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The Effect of Acetic Acid Concentration and Curing Time on the Characteristics of Native Chicken Legs Skin Gelatin

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ABSTRACT: Gelatin is a denaturalized protein that is derived from collagen by acidic or alkaline hydrolysis and is an important functional biopolymer that has a very broad application in many industrial fields. This research was aimed to determine the effect of acetic acid concentration and curing time on the characteristics of native chicken legs skin gelatin. The experiment used Completely Randomized Design (CRD) with two factors and three replicates of treatment. The first factor was concentration of acetic acid solution, consisted of (3, 5 and 7%). The second factor was immersion time in acetic acid (12, 24 and 36 hours). The result showed that concentration acetic acid solution had significant effect ($P<0.05$) on the the yields, gel strength, viscosity and protein content of native chicken legs skin gelatin but had no significant effect ($P>0.01$) on water content and pH value. The curing time had no significant effect ($P>0.05$) on the pH value, yields, gel strength and viscosity of gelatin. It was concluded that the native chicken legs skin gelatin with concentration of acetic acid 3, 5 and 7 % had similar characteristics to the commercial gelatin but the best characteristics gelatin was produced from 3 % acetic acid concentration and 24 hours curing time (yields 12.31 %, gel strength 64.16 g/Bloom, viscocity 5.50 cP, protein content 89.90%, water content 7.31% and pH value 5.33).

Keywords: Acetic acid, Gelatin, Native chicken legs skin and Curing

INTRODUCTION

Gelatin is a protein of animal origin, that can be obtained from collagen by acidic or alkaline hydrolysis. Gelatin is a denaturalized protein that is derived from collagen and is an important functional biopolymer that has a very broad application in many industrial fields. Its functional properties depend on processing conditions as well as the raw material (Sobral and Habitante, 2001). Gelatin production required a curing step to improve quality of gelatin. Curing materials from the group of acids have been widely applied in gelatin production. Effect of Acetic Acid concentration and curing time to produce gelain from native chicken legs skin was limited information. The quality of gelatin depends on its physichochemical properties, rheological properties and manufacturing method. Gelatin has been applied within the food, pharmaceutical, medical, cosmetic and photographic industries because of its unique functional (Karim and Bath, 2008). Most gelatins are currently made from beef bone and hide, different species of fish (Gomez-Estaca *et al.*, 2009). Scientists has been doing many research of gelatin from pigskin (Sompie *et al.*, 2012), from goat skin (Said *et al.*,2011), and gelatin from tunafish skin (Gudmundsson, 2002). Gelatin production required a curing step to improve quality of gelatin. Curing materials from the group of acids have been widely applied in gelatin production. Effect of acetic acid concentration and immersion time to produce gelatin from native chicken legs skin was limited information. Thus, this research was conducted to study the effect of combination between different concentration acetic acid solution and curing time on characteristics of native chicken leg skin gelatin.

MATERIALS AND METHODS

Materials. Five thousand g native chicken legs skin were used as a raw material, acetic acid solution (CH_3COOH 0.5M), and distilled water.

Preparation of gelatins. Gelatine was prepared by the acid extraction method (Ockerman and Hansen, 2000). Acetic acid (CH_3COOH 0.5M) concentrations of 3%, 5% and 7% (v/v) were used as a treatments. The raw material were soaked at different curing time of acetic acid solution 12 hours, 24 hours and 36 hours. After soaked, samples were neutralized to pH 6, weighed and extracted. The extraction process were performed on three steps (each step for 3 hours), the first step at 50°C, second step at 55°C and then at 60°C. Solubilized gelatin was separated from residual skin fragments by filtration through a nylon filter. The extracted gelatin was concentrated at 70°C for 5 hours and it was stored in the refrigerator 5-10°C for 30 minutes, then dried at 60°C for 24-36 hours until the gelatin sheet solid. Gelatin sheets were milled and packaged in vacuum plastic and stored in a desiccator for subsequent process.

Experimental design and data analysis. The experiment were determined by analysis of Completely Randomized Design (Steel and Torrie, 1991) with two factors and three replicates of treatments. The first factor was concentration of acetic acid solution consisting of 3 levels (3, 5 and 7 percents). The second factor was different curing time consisting of 3 levels (12, 24 and 36 hours). The significant differences of the average were determined using Duncan's new multiple range test.

