Effect of extraction temperature on characteristics of chicken legskin 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. Its functional properties depend on processing conditions as well as the raw material. The objective of the research was to study effect of extraction temperature on characteristics of native chicken legskin gelatin. This study used Completely Randomized Design (CRD) with four treatments (T1 = 50^0C, T2 = 55^0C, T3 = 60^0C, T4 = 65^0C) and five replications. Statistical analysis were carried out by one Anova and the mean difference was tested using Duncan's Multiple Range Test. The result of research indicated that, extraction temperature had significant effect ($P<0.05$) on yield, gel strength, viscocity and protein content of chicken legskin gelatin, but it had no significant effect ($P>0.05$) on water content. It was concluded that the use of extraction temperature 60^0C was (yields 13.75,gel strength 78.75 g bloom,viscosity 6.52 cP, protein content 84.23% and water content 6.20%).

Key words *: Chicken legskin, Extraction, Temperature*

1. 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. The quality of gelatin depends on its physichochemical properties, rheological properties and manufacturing method. Scientists has been doing many research of gelatin from pigskin from goat skin and from Tuna skin [1, 2, 3]. The use of gelatin to form edible films or coatings was very well studied in the 1960's, which resulted in many patents being filed, mainly in the pharmaceutical area [4, 5]. The process of gelatin production required a curing step and temperature extraction to improve quality of gelatin [2] . The application of the curing time and concentration of acetic acid 3.5 % had significant effect on physic properties of gelatin chicken legs skin [2, 6]. However, further effects of different temperature extraction on the alkali process from chicken legs gelatin was limited information. Thus, the research was aimed to study the effect of extraction temperature on characteristics of chicken legskin gelatin.

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2. Materials and Methods

Seven hundred (700) g chicken skin were used as a raw material and acetic acid (CH_3COOH) as a curing material. Gelatin was produced by the acid extraction method [2, 7] .

2.1. Procedure

Gelatine was prepared by the acid extraction method [8]. Acetic acid (CH_3COOH) concentrations of 3% (v/v) were used as a curing. The raw material were soaked for 24 hours. After soaked, samples were neutralized to pH 6, weighed and extracted. The extraction temperature process were performed on five steps (each step for 5 hours), the first step at 50 ^{0}C, second step at 55 ^{o}C, third step at 60 ^{o}C and then 65^{o}C as a treatments. Solubilized gelatin was separated from residual skin fragments by filtration through a nylon filter. The extracted gelatin was concentrated at 70 ^{o}C for 5 hours and it was stored in the refrigerator 5-10 ^{o}C for 30 minutes, then dried at 60 ^{o}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. The extracted gelatin at 60 ^{o}C for 6 hours and it was stored in the refrigerator 5-10 ^{o}C for 30 minutes, then dried at 60 ^{o}C for 24-48 hours until the gelatin solid. Gelatin sheets were milled and packaged in vacuum plastic and stored in a desiccator before analysis.

2.2.Experimental design and data analysis

The experiment were determined by analysis of Completely Randomized Design (CRD) with four treatments (T1 = 50^{0}C, T2 = 55^{0}C, T3 = 60^{0}C, T4 = 65^{0}C) and five replications. Statistical analysis were carried out by one Anova and the mean difference was tested using Duncan's Multiple Range Test [11].

2.3. Parameters

The parameters of this research were yields, gel strength, viscosity, protein content and water content. The yields obtained from dry weight ratio of raw material an d the weight of the extracted native chicken legskin gelatin multiplied by 100%. Gel strength was determined with a Universal Testing Machine (Zwick/Z0.5). The value og 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). Viscosity was measured by gelatin powder dissolved in distilled water at temperature of 40^{o}C with a solution concentration of 6,67%.

