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Quality of Gelatin Processed from Chicken Legs (*Tarsometa tarsus*) Skin with Different Method

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Abstract

This study aimed to utilize chicken legs skin (*Tarsometa tarsus*) to produce fine quality and physicochemical properties of gelatin derived from halal ingredients by using different degreasing methods of processing. Methods used in gelatin production were: 1) skin sample is not soaked in NaOH 0.05 M and liquid gelatin is centrifuged for 15 min with 3500 rpm (WONS); 2) skin sample is not soaked in NaOH 0.05 M and liquid gelatin is centrifuged for 15 min with 3500 rpm and then ethanol is added (1:1) (WONSE); 3) skin sample is not soaked in NaOH 0.05 M ethanol is added to liquid gelatin (1:1) (WONE); 4) skin is soaked in NaOH 0.05 M and liquid gelatin is centrifuged for 15 min with 3500 rpm (WNS); 5) skin is soaked in NaOH 0.05 M and liquid gelatin is centrifuged for 15 min and then ethanol is added to it (1:1) (WNSE); 6) skin is soaked in NaOH 0.05 M and ethanol is added to liquid gelatin (1:1)(WNE). Results showed that the different methods significantly affected ($p<0.05$) pH, viscosity, intensity of yellow (b value), protein and fat contents. WONS method produced the highest viscosity ($p<0.05$) and protein content ($p<0.05$), as well as the lowest fat content ($p<0.05$) with no differences for other characteristics with other treatments. Therefore, it can be concluded that methods where the skin has not been soaked in NaOH 0.05M and liquid gelatin has been centrifuged are the best ones to produce fine quality gelatin from chicken legs skin.

Keywords: chicken skin, gelatin, quality

1. Introduction

Gelatin is produced by protein hydrolysis of bone collagen and skin, which are widely used for various industrial purposes, either food industries or non-food industries. The main functions of gelatin in the food industry are foaming stabilizer, gelling, adhesive, viscosity agent, and emulsifier. Usually, halal gelatin is processed from cattle bone and skin collagen. Nonetheless, chicken bone and skin collagen have potential use as sources of gelatin.

Chicken legs *(Tarsometa tarsus)* which is also called chicken claw has a high protein content, about 22% [16].The high content of protein in the skin, especially chicken legs collagen protein, can be used as an alternative to halal gelatin products that are consumed by most people in Indonesia, both Islamic and Hindu [5]. Broiler numbers in 2014 reached 1.443349 billion of head/year [6]. Based on this data, if a chicken weights 1.5 kg/head, then 2 165 023.5 tons of chicken/year would be produced. It is known that the weight of the chicken legs skin represents about 1% of

total body weight, therefore, in one year about 21 650.235 tons of chicken legs skin could be produced. It is indicated that chicken legs skin could have a good potential as a source of halal gelatin.

Chicken legs skin gelatin is still very high in fat. Fat content should not exceed 5%, as it is an important quality requirement for gelatin. The fat contained in gelatin can lead to fat oxidation which causes rancidity and shortens shelf life. Based on [12] report which uses skin gelatin produced from chicken legs, fat content of produced gelatin is usually 15.7%. Therefore, this study aimed to utilize the chicken legs skin *(Tarsometa tarsus)* to produce fine quality and physicochemical properties of gelatin derived from halal ingredients processed using different degreasing methods.

2. Materials and Methods

Extraction of gelatin

Chicken legs were taken from a slaughterhouse that already have halal standards. Boneless chicken legs skin and nails were first cleaned. Samples of skin were soaked in 0.05M NaOH for 1 hr (every 30 minutes NaOH was changed) and then were washed until the pH became neutral. The skin samples that where not soaked in NaOH were washed and then used directly in the next step. The skin samples were then soaked in a 1.5% HCl solution for 24 hours, and then washed until the pH became neutral. The skin samples with a neutral pH were then heated using a water bath at a temperature of 90^{o}C for 2 hours. The gelatin solutions that resulted were treated as follows: a gelatin solution was centrifuged at 3500 rpm for 15 minutes, a gelatin solution was centrifuged at 3500 rpm for 15 minutes and then ethanol 1:1 was added, and finally ethanol 1:1 was added to a gelatin solution. All samples were then dried using an oven at a temperature of 60^{o}C for 24 hr. The resulting gelatin was analyzed for its proximate content, viscosity, pH, yield, and color.