Parameters. The characteristics parameters of this research were yield, gel strength, viscocity, protein content, water content and pH value gelatin. The yield obtained from dry weight ratio of raw material and the weight of the extracted pigskin multiplied by 100% (AOAC, 1995). Gel strength was determined with a Universal Testing Machine (Zwick/Z.0,5). Gelatin solution 6.67% w/v (6.67 grams to 100 ml distilled water) was heated at 60°C to dissolve the particles. Solution in the container Ø5 cm and height 6 cm was stored at 5C for 16-18 hours. Gelatin was placed at the bootom of the plunger (Ø=13mm). Measurement was conducted at the temperature of 10°C and the speed 10 mm/min as deep as 4 mm was used as plunger. The value of gel strength (g Bloom) use the formula = 20 + 2.86 x 10-3D, where D = F/G x 980; F = height chart before fracture; G = constant (0.07) (Said *et al.*, 2011). Viscocity was measured by gelatin powder dissolved in distilled water at a temperature of 40°C with a solution concentration of 6.67%.

RESULTS AND DISCUSSION

Yield. The yield is amount of dry gelatin produced from a number of raw materials with extraction process (Said, 2011). Statistical analysis showed that the interaction between the concentration of acetic acid and curing time had no significant ($P > 0.05$) while the concentration of acetic had significant effect ($P < 0.05$) on the yield of native chicken legs skin gelatin. Duncan test resulted that the yield of gelatin tended to rise with increasing the level of acetic acid concentration. Chamidah and Elita (2002) reported that acetic acid solution used to hydrolyze collagen making it easier solubility in hot water when the extraction of gelatin. The collagen structure is open due to several bond in protein molecules apart. Several author have reported different gelatin yield, from the 16 % (Binsi *et al.,* 2009), the skin of goat was 6.32% (Said *et al.*, 2011). Yield of these results were 13.01 to 14.42 % and it was included in the range of Indonesian National Standard of gelatin (Taufik, 2011).

Table 1. The characteristics of native chicken leg skin gelatin

Parameters	Curing (hours)	Acetic acid concentration (%) + Sd			Average
		3	5	7	
Yields (%)	12	13.20±0.05	13.52±0.02	14.22±0.01	13.74±0.02[b]
	24	14.12±0.03	14.42±0.21	13.12±0.11	13.88±0.03[b]
	36	13.01±0.07	13.11±0.10	14.21±0.14	13.44±0.03[a]
	Average	13.44±0.02[b]	13.68±0.05[c]	13.87±0.23[d]	
Gel Strenght (g/Bloom)	12	64.84±0.62	65.81±0.56	66.07±0.65	65.67±0.21[a]
	24	64.16±0.40	66.02±0.02	67.09±0.81	65.75±0.11[a]
	36	64.12±0.17	66.09 ±0.91	66.44±0.21	65.21±0.01[a]
	Average	64.37±0.17[c]	65.96±0.02[d]	66.53±0.21[e]	
Viscosity (cP)	12	5.70±0.37	4.43±1.04	4.28±0.03	4.80±0.16[b]
	24	5.50±0.12	4.40±0.11	4.30±0.10	4.73±0.31[b]
	36	4.50±0.16	4.41±1.14	4.27±0.07	4.39±0.01[a]
	Average	5.23±5.15[c]	4.41±0.79[d]	4.28±0.72[d]	
Protein Content (%)	12	88.63±0.08	88.21±0.17	88.10±0.08	88.31±0.21[a]
	24	89.60±0.10	89.33±0.12	88.60±0. 48	89.17±1.02[b]
	36	89.92±0.17	89.43±0.01	89.19±0.16	89.51±0.21[b]
	Average	89.38±0.62[c]	88.99±0.62[c]	88.63±0.63[c]	
Water Content (%)	12	7.36±0.01	7.19±0.16	7.44±0.27	7.33±0.20[a]
	24	7.31±0.03	7.19±0.21	7.12±0.23	7.22±0.19[a]
	36	7.22±0.19	7.44±0.27	7.34±0.38	7.34±0.27[a]
	Average	7.31±0.62[c]	7.27±0.22[c]	7.30±0.27[c]	
pH Value	12	5.26±0.08	5.28±0.17	5.31±0.08	5.28±0.54[a]
	24	5.33±0.10	5.26±0.12	5.23±0.48	5.27±0.33a
	36	5.23±0.34	5.25±0.56	5.30±0.16	5.26±0.43a
	Average	5.27±0.62b	5.26±0.06b	5.28±0.63b	

Different letters in the same row and colum indicated the significant differences (P<0.05)

