Quality of semi-dried chicken jerky incorporated with skin

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Abstract— **The objective of this study was to examine acid treatments and adding level of chicken skin for enhanced chicken jerky's textural properties. Jerky were made as follow compositions; control with no chicken skin, treatments with 1, 3, 5% chicken skin, respectively. After hand-mixing (for 3 min) and tumbling (for 30 min) for the distribution of curing ingredient, the cured meats dried for 180 min at 55°C, for 180 min at 65°C, and for 60 min at 75°C. In jerky processing, the addition of chicken skin resulted in a higher fat contents, and TBA due to skin's high fat, but the acid treatments of skin had an influence on decreased TBA in jerky than non-acid treatments. In addition, the use of chicken skin had the improvement in the moisture contents, yields, mechanical tenderness, and sensorial scores.**

Keywords— **Skin, chicken, jerky**

I. INTRODUCTION

The animal skin is utilized as a binding product for jellied products, for the production of gelation, to prepare a popped snack item or as a pre-emulsion for sausage production. Especially, the skin is to be used in sausage are cooked, minced and combined with water, fat and emulsifying or stabilizing agents such as soy protein isolate or sodium caseinate to produce the pre-emulsion. This may be used hot or chilled and is incorporated in the chopping stage of sausage manufacturing [1]. Gelatin is probably the most widely used of animal-derived extender ingredients, and most gelatin protein is extracted from this animal skin. Gelatin takes up water upon heating and forms a reversible cold-set gel, it is typically added to processed meat products to reduce purge loss during refrigerated storage. Powdered skin contains a high concentration of gelatin but is less refined and thus less costly [2].

One of the most common reasons for adding acids is to control pH, and this is usually done as a means to control the gelation of certain hydrocolloids and proteins. Because pH influences the gel-setting properties and the gel strength obtained, proper pH control is critical in the production of gelatin-based meat products [3]. This gelatin is extracted from collagen by a controlled acid hydrolysis, and the acid treatment for convert collagen into a form suitable for extraction is optimized by each manufacturer to give the required physical and chemical properties to the gelatin that is produced [4].

The new chicken convenience foods have been successfully marketed for consumption at home and in the growing fast food industry. However, one of the greatest reasons for the growth in chicken consumption may be the perception by health conscious consumers that chicken is a low-fat, high-protein source of healthy nutrition [5]. The objective of this study was to evaluate the quality properties of restructured chicken jerky prepared under various chicken skin contents, and find out whether skin addition and the acid treatments of skin can be effectively utilized for jerky processing.

II. MATERIALS AND METHODS

A. Raw materials and curing solution preparation

Fresh chicken breast meat and chicken skin were purchased from a local processor. The skin was trimmed of fat before use for jerky processing. The acid treatment of skin was conducted as follows: The cleaned chicken skin were soaked 10 volumes (v/w) of 0.1 N HCl solutions at 18°C for 24 h to be swollen, and after the acid treatment, the skin were neutralized with flowing tap water. For hot-water extraction, the skins (regardless of acid treatment) 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 80°C for 30min in a boiling water bath. The breast meat and skin were ground through an Φ – 8 mm plate. The curing solution was used a modification of curing solution by Song (1997) [6]. The pH of curing solutions was 5.45±0.06.

B. Preparation of jerky

The ground chicken breast meat and skin were mixed with curing solution by hand for 3 min. The meat and skin were then continuously tumbled in a tumbler (MGH-20, Vackona, Liesen, Germany) at 4°C for 30 min at 25 rpm. Cured meat was stuffed into cellulose casing (Φ – 20 mm), and dried in a convection dry oven (Enex-CO-600, Enex, Yongin, Korea) for 180 min at 55°C, for 180 min at 65°C, and for 60 min at 75°C [7].

C. Compositional properties and processing yields

Compositional properties of the samples were determined using AOAC (1995) [8], and processing yields were determined by calculating the weight differences of jerky before and after drying.

D. pH and water activity measurements

The pH of samples was determined with a pH meter (Model 340, Mettler-Toledo GmbH, Schwerzenbach, Switzerland). The pH values were measured by blending a 5 g sample with 20 ml distilled water for 60 s in a homogenizer (Ultra-Turrax T25, Janke & Kunkel, Staufen, Germany). Samples for water activity were minced into pieces approximately 1 mm^3 in size. The water activity of each sample was determined in duplicate with a hygrometer (BT-RS1, Rotronic ag., Bassersdorf, Switzerland).

