# STUDY OF GELATINE FROM DUCK BONE AS AN ALTERNATIVE SOURCE OF HALAL GELATINE

M. Habbib Khirzin*, Mustofa Hilmi
Processing Technology of Livestock Product Department, State Polytechnic of Banyuwangi
Jl. Raya Jember KM. 13, Labanasem, Kabat, Banyuwangi, East Java
*e-mail: habbibkhirzin@poliwangi.ac.id

## *ABSTRACT*

*Gelatine is a common ingredient that is often used in many fields, such as food, pharmacy, and cosmetics. It is usually extracted from pig and cow. Halal issues of gelatine sources and the outbreaks of mad cow disease encouraged people to find an alternative source of gelatine. One of the alternative sources of gelatine is duck bone. Duck bone has not been widely used as a raw material for gelatine. This research aimed to describe the physicochemical properties of duck bone gelatine, which was extracted by using the acid extraction method as an alternative source of halal gelatine. The extraction of duck bone gelatine used 5 % concentration of HCl (hydrochloric acid). The extraction process consisted of four steps; they were degreasing, defatting, demineralization, and acid extraction. The result showed that gelatine, which was extracted from duck bone, had these several characteristics: The yield of 6.24%, pH 4.0, the water content of 13.43%, the ash content of 13.42%, the protein content of 65.43%, and whiteness degree of 30.35%. Generally, gelatine, which extracted from duck bone, had similar characteristics with commercial gelatine and SNI standard. The further researcher had been suggested to reoptimized the extraction method in order to reduce ash content.*

*Keywords: Duck bone, Acid extraction, Halal gelatin*

## INTRODUCTION

Gelatine is a product of collagen hydrolysis from the skin, connective tissue, and animal bone. Gelatine is a derivative of collagen, which is functioned as a foaming agent, stabilizer, gelling agent, thickener, and emulsifier (Sari, 2017). Commercial gelatine is usually extracted from pig and cow. Nowadays, sources material of gelatine is mostly being reviewed by Moslem since Moslem is not allowed to consume pig and most gelatine are produced from pigskin. Gelatin Manufacturer Association of Asia Pacific (2007) reported that raw material that was used by gelatine producers was pigskin (46%), cow skin (28%), and cow bone (24%). Haram's status on pigskin based products and mad cow disease in some countries such as France, Japan, India, Germany, China, and Australia encourage people to find alternative sources of gelatine.

Indonesia is a country that the majority of its citizen is Moslem (87.18%) (Badan Pusat Statitstik, 2010). The halal issue becomes the most critical judgment to select food and drink. Islam teaches Moslem only to consume halal food and drink and forbid them to consume haram food and drink. As what being written in QS Al-Maidah 3 (5:3), "Forbidden to you (for food) are dead meat, blood, the flesh of swine, and that on which had been invoked the name of other than Allah SWT…." Besides that, the command to consume only halal food is also written on QS Al-Maidah 90, QS Al-An'am 145, and An-Nahl 115.

Gelatine demand in this past decade was increasing as the development of industrial food technology. Exploration of new gelatine sources as an alternative instead of using pigskin is still being reviewed. Several material sources of gelatine are poultry, seafood, and insect (Mariod, 2013). Miskah*et al.* (2010), Jannah *et al.* (2013), and Minah*et al.* (2016) reported that gelatine, which was extracted from poultry bone, seafood bone, and insect has similar characteristic with commercial gelatine. Poultry bones such as duck bones are easily founded in our environment.Duck bone has a potency to be developed become gelatine. Duck bone becomes an interesting study to be investigated as an alternative source of halal gelatine. The purpose of this research was to investigate the

https://doi.org/10.31938/jsn.v10i1.237

physicochemical properties of gelatine extracted from duck bone.

## MATERIAL AND METHOD

### *Material*

The equipment used in this research were digital balance, beaker glass, Erlenmeyer flask, volumetric flask, micropipette, hotplate stirrer, vortex mixer, spoon, tray, pan, stove, oven dryer, pH meter, whiteness meter, muffle, Soxhlet apparatus, protein destructor, and distillatory. The materials used in this research were duck bone, aquadest, natrium hidroxide, hidrochloric acid, benzene, kjeldahl tablet, potassium sulfate, sulfuric acid, methylene blue, methylene red, phenolphthalein indicator, boric acid.

### *Method*

Raw materials used in this research were duck bone, which was taken from a local restaurant in Banyuwangi, which specializes in fried duck menu. The bone used was the upper thigh. This research conducted in the Food Laboratory of Processing Technology and Livestock Product Department, Politeknik Negeri Banyuwangi. The research was divided into three steps. They were pretreatment, extraction, and analysis — pretreatment process based on Ulfa *et al.* (2015) method with slight modification. In the pretreatment process, duck bone was rinsed by water, then soaked with aquadest (1:3) w/v, and boiled at $80^0$C for two hours. Next, the sample was cut into small pieces (approximately 2-3 cm) and was soaked by 1 M NaOH solution (1:5) w/v for two hours. The sample was neutralized by aquadest and was soaked by 5 % HCl solution for 24 hours.

