Effects of Chicken Skin and Wheat Fiber Mixture on Quality Properties of Chicken Frankfurter

Kim H.Y. [1], Choi Y.S. [1], Choe J.H. [2], Kim H.W. [2], Park J.H. [2], Lee E.S. [2], Ju S.J. [3], Lee S.K. [4], Kim C. J. [1,2]

[1] Research Institute for Meat Science and Culture, Konkuk University, Seoul, Republic of Korea
[2] Department of Food Science and Biotechnology of Animal Resources, Konkuk University, Seoul, Republic of Korea
[3] R&D Center, Chicken University, Icheon, Republic of Korea
[4] Department of Animal Products and Food Science, Kangwon National University, Chuncheon, Republic of Korea

Abstract— **This study evaluated quality properties of chicken skin and wheat fiber on chicken frankfruter sausage. The chicken skin and fiber mixture (SFM) were manufactured based on the following formulation: 50% chicken skin, 20% wheat fiber, and 30% ice. The water content was higher ($P < 0.05$) in the chicken frankfurters with SFM than the control and increased ($P < 0.05$) as SFM level increased. The fat content was lower ($P < 0.05$) in the treatments formulated with SMF (replacing pork fat) than the controls containing pork back fat and decreased ($P < 0.05$) as SFM-1level increased. Increasing SFM level from 5% to 20% had no significant effect in cooking yield. The hardness of control was lower than samples containing SFM.**

Keywords—**chicken, skin, fiber, frankfurter**

I. INTRODUCTION

Frankfurters are one of the most popular traditional meat products in the world, they are non-fermented, emulsion type sausages, and are mostly produced from pork and beef, and are flavored with various spices the application of smoke[1]. In current, chicken meat and its products have experienced increasing popularity and become widely spread all over the world. Chicken frankfurter is one of the popular foodstuffs among these products. Consumers who purchase meat products want healthy, good tastes, and improving texture products. Dietary fiber and chicken skin are good sources in functional food industry.

Chicken skin, a by-product of fabrication operations, could be a potential water binder and texture-modifying agent for use in reduced-fat comminuted meat products. Improving the functionality (solubility) of chicken skin may increase its potential use in comminuted meat products as a less expensive water binder or texture-modifying agent.

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 skin were provided by Maniker F&G Co., Ltd (Yonginsi 388-278, Korea). Pork back fat (moisture 12.61%, fat 85.64%) was purchased from a local processor. All subcutaneous fat and visible connective tissue were removed from chicken breast. Lean materials, pork back fat and skin were initially ground through an 8 mm plate. 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. 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 chicken skin and fiber mixture

Suitable amounts of the chicken skin were tempered at 4 ℃ for 4 h prior to chicken skin and fiber mixture preparation. The chicken skin and fiber mixture (SFM) were manufactured based on the following formulation: 50% chicken skin, 20% wheat fiber, and

30% ice. SFM of chicken skin, wheat fiber, and ice were emulsified using a silent cutter (Nr-963009, Scharfen, Witten, Germany). Immediately after cutting, the chicken skin and fiber mixture was stored in the dark at 4 ℃ until required for product manufactures.

3. Frankfurter preparation and processing

Suitable amounts of the chicken breast and pork back fat were tempered at 4 ℃ for 24 h prior to meat batter preparation. Three different meat batters were produced and the experimental design and compositions are given in Table 1. After emulsification, nine batters were stuffed into collagen casings using a stuffer (IS-8, Sirman, Marsango, Italy), and each samples were heating at 75 ± 1 ℃ for 30 min and then cooled with cold water and stored at 4 ℃ for 1 day until cooking loss and TPA. The sensory evaluation and pH were analyzed each samples which were heating at 75 ± 1 ℃ for 30 min.

4. Analytical methods

4.1. Compositional properties

Compositional properties of the semi-dried jerky were performed using AOAC (2000). Moisture content was determined by weight loss after 12 h of drying at 105℃ 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 measured using a pH meter (Model 340, Mettler-Toledo GmbH Analytical, Schwerzenbach, Switzerland). All determinations were performed in triplicate.

