Effect of different types of acid solvent on functional and microbiological properties of chicken leg skin gelatin

M Sompie, S E Siswosubroto, G D Rembet and J W Ponto

Laboratory of Animal Production Technology, Faculty of Animal Husbandry, Sam Ratulangi University, Manado 95115, Indonesia

Corresponding author: meitysompie@yahoo.com

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 study was aimed to determine the effect of different types of acid solvent on functional and microbiological properties of chicken leg gelatin. This experiment used Completely Randomized Design 2x3 factorial pattern. The first factor is two types of curing acid (HCL and CH₃COOH), the second factor is curing concentration (1%, 3% and 5%) with three replications. This research materials used chicken leg. The variable studies were yield, gel strength, viscosity and total bacteria of gelatin. The results showed that the difference solvent and concentrations had no significant effect (P>0.01) to the functional and microbiological properties of chicken leg skin gelatin. It was concluded that chicken leg that were processed using 1%, 3% and 5% acetic acid (CH₃COOH) solvent produces the optimal functional properties of gelatin and can be applied to food products.

1. Introduction

Gelatin is a protein of animal origin, that can be obtained from collagen by acidic or alkaline hydrolysis [1]. The typical characteristics collagen protein includes containing at least 33% amino acid glycine and 22% proline [2]. Gel strength is a very important physical property of gelatin, depending on the hydrogen bonds between water molecules and the free hydroxyl group of amino acid groups, the size of protein chain, extraction method, the concentration and distribution of molecular weight of the gelatin [3-4]. Gelatin production required a curing and extraction step to improve quality of gelatin [5-6]. The quality of gelatin is formed with a low extraction temperature, because at this temperature less hydrolysis of polypeptide chains occurs. Curing materials from the group of acids have been widely applied in gelatin production [7]. The application of the curing time and concentration of acetic acid 3.5 % had significant effect on physical properties of gelatin of chicken legs skin [8]. The process of the reaction of acid that continues with high concentration, causing the chemical bonds in the collagen molecule to be damaged so that in the end it will have an impact on decreasing the quality and quantity of gelatin products. However, further effects of different type of curing process from chicken claw was limited information. Thus, the research has been done to study effect of acetic curing type and their concentration on functional and microbiological properties of chicken leg skin gelatin.
2. Material and methods

2.1. Material
2.000 g of chicken leg skin were used as a raw material, acetic acid (CH₃COOH), hydrochloric acid (HCL) and stilled water.

2.2. Procedures
Gelatine was prepared by the acid extraction method [9]. Acetic acid (CH₃COOH 0.5M) diluted with water in 1%, 3% and 5% (v/v) were used as treatments, then diluted HCL with water according to the treatment. The chicken leg skin was soaked on the acetic curing for 24 hours. After soaked, samples were neutralized to pH 6, weighed and extracted on water bath for 6 hours with temperature 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 6 hours and it was stored in the refrigerator 5°C for 30 minutes, then dried at 60°C for 24-36 hours until the solution dried. Gelatin sheets were milled and packaged in vacuum plastic and stored in a desiccator for analysis process.

2.3. Statistic
The experiment was conducted based on Completely Randomized Design with two factors 2x3 and three replicates of treatments. The treatments applied in this study were two types curing acid process (CH₃COOH and HCL) and three concentration of material for curing (1, 3 and 5%; v/v). The data were analyzed using ANOVA. The significant differences of the treatments were determined using Duncan's Multiple Range Test (DMRT) at 5% level [10].

2.4. Parameters
The parameters of this research were yields, gel strength, viscosity, and total bacteria. The yields obtained from dry weight ratio of raw material and the weight of the extracted native chicken leg skin gelatin multiplied by 100% (AOAC, 1995). Gel strength was determined with a Universal Testing Machine (Zwick/Z0.5). The value of gel strength (g Bloom) used the following 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°C with a solution concentration of 6.67 [9].

