PE4.55 Effects of Tumbling Condition on the Quality Characteristics of Restructured Chicken Breast Ham 191.00

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***Abstract*— The purpose of this study was to evaluate the effects of tumbling condition (time and temperature) on the quality characteristics of restructured chicken breast ham. Tumbling conditions were 10, 30, and 60 min at 3 or -3 °C, respectively. After tumbling, quality characteristic of treatments processed by each condition were measured. There were not significantly different in pH between tumbling time and temperature. Products yields of restructured chicken breast ham were the most effective tumbling condition at -3 ˚C for 60 min. Treatment tumbled for 60 min had significantly higher water holding capacity (WHC) than that tumbled for 10 min, but WHC was not affected by the tumbling temperature. Hardness of treatments tumbled at -3 ˚C had lower than that at 3 ˚C. Myofibrillar protein solubility of treatment tumbled for 60 min had the highest value of all, regardless of tumbling temperature. Therefore, tumbling technology for 30 min or more at -3 ˚C can be produced the restructured chicken breast ham of excellent quality.**

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***Index Terms*—Chicken breast, restructured ham, tumbling condition, marination**

I. INTRODUCTION

THERE has been an increase in further-processed poultry products during the last 20 years due to consumer demands. Marination is a popular technique used to tenderize and improve the flavor and succulence of meat (Lemos et al., 1999). Marination of raw poultry meat prior to consumption is a widespread practice, and up to 50% of the total raw poultry meat production may be marinated [2]. Marination mixtures can be applied to the meat through soaking, injection, or vacuum tumbling, depending on the type of meat product. Additional tumbling after marinating can have an important role in obtaining good distribution of brine, enhancing brine absorption, and facilitating protein extraction [3]. Boneless skinless breast fillets are usually tumble marinated under vacuum pressure.

Generally marination of poultry meat increases tenderness as measured by objective shear or texture panels [4, 5] and tumbling process are carried out in refrigerated states below 4°C. However, very few studies have been reported the study on the quality changes of restructured chicken breast ham when tumbling at supercooling temperature (0~-5 °C).

Therefore, the objective of this study was to evaluate the effects of tumbling time (10, 30, and 60 min) and temperature (3 and -3 °C) on the quality characteristics of chicken breast restructured ham.

II. MATERIALS AND METHODS

A. Sample collection and Process of restructured chicken breast ham

Boneless, skinless chicken fillets (*pectoralis major*) were obtained from commercial processing plants. Breast fillets were initially ground through Ø-13 mm plate. After the ground meat and 2% salt and 0.3% phosphate of meat weight were added, tumbling process using the tumbler (MKR-150C, Rühle GmbH., Grafenhausen, Germany) was carried out. Tumbling conditions were 10, 30, and 60 min at 3 or -3 °C, respectively. Also, all treatments were vacuum tumbled (610 mmHg, 8 rpm). The tumbled samples were stuffed in fibrous casing with Ø-50 mm and were heated in a water bath at 75 °C for 60 min and cooled at room temperature for 30 min.

B. Methods

The pH were measured in a homogenate prepared with 5 g of sample and distilled water (20 ml) using a pH meter (Model 340, Mettler-Toledo GmbH, Schwerzenbach, Switzerland). Product yields (%) were determined as a percentage of the initial (precook) weight. Water holding capacity (WHC) was measured by a modification of the procedure of Grau and Hamm [6]. Briefly, a 300 mg sample of muscle was placed in a filter press device and compressed for 2 min. WHC was calculated from duplicate samples as a ratio of the meat film area to the total area. Texture profile analysis was performed at room temperature with a texture analyzer (TA-XT2*i*, Stable Micro Systems Ltd., Surrey, England). Prior to analysis, samples were allowed to equilibrate to room temperature (20 ˚C, 3 h).

Cooked samples were cut to 20 mm height. The conditions of texture analysis were as follows: pre-test speed 2.0 mm/s, post-test speed 5.0 mm/s, maximum load 2 kg, head speed 2.0 mm/s, distance 8.0 mm, force 5 g. The calculation of TPA values was obtained by graphing a curve using force and time plots. Myofibrillar protein solubility was measured. 100 g of a tumbled sample was weighed into a beaker and then 900 ml of 2% NaCl solution was added. To measure the concentration of myofibrillar protein flowed out from inside of meat to surface, the sample and solution were washed using a stirrer for 10 min. After straining through a sieve with 1×1 mm mesh, the protein solubility of the filtrate was determined by the Biuret method [7] and the filtrate were centrifuged (10,000 rpm, 30 min), then the supernatant was clarified by a filtration through Whatman No. 1 filter paper. The protein solubility of the filtrate was also measured by the Biuret method. An analysis of variance were performed on all the variables measured using the General Linear Model (GLM) procedure of the SAS statistical package [8]. The Duncan's multiple range test (P<0.05) was used to determine difference between treatment means.

III. RESULTS AND DISCUSSION

Table 1-5 shows the physicochemical properties of restructured chicken breast ham with different tumbling time and temperature. The pH values of tumbled ground chicken breasts were ranged 5.98-6.04 and pH values of cooked restructured hams ranged 6.22-6.26 (Table 1). But there were not significantly different in pH between tumbling time and temperature (P>0.05).