Table 1
Chicken frankfurter sausage formulation with chicken skin and wheat fiber mixture

Ingredients		Treatment				
			SFM			
		CON	5%	10%	15%	20%
Main	Chicken breast (%)	60	60	60	60	60
	Pork back fat (%)	20	15	10	5	-
	SFM	-	5	10	15	20
	Ice (%)	20	20	20	20	20
Additive	NaCl (%)	1.5	1.5	1.5	1.5	1.5
	Phosphate (%)	0.3	0.3	0.3	0.3	0.3
	Sodium nitrite (%)	0.01	0.01	0.01	0.01	0.01
	Spice (%)	0.6	0.6	0.6	0.6	0.6

SFM: chicken skin and fiber mixture

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 mmdiameter 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.

4.4. Cooking yield

The meat batter was stuffed into the casing (initial weight), heat processed at 75 ± 1℃ for 30 min and then core temperature of samples was reached respectively at 75 ± 1℃. After cooling for 1h, cooked samples were weighed (cooking weight) and a percentage cooking yield was calculated from the weights.

$$\text{Cooking yield (\%)} = (\text{cooking weight} / \text{initial weight}) \times 100$$

4.5. Texture profile analysis (TPA)

The texture profile analysis of each sample was performed in duplicate. Samples were cut into sections with a height of 25 mm and φ 16 mm diameter. The textural properties for each sample were measured using a cylinder probe (φ 20 mm diameter), set attached to a Texture Analyzer (TA-XT2*i*, Stable Micro System Ltd., Surrey, UK).

4.6. Sensory evaluation

A trained 30-member panel consisting of researchers of the Department of Food Sciences and Biotechnology of Animal Resources at Konkuk University in Korea was used. Each frankfurter was evaluated in terms of color, flavor, juiciness, tenderness, and overall acceptability.

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., 1999). The Duncan's multiple range test with $\alpha = 0.05\%$.

III. RESULTS AND DICSUSSION

The water content was higher ($P < 0.05$) in the treatments with SFM than the control and increased ($P < 0.05$) as SFM level increased. The addition of SFM significantly reduced the fat content by increasing the water content. The highest lightness value for sample was for the control (20% pork back fat). Reducing the fat level decreased the lightness frankfurters. The addition of SFM resulted in decreased redness values and increased yellowness values. Increasing SFM level from 5% to 20% had no significant effect in cooking yield. The hardness of control was lower than

Table 2
Proximate composition of chicken frankfurter sausage formulation with chicken skin and wheat fiber mixture

Properties	Treatment				
		SFM			
	CON	5%	10%	15%	20%
Water content (%)	63.04 ± 0.84^{e}	64.87 ± 0.19^{d}	67.21 ± 0.13^{c}	68.97 ± 0.37^{b}	70.78 ± 0.43^{a}
Protein content (%)	16.40 ± 0.56	16.57 ± 0.68	16.62 ± 0.51	16.63 ± 0.77	16.65 ± 0.54
Fat content (%)	16.34 ± 0.32^{a}	14.58 ± 0.01^{b}	11.82 ± 1.28^{c}	8.61 ± 0.33^{d}	5.66 ± 0.11^{e}
Ash content (%)	2.69 ± 0.08^{d}	2.79 ± 0.02^{c}	2.88 ± 0.01^{b}	2.89 ± 0.01^{b}	2.98 ± 0.01^{a}

All values are mean ± standard deviation of three replicates.
$^{a-e}$ Means within a row with different letters are significantly different ($P < 0.05$).
SFM: chicken skin and fiber mixture

Table 3
pH, color and yield value of chicken frankfurter sausage formulation with chicken skin and wheat fiber mixture

Properties	Treatment				
		SFM			
	CON	5%	10%	15%	20%
pH	6.35 ± 0.03^{bc}	6.32 ± 0.02^{d}	6.33 ± 0.01^{cd}	6.35 ± 0.03^{b}	6.39 ± 0.01^{a}
L^*-value	80.45 ± 0.46^{ab}	80.19 ± 0.23^{ab}	79.84 ± 0.40^{bcd}	79.45 ± 0.27^{cd}	79.23 ± 0.13^{d}
a^*-value	5.03 ± 0.24^{b}	5.51 ± 0.26^{a}	5.52 ± 0.16^{a}	5.55 ± 0.17^{a}	5.60 ± 0.13^{a}
b^*-value	18.14 ± 0.37^{e}	18.39 ± 0.44^{de}	18.89 ± 0.24^{c}	19.38 ± 0.11^{ab}	19.45 ± 0.31^{ab}
Yield (%)	94.48 ± 0.23^{ab}	94.43 ± 0.48^{ab}	94.29 ± 0.16^{ab}	94.52 ± 0.50^{ab}	94.58 ± 0.39^{a}