3. Results and discussion

3.1. Yield
Yield is the amount of dry gelatin produced from a number of skin raw materials in a clean state through an extraction process [8]. Statistical analysis showed that the curing type and concentration of curing had no significant effect (P>0.01) on the yield of chicken leg gelatin. The higher yield produced showed that the methods used are efficient and effective. Yield from chicken leg skin gelatin was ranged 12.10 to 13.11 %. It values was not different with yield from native chicken leg skin gelatin was 13.01 to 14.42 [11-16]

3.2. Gel Strength
Gel strength is one of the functional properties that is very important. The use of gelatin is determined based on the range of values of the gel strength [5-12]. The value of gel strength tended to increase in level 3 % acetic acid curing. Gel formation occurs due to the development of gelatin molecules during the extraction process. Based on Table 1 showed that gel strength value in chicken leg skin gelatin, both those produced using CH₃COOH and HCL curing materials had no significant effect (P>0.01). Gel formation resulted from hydrogen bonds between gelatin molecules and producing a semi-solid gel that is bound in a water component [13-14]. The higher gel strength of chicken claw gelatin was 85.10 g Bloom. It indicates that the production process becomes more efficient [15-16].
3.3. Viscosity
Statistical analysis indicated that the concentration and curing time in acetic process of gelatin had no significant effect (P>0.01) on chicken leg gelatin. The value of viscosity tended to decrease in gelatin from HCL curing process. The curing material has been breaking the peptide bonds of amino acids into short-chain molecule so that its viscosity decrease. Viscosity from chicken claw gelatin was ranged 7.02 to 8.93 cP. Its values are included in the ISO range 2.0 to 7.5 cP [8,11,17,18].

3.4. Total Bacteria
Based on Table 1 showed that the total bacteria in gelatin products, both those produced using CH₃COOH and HCL curing materials are not much different from the average range of 1.6-3.4 x10⁴ CFU/g. The total bacteria in chicken leg skin gelatin is still lower than the results obtained from previous researchers that is 5.7x10⁹ and 4.0x10⁹ CFU / g for gelatin for tuna skin and from shark gelatin [4,5]

4. Conclusion
It was concluded that chicken leg that were processed using 1%, 3% and 5% acetic acid (CH₃COOH) solvent produces the optimal functional properties of gelatin and can be applied to food products.

Acknowledgements
The research has been funded by the Ministry of Research Technology and Higher Education, Republic of Indonesia based on Research Grant Implementation, No. 198/UN12.13/LT/2019

References
[1] Sobral P J A and Habitate A M Q B 2001 Food Hydrocolloids 15 377–82
[2] Gelse K, Pöschl E and Aigner T 2003 Advanced Drug Delivery Reviews 55 1531–46
[3] Hidaka S and Liu S Y 2002 J. Food Composition and Analysis 16 477–483
[4] Cho S M, Kwak K S, Park D C, Gu Y S, Ji C I and Jang’ D H 2004 Food Hydrocolloid 18 573–9
[5] Agustin A T and Sompie M 2014 Proc. Int. Conf Challenges of Biotechnological Research in Food and Health Solo Indonesia p. 103–4
[6] Pranoto Y, Chong M L and Park H J 2006 J. Food. Sci and Tech. 40 766–74
[7] Muyonga J H C, Cole G B and Duodu K G 2004 Food Hydrocolloids 18 581–92
[8] Sompie M, Siswosubroto S E and Pontoh J H W 2015 Proceedings The 6th ISTAP 2 714–718
[9] Said M I, Triatmojo S, Erwanto Y dan Fudholi A 2011 Media Peternakan 34 3 184–189
[10] Steel R G D and Torrie J H 1980 Principles and Procedures of Statistics A Biometrical Approach 2nd ed. (New York: McGraw-Hill Book Company)
[11] Sompie M, Triatmojo S, Pertiwiningrum A and Pranoto Y 2012 *J. Indonesian Tropical Animal Agriculture* **37** 176–82
[12] Gautieri A, Vesentini S, Montevecchi F M and Redaelli A 2008 *J. Biomech.* **12** 134–140
[13] Gennadios A, Brandenburg A, Weller L C and Testin R F 1993 *J. Agr. Food Chem.* 1835–39
[14] Giménez B, Gómez-Guillén M C and Montero P 2005 *Food Hydrocolloids* **19** 951–7
[15] Gómez-Estaca J, Bravo I, Gómez-Guillén M C, Alemán A and Montero P 2008 *Food Chem.* **112** 18–25
[16] Hidaka S S and Liu Y 2002 *J. Food Composition and Analysis* **16** 477–83
[17] Karim A A and Bhat R 2009 *Food Hydrocolloids* **23** 563–576
[18] Sompie M, Surtijono S E, Pontoh J W and Lontaan N 2015 *Procedia Food Science* **3** 383–388