Proximate Analysis [1]

Proximate analysis of the chicken leg skin gelatin included moisture content, ash content, protein content, fat content.

Analysis of gelatin viscosity [8]

Gelatin solution (150 ml) with a concentration of 6.67% at a temperature of 60 °C was inserted into the space provided. The rotor was dipped into the sample and allowed to spin until the appointment of a scale needle stops at a certain scale. The scale read indicated the viscosity of the sample (cP).

Determination of pH [1]

Gelatin solution at concentration of 6.67% was placed into beaker glass. After calibration, cathode of pH meter was dipped in gelatin. The constant digital number displayed in the screen was pH value of sample.. The cathode was rinsed and dried for next measurement.

Determination of gelatin yield [11]

Yield determination was calculated based on the weight ratio of gelatin obtained against severe skin chicken legs, and expressed in percent (%).

Color Measurement [9]

Color analysis was performed using chromameter measuring the spectrum of light reflected from gelatin, determined by the coordinates L, a * and b *. Notation L *, 0 (black), 100 (white) showed reflected light producing achromatic colors of black gray and white.

3. Results and Discussion

The water content of the resulted gelatin meet standards set BSNI 01-3735-1995 (maximum 16%). Different fat removal methods showed no significant effects on moisture content, and resulted in low moisture content, since all samples received same extraction and drying methods.[2]stated that low moisture content in gelatin was due to the

Table 1. Proximate analysis of chicken leg *(Tarsometa tarsus)* skin gelatin with different fat removal methods

Variables (%)	Treatments						SNI
	WONS	WONSE	WONE	WNS	WNSE	WNE	
Moisture	7.65± 1.79	7.68± 1.03	7.56±1.19	6.46± 0.75	6.99±0.38	6.69±0.53	max 16%
Ash	0.27±0.11	0.27±0.05	0.29± 0.07	0.29± 0.02	0.24±0.01	0.22±0.024	max 3.25%
Protein	92.36±0.35cd	93.52±0.34bc	89.22± 2.39d	97.20±0.74a	95.85±1.03ab	91.35±2.74cd	
Fat	0.92± 0.34 bc	1.90± 0.49ab	2.95 ± 0.59a	0.45± 0.23 c	1.62 ±0.91b	2.81 ±0.49a	

Different letters following the values in the same line indicate significantly different (P <0.05)

Notes: wons = skin without soaked NaOH and gelatin solution centrifuged, WONSE = skin without soaked NaOH and gelatin solution centrifuged and added ethanol, Wone = skin without soaked NaOH and gelatin solution was added ethanol, WNS = skin soaked NaOH and gelatin solution were centrifuged, WNSE = skin soaked gelatin solution NaOH and centrifuged and added ethanol, WNE = skin without soaked gelatin solution NaOH and added ethanol

weak water holding capacity which makes the water easily evaporate during drying.

The ash content was also not significantly different. The resulting gelatin was considered as good quality in term of ash content standard of BSNI [3] that 3.25%. This is in line with previous report. [4] recommended that ash content for a high quality gelatin was less than 0.5%. Low ash content of gelatin was affected by dissolved organic material during fat removal process.

Different treatments significantly (p <0.05) affected protein and fat content of the gelatin. The protein content was inversely related to fat levels. High level of protein in gelatin showed a good degree of purity.[14] stated that the gelatin was product of protein conversion produced by the hydrolysis of collagen, thus the protein was very high.

Low fat content was obtained in WNS treatment, but the result was not significantly different from WONS. [13] reported that lipids could be extracted at the same time as the collagen, and despite the mechanical removal and filtration step, it was possible that traces of lipids remained in the final product. Removal of fat by centrifugation is very effective because it can separate different molecular weights. [10] showed that the lower fat and ash contents represented efficient removal methods and showed a good gelatin quality. Furthermore, low fat level may maintain gelatin quality and extends its shelf life.