E. TBA (Thiobarbituric acid) value

Thiobarbituric acid (TBA) values were determined using the distillation method of Tarladgis, Watts, Younathan, and Dugan (1960) [9]. Results were expressed as mg of malonaldehyde per kg of sample.

F. Shear force measurements

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

G. Sensory evaluation

Each jerky sample was subjected to sensory evaluations. The samples were served to 12 panelists with previous experience. The color, flavor, tenderness, juiciness, and overall acceptability of the samples were evaluated using a 10-point horizontal scale [7], [10].

H. 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 [11]. The Duncan's multiple range test (P<0.05) was used to determine differences among treatment means.

III. RESULTS AND DISCUSSION

A. Properties of raw materials

The longer acid treatment times resulted in a decrease of pH and increase of yields in skin, but there was no difference in the changes of pH and yields after 12 h. Also, the pH increased and yields decreased in skin with increased washing time, and these differences were up to 24 h. Therefore, the acid treatment during 12 h and the washing process during 24 h were the most effective acid treatment and washing time condition.

The pH and compositional properties of chicken breast meat and skin before and after cooking are shown in Table 1. The chicken skin, regardless of acid treatment and cooking, had significantly higher pH and fat contents, and significantly lower protein and ash contents than breast meat. Also, the cooking of skin resulted in an increase in the moisture contents, but decrease in the fat contents. Therefore, the acid treatments and cooking process of chicken skin might

be utilized for improved texture modification of dried foods such as jerky.

Table 1 pH and compositional properties of raw materials

Materials[1]		pH	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
CBM		5.99^{C}	74.94^{B}	22.58^{A}	1.09^{D}	1.31^{A}
Before cooking	CS	6.24^{B}	54.22^{E}	13.06^{B}	31.44^{A}	0.64^{B}
	AS	6.46^{A}	68.89^{C}	8.35^{C}	22.49^{B}	0.11^{C}
After cooking	CS	6.28^{B}	58.76^{D}	14.42^{B}	24.63^{B}	0.59^{B}
	AS	6.51^{A}	79.04^{A}	9.27^{C}	11.15^{C}	0.10^{C}

All values are means.
[1] CBM: Chicken breast meat, CS: Chicken skin, AS: Acid-treated chicken skin
[A-E] Means within a column with different letters are significantly different (P<0.05).

B. Compositional properties of jerky

The effects of skin addition on the compositional properties of chicken jerky are shown in Table 2. The semi-dried chicken jerky added 5% acid-treated skin had higher moisture and lower protein contents than the control jerky. In addition, the control had lower fat contents than the samples containing 3% and 5% chicken skin, and the acid treatments of skin had a slight influence on decreased fat contents in semi-dried chicken jerky. Also, the addition of skin resulted in a significant decrease in the ash contents of samples except for the jerky with 1% skin, and this may be due to chicken skin having a lower ash contents.

Table 2 Compositional properties of chicken jerky

Treatments[1]		Moisture (%)	Protein (%)	Fat (%)	Ash (%)
Control		31.94^{B}	47.42^{A}	4.06^{B}	5.73^{A}
CS	1%	31.89^{B}	47.38^{A}	4.51^{AB}	5.72^{A}
	3%	31.75^{B}	47.31^{AB}	4.83^{A}	5.66^{ABC}
	5%	31.68^{B}	47.11^{AB}	4.92^{A}	5.58^{BC}
AS	1%	32.19^{AB}	47.21^{AB}	4.38^{AB}	5.70^{AB}
	3%	32.68^{AB}	46.98^{AB}	4.56^{AB}	5.55^{CD}
	5%	32.87^{A}	46.68^{B}	4.63^{AB}	5.42^{D}

All values are means.
[1] Control: No chicken skin, CS: Chicken skin, AS: Acid-treated chicken skin
[A-D] Means within a column with different letters are significantly different (P<0.05).