Gel strength. Gel strength is very important on physical properties of gelatin. The average gel strength of native chicken legs skin gelatin was displayed in Table 1. Statistical analysis indicated that the level of acetic acid concentration gave significant effect (P<0.05) while the level curing time and their interaction had no significant effect (P>0.05) on gelatin. The value of gel strength was increase with increasing acetic acid level. Arnesen and Gildberg (2002) reported that a high content of hydroxyproline caused the gel strength increased. The presence of hydroxyproline caused the stability of the hydrogen bonds between water molecules and free hydroxyl groups of amino acids in gelatin, it is very important for gel strength. Furthermore Sims *et al.* (1997) reported that the gel formation of a stable condition that ability of a free chain to form a lot of crosslinking. Gel strength values of gelatin was ranged 64.12 - 67.09 g Bloom, that in line with the criteria of ISO 75-300 g Bloom (Said, 2011)

Viscosity. The average viscosity of native chicken legs skin gelatin is displayed in Table 1. Statistical analysis indicated that interaction between acetid acid concentration and curing time

had no significant effect (P0>0.05) on gelatin. The value of viscocity tended to decreased at the acetic acid and curing time increased. In order words, the higher concentration, the viscosity was tended to decreased. This is because the curing material has been breaking the peptide bonds of amino acids into short-chain molecule so that its viscosity decrease. This is because the viscosity of gelatin is directly proportional to the gel strength that was not significantly different between treatments (Astawan *et al.,* 2002). Furthermore, Ulfah *et al.* (2011) explained that viscosity is affected by molecular weight and amino acid chain length. Increased concentrations of CH_3COOH in the gelatin production process can reduce the viscosity. This is because the curing material has been breaking the peptide bonds of amino acids into short-chain molecule so that its viscosity decrease. Viscosity values from these research was ranged 4.27 to 5.70 cP. It values is included in the ISO range 2.0 to 7.5 cP (Sompie *et al.,* 2012).

Protein Content. Gelatin is the collagen protein, a group derived from the structural proteins and extracellular matrix and produced in large quantities (Said *et al.,* 2011). The average protein content of native chicken legs skin gelatin was presented in Table 1. Statistical analysis indicated that the differences in level of acetic acid concentration had high significant effect (P<0.05) on protein content of gelatin, whereas the curing time and the interaction between these two different factors had no significant effect (P> 0.05) on levels of protein gelatin. Duncan test results showed that protein content of gelatin from chicken skin had a tended to increase with increasing level of acetic acid solution. According to Swatland (1984), age slaughter affect the content of collagen in the skin, increasing age increased collagen protein. Protein content from native chicken skin gelatin ranged 88.10 to 89.92 %, that it was not different with commercial gelatin (Said *et al.,*2011)

Water content. The water content average of native chicken legs skin gelatin was presented in Table 1. Statistical analysis indicated that the differences in level of acetic acid concentration no significant effect (P>0.05) on water content of gelatin. Tabel 1 showed that water content of gelatin from chicken legs skin had a tended to decreased with increasing level of acetic acid solution and curing time. Water content of gelatin decreased due to the denaturation resulting in molecular changes and the amount of water that is bound to decline collagen structure and produce gelatin with a weak structure, so that the water holding capacity will lead to volatile water during the drying gelatin and water content becomes lower dry gelatin (Astawan and Aviana, 2002). Water content from native chicken legs skin gelatin ranged 7.12 to 7.44 %, that it was not different with commercial gelatin (Taufik, 2011)

pH Value. The pH value of gelatin is very important on chemical properties because its can affect the properties of gelatin others to determined the subsequent application of gelatin. The average pH value of native chicken legs skin gelatin was ranged between 5.03 to 5.41. Statistical analysis indicated that interaction between level of acetic acid concentration had no significant effect (P>0.05) on pH value of native chicken skin gelatin. This is because the raw materials that have been in curing skin with acetic acid before undergoing a process of neutralization and washing before further processing so that the acid molecules that are bound to skin protein amount is very small. Conditions in the range of neutral pH values indicate that the process of neutralizing and washing the raw material before the extraction process is running perfectly so that contamination can be minimized. Therefore, the neutralization process plays an important. The pH values average of gelatin was ranged 5.03 to 5.41 that in line with the commercial gelatin (Taufik, 2011)

CONCLUSIONS

Native chicken legs skin gelatin with concentration of acetic acid 3, 5 and 7 % had similar characteristics to the commercial gelatin but the best characteristics gelatin was produced from

3 % acetic acid concentration and 24 hours curing time (yields 12.31 %, gel strength 64.16 g/ Bloom, viscosity 5.50 cP, protein content 89,90 %, water content 7.31% and pH value 5.33).

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