3. Results and Discussion

Table 1. The characteristics of native chicken legskin gelatin

Extraction (^{o}C)	Yield (%)	Gel Strength (g Bloom)	Viscocity (cP)	Protein Content (%)	Water Content (%)
50	12.28±0.25^a	77.56±0.08^a	7.02±0.14^a	83.46±0.24 ^{a}	6.23±0.62
55	13.53±0.12^b	78.67±0.10^b	6.54±0.10^b	84.10±0.08^{ab}	6.22±0.21
60	13.75±0.05^b	78.75±0.29^b	6.52±0.16^b	84.23±0.48^b	6.20±0.23
65	14.14±0.01^{bc}	79.03±0.12^c	6.07±0.19^b	84.02±0.22 ^{ab}	6.20±0.32

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

3.1.Yields

Statistical analysis indicated that the differences of extraction temperature had significant effect (P<0.05) on yield of native chicken legskin gelatin. The value of yield decrease with increasing level of extraction temperature. Duncan test resulted that the yield of gelatin tended to increase with increasing the level of extraction temperature. The acetic acid solution used to hydrolyze collagen making it easier solubility in hot water when the extraction of gelatin. Yield values from native chicken legskin gelatin was ranged 12.28 to 14.14 %. It values was not different with yield from chicken skin gelatin was 13.01 to 14.42 [3, 7].

3.2. Gel strength

Gel strength average of native chicken legskin gelatin was displayed in Table 1. Statistical analysis indicated that the differences of extraction temperature had significant effect ($P<0.05$) on gel strength of native chicken legskin gelatin. The value of gel strength tended to decrease with increasing level of extraction temperature. 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.The gel formation of a stable condition that ability of a free chain to form a lot of crosslinking [9]. Gel strength of gelatin is very important on physical properties of gelatin. Gel strength values from native chicken legskin gelatin was ranged 77.56 – 79.03 g Bloom, that in line with the criteria of ISO 75-300 g Bloom [2, 3, 7, 10].

3.3.Viscocity

Statistical analysis indicated that the extraction temperature had no significant effect ($P>0,05$) on gelatin. The value of viscocity tended to decrease at the extraction temperature increased. In order words, the higher concentration, the viscosity was tended to inreased. This is because the viscosity of gelatin is directly proportional to the gel strength that was not significantly different between treatments. The viscosity is affected by molecular weight and amino acid chain length [10]. Increased concentrations of acetic acid in the gelatin production process can reduce the viscosity. The curing material has been breaking the peptide bonds of amino acids into short-chain molecule so that its viscosity decrease. Viscocity values from native chicken legskin was ranged 6.07 to 7.02 cP. It values is included in the ISO range 2.0 to 7.5 cP [7, 10].

3.4. Protein Content

Gelatin is the collagen protein, a group derived from the structural proteins and extracellular matrix and produced in large quantities [2, 9]**.** Statistical analysis indicated that the different of extraction temperature had significant effect ($P<0.05$) on protein content of chicken legskin gelatin. Duncan test results showed that protein content of gelatin from chicken legskin had a tended to increase with increasing temperature of extraction. This is beacause age slaughter affect the content of collagen in the skin, increasing age increased collagen protein. Protein content from chicken legskin gelatin ranged 83.46 to 84.02 % [6] That it was not different with protein content from chicken leg skin ranged 83-90 % and commercial gelatin, 91, 63% [2, 8].

3.5. Water Content

The water content average of native chicken legskin gelatin was presented in Table 1. Statistical analysis indicated that the differences in level extraction temperature had no significant effect ($P>0.05$) on water content of gelatin. Water content of gelatin had a tended to decreased with increasing level of temperature. This is because the denaturation in molecular changes and the amount of water that is bound to decline collagen structure. The water holding capacity will lead to volatile water during the drying gelatin and water content becomes lower [2, 7]. Water content from native chicken legskin gelatin ranged 6.20 to 6.23 %. That it was not different with water content from chicken leg skin ranged 7.12-7.44 % [3, 7, 10].

4. Conclusion

It was concluded that the use of extraction temperature 60^0C was the best characteristics of native chicken legskin gelatin (yields 13.75, gel strength 78.75 g bloom, viscosity 6.52 cP, protein content 84.23% and water content 6.20%).

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