Table 1. The comparison on pH of restructured chicken breast ham with different tumbling time and temperature before and after cooking

Time (min)	Tumbling temperature			
	Before cooked		After cooked	
	3 °C	-3 °C	3 °C	-3 °C
10	6.04±0.02	6.00±0.02	6.25±0.03	6.23±0.03
30	6.00±0.01	5.98±0.02	6.25±0.04	6.23±0.03
60	6.02±0.02^{a}	5.99±0.03^{b}	6.26±0.02^{a}	6.22±0.02^{b}

All values are means ± standard deviation.
$^{a, b}$ Means values with different superscripts within a same row are significantly different (P<0.05).

The product yields of restructured chicken breast ham had increased as increasing tumbling time, regardless of tumbling temperature (P<0.05; Table 2). Also, according to the tumbling temperature, the product yields tumbled at -3 ˚C treatments were significantly higher than those tumbled at 3 ˚C treatments (P<0.05). Therefore, products yields of restructured chicken breast ham were the most effective tumbling condition at -3 ˚C for 60 min.

In the side of WHC (Table 3), regardless of the tumbling time and temperature, longer tumbling times resulted in an increase in the WHC of cured ground chicken breasts. Treatment tumbled for 60 min had significantly higher WHC than that tumbled for 10 min. Also, WHC was not affected by the tumbling temperature (P>0.05).

Table 2. The comparison on product yields (%) of restructured chicken breast ham with different tumbling time and temperature

Tumbling time (min)	Tumbling temperature	
	3 °C	-3 °C
10	81.37±1.54^{Bb}	83.15±0.74^{Ca}
30	82.47±2.95^{Ab}	86.70±2.07^{Ba}
60	82.73±2.47^{Ab}	88.33±0.94^{Aa}

All values are means ± standard deviation.
$^{a, b}$ Means values with different superscripts within a same row are significantly different (P<0.05).
$^{A-C}$ Means values with different superscripts within a same column are significantly different (P<0.05)

Table 3. The comparison on water holding capacity (%) of ground chicken breast with different tumbling time and temperature

Tumbling time (min)	Tumbling temperature	
	3 °C	-3 °C
10	79.64±3.71^{B}	80.33±0.31^{B}
30	80.33±0.74^{AB}	81.30±1.39^{AB}
60	81.95±6.78^{A}	82.20±2.59^{A}

All values are means ± standard deviation.
$^{A, B}$ Means values with different superscripts within a same column are significantly different (P<0.05)

In the treatments tumbled at 3 ˚C, hardness of treatment tumbled for 60 min was significantly lower than that of treatment tumbled for 10 min (P<0.05), but there was not significantly different in hardness between treatments tumbled at -3 ˚C (P>0.05; Table 4). According to tumbling temperature, treatment tumbled at -3 ˚C had lower hardness than that tumbled at 3˚C in treatments tumbled for 10 and 30 min (P<0.05). But when tumbled for 60 min, tumbling temperature affected hardness of restructured chicken breast ham (P>0.05).

Myofibrillar protein solubility (Table 5) of treatment tumbled for 60 min had the highest value of all, regardless of tumbling temperature (P<0.05). When centrifuged the filtrate tumbled for 60 min, treatment tumbled at -3 ˚C was lower protein solubility than that tumbled at 3 ˚C (P<0.05).

Table 4. The comparison on hardness (N) of restructured chicken breast ham with different tumbling time and temperature

Tumbling time (min)	Tumbling temperature	
	3 °C	-3 °C
10	6.12±0.70^{Aa}	5.37±0.68^{b}
30	5.89±0.98^{ABa}	5.36±1.00^{b}
60	5.36±0.80^{B}	5.21±0.52

All values are means ± standard deviation.
[a, b] Means values with different superscripts within a same row are significantly different (P<0.05).
[A, B] Means values with different superscripts within a same column are significantly different (P<0.05).

Table 5. The comparison on protein solubility (mg/ml) of restructured chicken breast ham with different tumbling time and temperature before and after cooking

Time (min)	Tumbling temperature			
	Before centrifuged		After centrifuged	
	3 °C	-3 °C	3 °C	-3 °C
10	48.78±0.13^{B}	49.98±0.23^{B}	24.59±0.10^{B}	25.71±0.11^{B}
30	49.74±0.16^{B}	52.15±0.17^{AB}	24.27±0.11^{B}	27.55±0.23^{AB}
60	53.27±0.17^{A}	55.99±0.19^{A}	29.96±0.23^{Ab}	32.60±0.17^{Aa}

All values are means ± standard deviation.
[a, b] Means values with different superscripts within a same row are significantly different (P<0.05).
[A, B] Means values with different superscripts within a same column are significantly different (P<0.05).

IV. Conclusion

In conclusion, tumbling time affected the quality properties of restructured chicken breast ham such as product yields, WHC, hardness. Especially if tumbled 30 min or more, it could be obtained the high quality restructured chicken ham. Also, tumbling technology at -3 ˚C can be produced meat products of excellent quality.

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