EFFECTS OF VARIOUS CURING PROCESS ON QUALITY CHARACTERISTICS OF CHICKEN BREAST *BULGOGI* WITH CHICKEN GELATIN AND WHEAT FIBER

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Abstract— This study was conducted to determine the effect of various curing process on quality properties of chicken breast *bulgogi* with chicken gelatin and wheat fiber. The curing process samples were as follow: CON (curing by only tumbling), TTC (curing by tenderizer and tumbling), ITC (curing by injector and tumbling). The water content of TTC had significantly lower the both CON and ITC (*P*<0.05). The protein and fat content of ITC had the lower among others treatments. The lightness, redness, and yellowness value of uncooked chicken breast *bulgogi* had higher than cooked treatments. The curing and cooking yield of ITC had significantly higher the both CON and TTC (*P*<0.05). The shear force of TTC had significantly lower than shear force the both CON and ITC.

Key Words—chicken, injector, tenderizer, *bulgogi*

I. INTRODUCTION

Chicken breast *bulgogi* is prepared by curing meat with soy sauce or hot-pepper paste along with garlic, onions, pears, starch syrup, and other seasonings and then barbequing the meat prior to consumption. Recently, the availability of commercial curing and ready-to-cook chicken breast *bulgogi* products has increased in Korea in response to increased consumer demand [1]. Consumer requirement for food which is safe, healthier, diverse and convenient is increasing. Dietary fiber and gelatin are good sources in healthier food industry.

Gelatin, one of the most popular biopolymers, is widely used in food, pharmaceutical, cosmetic, and photographic applications because of its unique functional and technological properties. In the food industry, gelatin is utilized in confections (mainly for providing chewiness, texture, and foam stabilization), low-fat spreads (to provide creaminess, fat reduction, and mouthfeel), dairy (to provide stabilization and texturization), baked goods (to provide emulsification, gelling, and stabilization), and meat products (to provide water-binding). Gelatin, being low in calories, is normally recommended for use in foodstuffs to enhance protein levels, and is especially useful in body-building foods. In addition, gelatin is also used to reduce carbohydrate levels in foods formulated for diabetic patients.

Dietary fiber is desirable not only for their nutritional properties but also their functional and technological properties in reducing formulation cost, substituting fat, and enhancing texture. Fiber supplements can be used in cooked meat products to increase the cooking yield due to their water and fat binding properties and to improve textural properties.

II. MATERIALS AND METHODS

1. *Materials*

Chicken breast and feet were provided by Maniker F&G Co., Ltd (Yonginsi 388-278, Korea). All subcutaneous fat and visible connective tissue were removed from chicken breast. They were placed in polyethylene bags, vacuum packaged using a vacuum packaging system (FJ-500XL, Fujee Tech, Seoul, Korea) and stored at -21°C until required for product manufactures. Feet were skinned, washed using tap water, and were immediately frozen and stored at -21°C until used. The fiber used was wheat fiber Vitacel® (J. Rettenmaier & Söhne GmbH, Rosenberg, Germany). This fiber consists of 74% cellulose, 26% hemicellulose and < 0.5 of lignin; WF400 with 500 µm long particles. All reagents were of analytical grade. All experiments were performed in duplicate with at least three replicates. The results were expressed as mean and standard deviation.

2. Preparation of gelatins

The extraction procedures are shown in Figure 1. The cleaned chicken feet were soaked 10 volumes (v/w) of hydrochloric solution (0.1N HCl) at 18 °C for 24 h to be swollen. After the acid treatment, the feet were neutralized with flowing tap water. For hot-water extraction, they were placed in polyethylene bags and vacuum packaged using a vacuum packaging system (FJ-500XL, Fujee Tech, Seoul, Korea) and then they heated at temperature at 75 °C for 2 in a boiling water bath. The extracted gelatin was frozen at -70 ± 1°C and dried at -40 °C under 80 × 10^{-3} torr pressure using a freeze-dryer (PVTFD20R, Ilshinlab, Yangju, Korea). The gelatin was dehydrated until that reached a constant weight (<3% final moisture) for 48 h at the freeze-dryer.

3. Preparation of chicken breast bulgogi

The experimental design and curing process of chicken breast *bulgogi* prepared with wheat fiber and chicken feet gelatin is shown in Figure 2. The composition (w/w) of chicken *bulgogi* curing solution was water (8%), soy sauce (12%), phosphate (0.3%), wheat fiber (5%) and chicken feet gelatin (4.2%). CON was only cured by tumbling for 1 h at 0 ± 1 °C (MKR150, RÜHLE GmbH, Germany). TTC was tenderized by tenderizer (DK-9003, DONGKANG co., Seoul) and then they were cured by tumbling for 1 h at 0 ± 1 °C. ITC was injected to 120% of chicken breast using a multi needle injector (PR8, RÜHLE GmbH, Germany) and was cured by tumbling with residual curing solution for 1 h at 0 ± 1 °C. Each sample were heating at 75 ± 1 °C for 30 min using chamber and then cooled with cold water and stored at 4 °C until analysis.