The pretreatment process produced ossein. It was a soft duck bone — extraction process based on Sirikhwatinrat *et al.* (2015) method with slight modification. Aquadest soaked the sample (1:3) w/v then was gradually boiled at $70^0$C and $80^0$C for an hour, respectively. Boiling results were filtrated with cheesecloth. Furthermore, sample was collected in beaker glass. The sample was dried using an oven vacuum dryer overnight. The sample powder (gelatine) had been analyzed its physicochemical properties, such as yield, pH, water content, ash content, protein content, and whiteness degree.

## RESULT AND DISCUSSION

### *Gelatine Extraction*

The gelatine extraction process consisted of several steps. Gelatine was strongly bonded in bone tissue with fat, carbohydrates, and mineral such as calcium, phosphor, magnesium so that the extraction process needs a long time. The extraction process needed pretreatment to produce ossein (soft bone), so gelatine can be extracted easily. The first pretreatment process was degreasing with high temperature for two hours. The purpose of this step was to break mineral at high temperatures. The second pretreatment was defatting and deproteination with NaOH solution. NaOH is a reliable base solution so that it can bond fat tissue in bone. Deproteination could reduce the amount of non-collagen protein in animal bone.

Gelatine is a partially hydrolyzed product from collagen. When collagen boiled over $50^0$C, its triple helix structures will break. It can be caused by the increase of gelatine solubility in water. Gelatine extraction using hot water would cause gelatine soluble in water. This process gave residue such as mineral and a little amount of fat so that it needed to be filtered after the extraction. The drying process after filtration aimed to enhance the concentration of gelatine and shelf life. Dried gelatine should be stored in an airtight place because it is hygroscopic.

### *Physicochemical Properties*

The physicochemical properties of gelatine, which was tested, were yield, pH, water content, ash content, and whiteness degree. The result of the research was shown in Table 3. The Gelatine yield extracted from duck bone was 6.24%. This yield was lower compared to gelatin from commercial sources. The yield was the ratio of the initial

and final weight of the sample. It was various depended on the raw material. Miskah *et al.* (2010) reported that gelatine yield, which was extracted from chicken bone, was 4-8%. On the other hand, Rapika *et al.* (2016) reported that the yield of cow skin gelatine was 23.23%. Generally, gelatine yield from animal bone was lower than from animal skin because of the animal bone harder than their skin.

Color was one of the physical analysis to determine the quality of gelatine. The whiteness degree of duck bone gelatine was 30.35%. This value fulfilled the SNI standard of gelatine, from 30 to 75%. Generally, Gelatine has a light brown and dark brown color. pH was one crucial parameter to determine the quality of gelatine. Duck bone gelatine pH was 4.0. This value still fulfilled Gelatin Manufacturer Institute of America (2012) standard, from 3.8 to 5.5, and SNI standard from 4 to 7. Huda (2013) stated that pH value of gelatine was affected by concentration of HCl and extraction time. The higher the concentration of HCl, the smaller pH of gelatine.

Water content was one of the gelatine quality standards. It affected color, taste, and shelf life. The water content of duck bone gelatine was 13.43%. This result fulfilled the SNI standard, which is a maximum of 16%. The lower the water content of gelatine, the higher its shelf life. Ash was a mineral compound in the animal bone. Generally, a mineral from bone was dominated by calcium, phosphorus, and magnesium. Ash content of duck bone gelatine was 13.42%. It was higher than the SNI standard, a maximum of 3.25%. The high ash content indicated that there were component minerals in duck bone gelatine. Sasmitaloka *et al.* (2017) stated that the ash content of gelatine could become a standard of the successful extraction process. The higher ash content of gelatine showed that the extraction process had been optimized yet because there was mineral residue. Suitablegelatine had low and bright color ash residue.

Gelatine consisted of a minimum of 50% protein. It consisted of almost all amino acids except tryptophan and cysteine. The protein content of duck bone gelatine was 65.43%. It met the minimum standard of SNI, 50%. Jannah *et al.* (2013) reported that chicken bone gelatine extracted using acetic acid, had 86% protein content. Collagen protein was strongly bonded on incomplete tissue bone. The pretreatment process made collagen separated from tissue gradually. While extraction caused the collagen denaturated (the unfolding of the tertiary structure of collagen) so that collagen changed into gelatine during the heating process. This process was irreversible, where collagen was changed into gelatine, could not be changed again into collagen.

Tabel 1. Physicochemical properties of duck bone gelatine

| No | Parameter | Value | SNI |
|---|---|---|---|
| 1 | Yield | 6.24 % | - |
| 2 | pH | 4.0 | 4-7 |
| 3 | Whiteness | 30.35% | 30-75% |
| 4 | Water content | 13.43% | Max 16% |
| 5 | Ash content | 13.42% | Max 3.2% |
| 6 | Protein content | 65.43% | Min 50% |

***Discussion***

Gelatine demand of the world continues to grow year by year. Gelatine is most widely used in many fields. The newest innovation of gelatine is the development of the edible film. This edible film can be used for packaging coating so that the product can be immediately eaten. In the functional food field, the gelatine was also developed to be peptide through the hydrolysis process. The peptide can become a scavenger agent (antioxidant) and reduce high blood pressure (antihypertensive). Gelatine peptide can be consumed safely without any side effects. So, it can become an alternative treatment for degenerative disease.