All values are mean ± standard deviation of three replicates.
$^{a-e}$ Means within a row with different letters are significantly different ($P < 0.05$).
SFM: chicken skin and fiber mixture

samples containing SFM and due to increasing of SFM-1 was increased wheat fiber and decreased pork back fat. Springiness in frankfurters supplemented with SFM-1 was slightly lower than the control. Cohesiveness, gumminess, and chewiness were higher for samples containing SFM than control. Tenderness and juiciness scores increased with the levels of SFM-1 and SFM-2.

IV. CONCLUSIONS

The addition of chicken skin and wheat fiber mixture (SFM) is improving quality properties of chicken meat products.

ACKNOWLEDGMENT

This research was supposed (608001-05-2SB310) by Rural Development Administration (Republic of Korea) and the authors were partially supported by the Brain Korean 21 Project form Ministry of Education and Human Resources Development (Republic of Korea).

REFERENCES

1. Ayo, J., Carballo, J., Solas, M. T., & Jimenez-Colmenero, F. (2008). Physicochemical and sensory properties of healther frankfurters as affected by walnut and fat content. *Food Chemistry*, *107*, 1547-1522

Table 4
Texture properties of chicken frankfurter sausage formulation with chicken skin and wheat fiber mixture

Properties	Treatment				
		SFM			
	CON	5%	10%	15%	20%
Hardness	403.43 ± 17.94^{e}	419.36 ± 1.97^{de}	463.60 ± 9.97^{c}	540.43 ± 8.86^{b}	557.53 ± 6.44^{a}
Cohesiveness	0.54 ± 0.04	0.56 ± 0.02	0.56 ± 0.02	0.54 ± 0.02	0.54 ± 0.02
Gumminess	219.77 ± 22.46^{cd}	235.21 ± 9.30^{c}	258.76 ± 11.90^{b}	292.46 ± 10.67^{a}	300.20 ± 8.68^{a}
Springiness	0.90 ± 0.08^{a}	0.89 ± 0.01^{a}	0.86 ± 0.03^{ab}	0.85 ± 0.01^{ab}	0.84 ± 0.01^{ab}
Chewiness	197.89 ± 30.48^{cd}	208.84 ± 7.52^{c}	223.48 ± 13.16^{bc}	247.55 ± 7.35^{ab}	251.58 ± 4.58^{ab}

All values are mean ± standard deviation of three replicates.
$^{a-e}$ Means within a row with different letters are significantly different ($P < 0.05$).
SFM : The chicken skin and fiber mixture

Table 5
Sensory properties of chicken frankfurter sausage formulation with chicken skin and wheat fiber mixture

Properties	Treatment				
		SFM			
	CON	5%	10%	15%	20%
Color	8.50 ±0.53	8.50 ± 0.53	8.63 ± 0.52	8.50 ± 0.53	8.50 ± 0.53
Flavor	8.63 ± 0.74	8.75 ± 0.71	8.75 ± 0.71	8.63 ± 0.74	8.63 ± 0.74
Tenderness	7.38 ± 1.19^{d}	7.75 ± 0.71^{bcd}	8.25 ± 0.71^{abc}	8.38 ± 0.52^{ab}	8.63 ± 0.52^{a}
Juiciness	7.81 ± 1.00^{b}	7.81 ± 0.65^{b}	7.88 ± 0.64^{b}	7.81 ± 0.65^{b}	7.81 ± 0.65^{b}
Overall acceptability	8.50 ± 0.53^{ab}	8.75 ± 0.46^{a}	8.38 ± 0.52^{abc}	8.00 ± 0.53^{bc}	7.75 ± 0.46^{c}

All values are mean ± standard deviation of three replicates.
$^{a-d}$ Means within a row with different letters are significantly different ($P < 0.05$).
SFM : The chicken skin and fiber mixture