4. Analytical methods

4.1. Compositional properties

Compositional properties of the chicken breast *bulgogi* were performed using AOAC (2000). Moisture content was determined by weight loss after

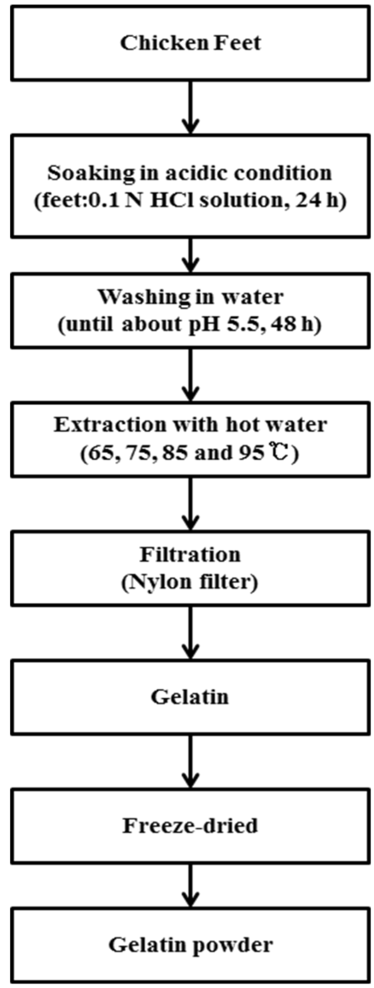

Figure 1. Procedures for preparation of the gelatin from the chicken feet

12 h of drying at 105°C in a drying oven (SW-90D, Sang Woo Scienctific Co., Bucheon, South Korea). Fat content was determined by Soxhlet method with a solvent extraction system (Soxtec® Avanti 2050 Auto System, Foss Tecator AB, Höganas, Sweden) and protein was determined by Kjeldahl method with an automatic Kjeldahl nitrogen analyzer (Kjeltec® 2300 Analyzer Unit, Foss Tecator AB, Höganas, Sweden). Ash was determined according to AOAC method 923.03.

4.2. pH

The pH was determined, following grinding and homogenization of 5 g of sample with 20 ml of distilled water for 60 s (Ultra-Turrax® T25, Janke & Kunkel, Staufen, Germany) and the pH was then

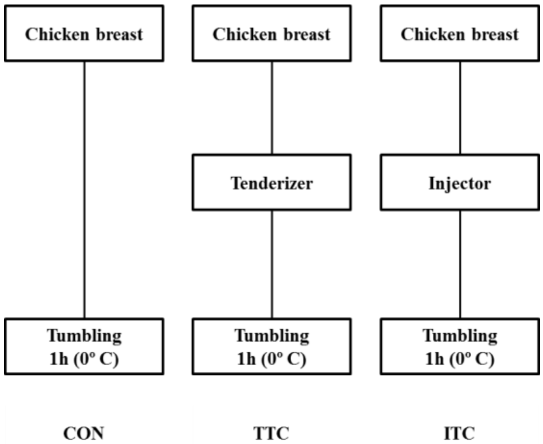

Figure 2. The diagram of chicken breast *bulgogi* made with various curing process

measured using a pH meter (Model 340, Mettler-Toledo GmbH Analytical, Schwerzenbach, Switzerland). All determinations were performed in triplicate.

4.3. Color evaluation

Samples were evaluated on the surface. Color measurements were taken with colorimeter (Chroma meter CR-210, Minolta, Japan; illuminate C, calibrated with white standard plate L* = 97.83, a* = -0.43, b* = +1.98), consisted of an 8 mm diameter measuring area and a 50 mm diameter illumination area. Color values (CIE L*, a*, and b*) were measured on the surface of samples and results were taken in triplicate for each sample.

Table 1
Proximate composition of chicken breast *bulgogi* made with various curing process

Properties	Treatment		
	CON	TTC	ITC
Water content (%)	71.54 ± 0.11^{b}	70.88 ± 0.12^{c}	73.77 ± 0.48^{a}
Protein content (%)	26.85 ± 0.08^{a}	26.60 ± 0.13^{b}	22.86 ± 0.09^{c}
Fat content (%)	1.11 ± 0.18^{ab}	1.46 ± 0.22^{a}	0.98 ± 0.17^{b}
Ash content (%)	1.77 ± 0.03^{b}	1.99 ± 0.07^{a}	2.04 ± 0.01^{a}

All values are mean ± standard deviation of three replicates.
[a-c]Means within a row with different letters are significantly different (P<0.05).