National gelatine demand is still dependent on imports from China, Brazil, and Australia. During the past ten years, many emerging issues of halal and animal diseases happened in the Asian countries. Islam teaches Muslims to be careful in choosing food. Islam recommends consuming food, which is lawful and good for health. It is stated in QS. Al-Baqarah 168

and 173. It is also re-emphasized in QS. An-Nahl 115. The exploration of gelatine sources except cows and pigs is still developed during a view decade. One of the resources is poultry.

Poultry is an animal that is breed by the majority of people in Indonesia. Poultry produced waste, one of them was bone. Bone waste was only processed to become powder for animal feed. The extraction of poultry bone, such as duck bone to produce gelatine, was one of the best ways to enhance its added value. Preliminary studies of the gelatin potential of these duck bones illustrate that gelatin can be extracted not only from cattle and pigs. The weakness of the research results is the yields are still low. The optimization of the extraction method needs to be conducted to produce better physicochemical characteristics. So, it is expected to be mass-produced. Collaboration from various disciplines is also needed to produce high-quality gelatine products. If all of this can be achieved, then halal gelatine production from local sources can compete with imported gelatin.

## CONCLUSION

Gelatine extraction was divided into two steps. They were pretreatment and extraction. Gelatine, which was extracted from duck bone, had these several characteristics: yield of 6.24%, pH 4.0, the water content of 13.43%, the ash content of 13.42%, the protein content of 65.43%, and color degree of 30.35%. Generally, gelatine, which was extracted from duck bone, had similar characteristics with commercial gelatine and SNI standard. The disadvantage of gelatine from duck bone was the yield still lower compared to gelatine from cow skin. Re-optimization of extraction methods needs to be done so that gelatin has betteryield and physicochemical characteristics.

## ACKNOWLEDGMENT

The author would like to thank the Directorate of Research and Community Service Ministry of Research Technology and Higher Education for providing research funding within the framework of the beginner lecturer research program in 2019.

## REFERENCES

Badan Pusat Statitstik. (2010). *Citizen Based on The District and Religion*. [Online]. Obtained from Http://www.sp2010.bps.go.id/index. php /site/tabel?tid=321.

Buckle, K.A., Edward R.A., Fleet G.H., &Wotton, M. (1987). *Food Science*. Jakarta: UI-Press.

Gelatin Manufacturer Association of Asia Pacific. (2007). *GelatinFood Science*.[Online]. Obtained from Http:// www.gelatin.co.za/gltn1.

Gelatin Manufacturer Institute of America. (2012). *Gelatin Handbook*.[Online]. Obtained from http://www.gelatin-gmia. Com/gelatinhandbook.

Gelatin Manufacturer of Europe. (2000). *Monograph. Standard Method for The Testing of Edible gelatin. Version I.* [Online]. Obtained from http://www.gelatin.org/ gme.html.

Huda, N., Seow, E.K., Normawati, M.N., & Aisyah, N.M. (2013). Preliminary study on physicochemical properties of duck feet collagen. *International Journal of Poultry Science*, 12(10), 615-621.

Huda, W.H., Atmaka,W., &Nurhartadi, E. (2013). The study of gelatin physicochemical properties from chicken feet with different acid concentrations and incubation time. *Journal of Food Technoscience*, 2(3), 70-75.

Jannah, A., Maunatin, A., Windayanti, A., Findianti, Y., & Mufidah, Z. (2013). Isolation and characterization of gelatin from the chicken bone with

acid extraction method. *Journal of Alchemy*, 2(3), 184-189.

Mariod, A.A. (2013). Insect oil protein: Biochemistry, food, and other uses: Review. *Journal Agriculture Sciences,* 14(9B), 78-80.

Minah, F.N., Siga, M.D.W., & Catur, P.S. (2016). Gelatin extraction from tuna bone collagen hydrolysis with different acid concentration and extraction time. National Conference on Innovation and Technology Application. Industrial Engineering Faculty. ITN Malang.

Miskah, S., Ramadianti, I.M., & Hanif, A.F. (2010). The effect of different acetic acid concentrations, HCl solution, and soaking time on chicken feet and bone gelatin. *Journal of Chemistry engineering*, 17(1), 1-6.

Rapika., Zulfikar, & Zumarni. (2016). Gelatin physics quality from cow skin extraction with different hydrochloric acid concentration and incubation time. *Journal of Animal Science,* 13(1), 26-32.

Sari, D.K. (2017). *Halal gelatin production from chicken feet skin with different defatting method and its application on ice cream*. (Thesis). