (broilers, *Muscularis pectoralis major*, 5 wk of age, approximately 1.5-2.0 kg live weight) was purchased from a local market. The muscle was trimming of visible fat before using for massage processing, and was ground by a grinder with an 8 mm plate (PM-100, Mainca, Barcelona, Spain) and stored at 3 °C. Curing solution (5.66% salt concentrate) were prepared and stored at 3 °C or -3 °C (supercooling).

2. Manufacturing massaged chicken breast muscle

The massaged meat were formulated with 75% ground chicken breast muscle and 25% curing solution, based on total weight. The ground chicken breast muscle in final salt concentration was fixed as 1.5%. The massaging processes using the massager (RM-20, Mainca, Barcelona, Spain) was carried out for 1-5 h which in cold storage facility is set to 3 ˚C or -3 ˚C. Massaged meat was stuffed into collagen casing (Φ - 24 mm), and cooked in water bath for cooking 75 °C for 30 min. The samples were vacuum-packaged into polyethylene bags and stored at 4 °C until analysis.

3. Analysis of massaged chicken breast muscle

3.1 Massaging temperature

The core temperature of ground chicken breast muscle was monitored with a digital thermometer (Tes-1305, Tes Electrical co., Taiwan) equipped with a data logger (RS-232, Tes Electrical CO., Taiwan) by inserting a iron constantan thermo-couple.

3.2 Cooking yield

Cooking yield (%) was determined on individual treatments by calculating the weight differences before and after cooling as follows; Cooking yield (%) = [sample weight after cooking (g) / sample weight before cooking (g)] × 100

3.3 Water holding capacity (WHC)

The water holding capacity of batter was measured by the procedure of Grau and Hamm [6].

3.4 Myofibrillar protein solubility

The myofibrillar protein solubility was measured by the procedure of Saffle and Galbreath [7].

3.5 Texture profile analysis(TPA)

Texture profile analysis was performed at room temperature with a texture analyzer (TA- XT2*i*, stable Micro Systems, England). TPA were analysised as described by Boume [8].

3.6 Statistical analysis

An analysis of variance was performed on all the variables measured using the general linear model (GLM) procedure of the SAS statistical package [9]. Duncan's multiple range test ($P < 0.05$) was used to determine the differences between treatment means.

III. RESULTS AND DISCUSSION

Figure 1 shows the changing of temperature on ground chicken breast muscle during massaging processes. The initial temperature of massaging processes shows that the -3 ˚C treatment was lower than 3 ˚C treatment. The final temperature was around 8 ° C, and the temperature of each treatment was reached in different time. It reached in time as follows; 2 h 30 min for 3 ˚C treatment, 3 h 30 min for -3 ˚C treatment.

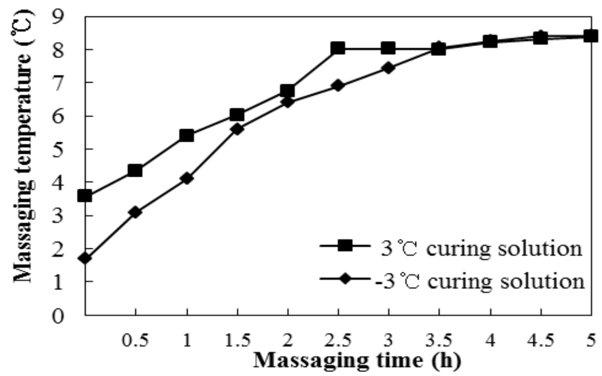

Figure 1. The comparison on massaging temperature of ground chicken breast muscle with massaging time. Treatments; (◆) massage condition set to 3 ˚C; (■) massage condition set to -3 ˚C.

Figure 2 shows the cooking yields of ground chicken breast muscle which were produced with different massaging time and temperature. The cooking yields of both treatments slightly incre-ased when massaging time was increased ($P < 0.05$). And, the cooking yields of ground chicken breast muscle showed the most effective massag-ing condition at -3 ˚C for 4 h and 5 h ($P < 0.05$).

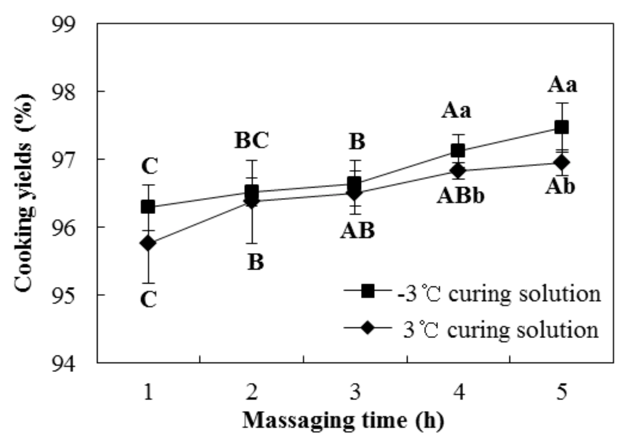

Figure 2. The comparison on cooking yields of ground chicken breast muscle with different massag-ing time and temperature. A-C Means within same temperature with different letters are signify-cantly different ($P < 0.05$). a,b Means within same time with different letters are significantly different ($P < 0.05$). Treatments; (◆) massage condition set to 3 ˚C; (■) massage condition set to -3 ˚C.

The WHC of the ground chicken breast muscle with different massaging time and temperature was shown in Figure 3. According to the massag-ing temperature, the WHC of -3 ˚C treatment was significantly higher than that of 3 ˚C treatment (*P*

< 0.05). The increased massaging time of the ground chicken breast muscle caused the improvement of the WHC ($P < 0.05$).