4.4. Curing yield

The sample was raw chicken breast (initial weight). Three cured samples were weighed (curing weight: CON (curing by only tumbling), TTC (curing by tenderizer and tumbling), ITC (curing by injector and tumbling)) and a percentage curing yield was calculated from the weights.

$$\text{Curing yield (\%)} = (\text{curing weight} / \text{initial weight}) \times 100$$

4.5. Cooking yield

The cured samples (initial weight) were heating at 75 ± 1°C for 30 min and then core temperature of samples was reached respectively at 75 ± 1°C. After cooling for 1h, cooked samples were weighed (cooking weight) and a percentage cooking yield

Table 1
pH value and CIE L, a, b value of chicken breast *bulgogi* made with various curing process

Properties		Treatment		
		CON	TTC	ITC
Cooked	pH	6.09 ± 0.03	6.06 ± 0.03	6.00 ± 0.03
	L^*	48.29 ± 1.29^{a}	46.81 ± 1.12^{b}	46.23 ± 1.53^{b}
	a^*	10.46 ± 0.65^{a}	10.32 ± 1.12^{a}	9.22 ± 0.40^{b}
	b^*	16.09 ± 1.00^{a}	15.31 ± 0.30^{b}	15.42 ± 0.37^{b}
Uncooked	pH	6.30 ± 0.04	6.16 ± 0.09	6.31 ± 0.05
	L^*	71.71 ± 1.40	70.45 ± 2.81	70.59 ± 2.66
	a^*	4.52 ± 0.49	4.48 ± 0.75	4.83 ± 0.72
	b^*	21.87 ± 1.41^{b}	22.80 ± 1.50^{ab}	23.56 ± 0.93^{a}

All values are mean ± standard deviation of three replicates.
[a-b]Means within a row with different letters are significantly different (P<0.05).

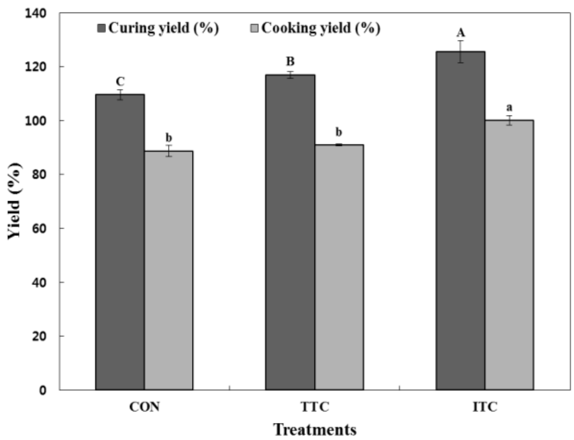

Figure 3. The curing and cooking yield of chicken breast *bulgogi* made with various curing process

[a-c] Means values with different letters among the cooking yield of treatment are significantly different (P<0.05).

[A-C] Means values with different letters among the tumbling yield of treatment are significantly different (P<0.05).

was calculated from the weights.

Cooking yield (%)
= (cooking weight / initial weight) × 100

4.6. Shear force measurement

Shear force values were determined with a Warner-Bratzler shear attachment on a texture analyzer (TA-XT2i, Stable Micro System Ltd., Surrey, UK). Test speeds were set at 2 mm/s. Data were collected and analyzed from the shear force values (kg) to obtain for the maximum force required to shear through each sample.

4.7. Statistical analysis

All analyses were conducted at least three times under each experimental condition and the mean values were reported. Analysis of variance were performed on all variables measured using the General Linear Model (GLM) procedure of the SAS statistical package (SAS Institute, Inc., 2010). The Duncan's multiple range test with α = 0.05%.

RESULTS AND DICSUSSION

The protein and fat content of ITC had the lower among others treatments. In contrast to, the water content of TTC had significantly lower the both CON and ITC (P<0.05). The pH of uncooked chicken breast *bulgogi* ranged from 6.00 to 6.09, and that of cooked chicken breast *bulgogi* ranged from 6.16 to 6.31 (P > 0.05). The lightness, redness, and yellowness value of uncooked chicken breast *bulgogi* had higher than cooked treatments. The curing and cooking yield of ITC had significantly higher the both CON and TTC (P < 0.05). The shear force of TTC had significantly lower than shear force the both CON and ITC (P<0.05).

CONCLUSIONS

The tenderizer and injector can be utilized curing process of chicken breast chicken *bulgogi* with chicken feet gelatin and wheat fiber.

ACKNOWLEDGMENTS

This research was supposed (608001-05-2SB310) by Rural Development Administration (Republic of Korea). The authors also partially supported by the Brain Korean 21 (BK21) Project from Ministry of Education and Human Resource Development.

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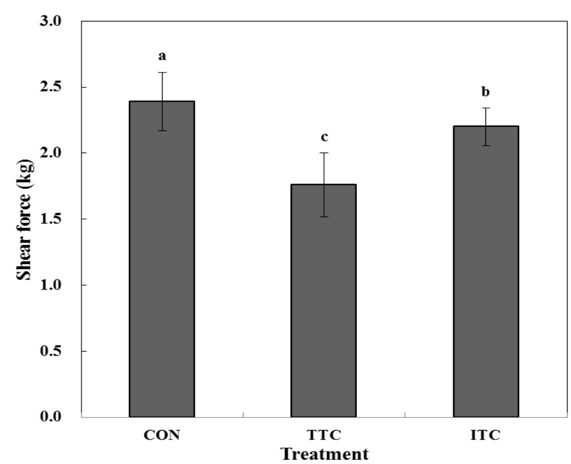

Figure 4. The shear force of chicken breast *bulgogi* made with various curing process

[a-c] Means values with different letters among the cooking yield of treatment are significantly different (P<0.05).