C. Physicochemical properties of jerky

Table 3 shows the effects of chicken skin contents on physicochemical properties of semi-dried chicken jerky. The pH and water activity range of jerky was respectively 6.20-6.21 and 0.81-0.82, but there was no difference among the samples. In addition, as the skin contents increased, significant changes were observed in the TBA values of jerky treatments, and compared to the control jerky samples, the chicken jerky prepared with 3% and 5% skin had significantly higher TBA values except for treatments with 1% skin, regardless of acid treatment, and this might be due to chicken skin having a higher fat content (Table 1). Although the addition of skin resulted in an increase in TBA values of samples, the jerky added acid-treated skin had slightly lower values than the treatments with non acid-treated skin, and therefore, the acid treatments of skin in jerky process could be effectively responsible for decrease of lipid oxidation.

The effects of chicken skin addition on the processing yields of semi-dried chicken jerky are shown in Table 3. The processing yields of chicken jerky in this study increased gradually with increased skin levels, and the semi-dried chicken jerky added 3% and 5% skin had higher processing yields than the control samples except for treatments with 3% acid-treated skin. Additionally, compared to control samples, the chicken jerky with 3% and 5% skin had significantly lower shear force, and within the treatments added 3% and 5% skin, the acid treatments of skin had a significant influence on decreased shear force in semi-dried chicken jerky.

Table 3 Physicochemical properties of chicken jerky

Treatments[1]		pH	Water activity	TBA (mg/kg)	Processing yields (%)	Shear force (N)
Control		6.20	0.818	0.16^{E}	38.85^{D}	177.04^{A}
CS	1%	6.20	0.821	0.18^{CDE}	39.21^{CD}	175.54^{A}
	3%	6.21	0.817	0.21^{AB}	39.76^{ABC}	158.84^{B}
	5%	6.21	0.815	0.22^{A}	39.98^{A}	143.69^{D}
AS	1%	6.20	0.815	0.17^{DE}	38.97^{D}	174.72^{A}
	3%	6.20	0.815	0.19^{BCD}	39.38^{BCD}	151.76^{C}
	5%	6.20	0.812	0.20^{ABC}	39.93^{AB}	131.57^{E}

All values are means.
[1] Control: No chicken skin, CS: Chicken skin, AS: Acid-treated chicken skin

[A-E] Means within a column with different letters are significantly different ($P<0.05$).

D. Sensorial properties of jerky

The sensorial properties of semi-dried chicken jerky prepared with chicken skin are given in Table 4. With increased skin levels, no significant changes were observed in the sensorial color and flavor properties of jerky products, but there were differences among the samples in the tenderness, juiciness, and overall acceptability. Compared to the control jerky samples, the semi-dried jerky prepared with 5% skin, regardless of acid-treatments, had significantly higher tenderness scores, and the incorporation of 5% acid-treated skin in this study had an influence on improved juiciness and overall acceptability in jerky.

Table 4 Sensorial properties of chicken jerky

Treat-ments[1]		Color	Flavor	Tender-ness	Juiciness	Overall acceptability
Control		8.22	8.00	7.44^{C}	7.44^{B}	8.33^{B}
CS	1%	8.22	8.00	7.56^{C}	7.67^{AB}	8.50^{AB}
	3%	8.11	8.00	7.89^{ABC}	7.78^{AB}	8.56^{AB}
	5%	7.89	7.89	8.22^{AB}	8.00^{AB}	8.67^{AB}
AS	1%	8.22	8.00	7.78^{BC}	7.89^{AB}	8.56^{AB}
	3%	8.22	7.89	8.00^{ABC}	8.00^{AB}	8.83^{AB}
	5%	8.11	7.78	8.50^{A}	8.33^{A}	8.94^{A}

All values are means.

[1] Control: No chicken skin, CS: Chicken skin, AS: Acid-treated chicken skin

[A-C] Means within a column with different letters are significantly different ($P<0.05$).

IV. CONCLUSIONS

The use of skin correlated positively with fat contents and TBA values of jerky samples, but these situations were diminished by the acid treatments of skin. In addition, the partial of chicken breast meat with skin improved the moisture contents, the tenderness, and sensorial properties of jerky products, and especially, the addition of 5% acid-treated chicken skin had a positive effect on the semi-dried chicken jerky in physicochemical properties and cut down the cost of production on the economical aspects.

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