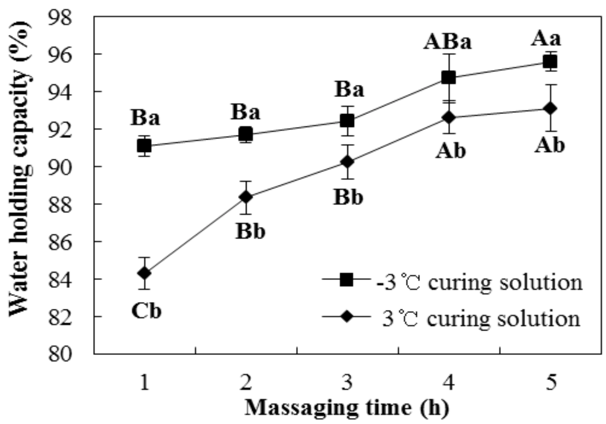

Figure 3. The comparison on water holding capacity of the ground chicken breast muscle with different massaging time and temperature. A-C Means within same temperature with different letters are significantly different ($P < 0.05$). a,b Means within same time with different letters are significantly different ($P < 0.05$). Treatments; (◆) massage condition set to 3 ˚C; (■) massage condition set to -3 ˚C.

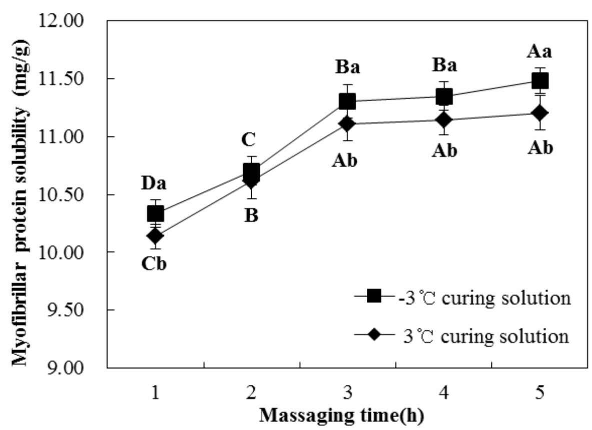

Figure 4. The comparison on myofibrillar protein solubility of the ground chicken breast muscle with different massaging time and temperature. A-D Means within same temperature with different letters are significantly different ($P < 0.05$). a,b Means within same time with different letters are significantly different ($P < 0.05$). Treatments; (◆) massage condition set to 3 ˚C; (■) massage condition set to -3 ˚C.

The result of myofibrillar protein solubility is shown in Figure 4. As massage processing progressed, myofibrillar protein solubility in both treatments was increased significantly ($P < 0.05$). The treatment massaged at -3 ˚C had higher myofibrillar protein solubility each time than the other ($P < 0.05$).

Tabel 1. Changes of texture on ground chicken breast muscle by massaging according to time and temperature levels

Traits	Tem. (˚C)	Massaging time (h) 1	2	3	4	5
Hardness (kg)	3	0.34± 0.03	0.34± 0.03	0.34± 0.02^{a}	0.33± 0.02^{a}	0.33± 0.03^{a}
	- 3	0.35± 0.02	0.33± 0.05	0.32± 0.05^{b}	0.31± 0.05^{b}	0.30± 0.03^{b}
Springiness	3	0.82± 0.04^{B}	0.83± 0.02^{Bb}	0.83± 0.04^{Bb}	0.85± 0.03^{Bb}	0.88± 0.02^{A}
	- 3	0.83± 0.04^{B}	0.85± 0.05^{ABa}	0.87± 0.04^{ABa}	0.87± 0.05^{ABa}	0.88± 0.06^{A}
Cohesiveness	3	0.51± 0.02^{Bb}	0.53± 0.03^{ABb}	0.56± 0.02^{A}	0.56± 0.03^{Ab}	0.56± 0.03^{Ab}
	- 3	0.56± 0.03^{Ba}	0.58± 0.04^{Ba}	0.58± 0.02^{B}	0.59± 0.02^{Ba}	0.60± 0.03^{Aa}
Gumminess (kg)	3	0.18± 0.02	0.18± 0.03	0.19± 0.01	0.19± 0.02	0.18± 0.02
	- 3	0.20± 0.02	0.19± 0.04	0.19± 0.04	0.18± 0.03	0.18± 0.02
Chewiness (kg)	3	0.14± 0.02	0.15± 0.02	0.16± 0.01	0.16± 0.02	0.16± 0.01
	- 3	0.16± 0.02	0.16± 0.03	0.16± 0.03	0.16± 0.02	0.16± 0.02

All values are mean ± standard deviation of three replicates.
^{A,B} Means within a row with different letters are significantly different ($P < 0.05$).
^{a,b} Menas within a column with different letters are significantly different ($P<0.05$)

The texture profile analysis (TPA) of ground chicken breast muscle was shown in Table 1. The increase in massaging time causes to decrease hardness, but it leads to improve springiness and cohesiveness. Cohesiveness in the treatment massaged at -3 ˚C is significantly higher than the treatment massaged at 3 ˚C ($P < 0.05$).

IV. CONCLUSION

The results of this study show that massage processing for 4 h was improved the cooking yields, WHC and myofibrillar protein solubility of ground chicken breast muscle. Also, massaging process at -3 ˚C for 4 h might be an effective method to produce chicken meat product with improved cooking yield, WHC and myofibrillar protein solubility.

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