Table 2. Physical properties of chicken leg skin gelatin with different fat removal methods

Variables	Treatments						GMIA
	WONS	WONSE	WONE	WNS	WNSE	WNE	
pH	4.00±0.52ab	3.84±0.23b	4.26±0.46a	3.86±0.21b	3.8±0.38b	3.79±0.22b	3.8-5.5
viscosity (cP)	12.43±0.64a	7.70±0.46bc	9.38±2.95b	7.45±0.33bc	6.83±0.33c	8.63±0.30bc	1.5-7
Colour a	1.92± 0.62	1.84±0.72	2.64±0.37	2.23±0.48	2.22±0.22	2.21±0.28	
Colour b	15.11±0.43b	13.48±1.16c	16.36±0.60a	14.71±0.95b	14.45±0.13bc	15.50±0.44ab	
Colour L	78.45±2.71	79.13±4.97	76.48±2.17	77.54±2.66	77.7±1.72	75.57±2.05	
Yield (%)	8.55±1.23	8.07±1.68	8.66 ±1.65	9.22±1.04	8.84± 0.57	9.92±0.53	

Different letters following the values in the same line indicate significantly different (P <0.05)

Notes: wons = skin without soaked NaOH and gelatin solution centrifuged, WONSE = skin without soaked NaOH and gelatin solution centrifuged and added ethanol, Wone = skin without soaked NaOH and gelatin solution was added ethanol, WNS = skin soaked NaOH and gelatin solution were centrifuged, WNSE = skin soaked gelatin solution NaOH and centrifuged and added ethanol, WNE = skin without soaked gelatin solution NaOH and added ethanol

The results exhibited that treatments significantly affected the pH ($p < 0.05$). Table 1 indicated that treatments without soaked with NaOH and centrifuged (WONS) was not different with all treatments soaked with NaOH and treatment with the addition of ethanol. Thus fat removal without NaOH and ethanol can be used. The pH value of the resulting gelatin is acid, since the acid is used in the conversion process of collagen into gelatin. [4] reported that the acid destabilizes the triple helical structure of collagen by disrupting acid labile cross-links at the telopeptide region and amide bonds of the triple helix as well as non-covalent intra and inter-molecular bonds. In this study, the concentrated acid (HCl 1.5%) was used, which was capable of penetrating into the skin tissue for pH reduction. The concentration of acid and pretreatment time influenced the physicochemical properties of the gelatin [7].

The gelatin viscosity is very important in its application to a product. Fat removal methods showed significant effect on the viscosity of the gelatin ($p < 0.05$). The highest viscosity was obtained from treatment of WONS (without soaked with NaOH and centrifuged). Fat decreasing by centrifugation possibly unaltered the molecular structure of gelatin that causes increasing viscosity. [15] stated that the viscosity was affected by the molecular weight and amino acid chain length of the gelatin.

Different methods of fat removal no significantly affected gelatin yield. Treatment of WNE (soaked with NaOH and addition of ethanol) resulted in the highest yield, but not different to other treatments, with the exception of the treatment WONSE (without soaked with NaOH and the solution was centrifuged and added by ethanol). The yield indicates the value of the quantity and effectiveness of a product processing. The quality and quantity of chicken leg skin gelatin shows inverse correlation. The treatment of the fat removal reduced the quantity of gelatin.

Table 2 exhibits color properties of gelatin including lightness (L*), red intensity (a), and yellow intensity (b). The differences in treatment significantly affected intensity of the yellow color ($p < 0.05$), but had no significant effect on the intensity of the brightness and the red color. The yellow color is influenced by raw material, extraction temperature, temperature and drying time, thus these factors contributed to non-enzymatic browning reaction of the product. [13] stated that maillard reaction occurred between the proteins and the traces of lipids during extraction process, which contribute to gelatin darkening.

4. Conclusion

Methods where skin samples have not been soaked in 0.05M NaOH and have been centrifuged were the best ones for producing quality gelatin from chicken legs *(Tarsometa tarsus)* skin.

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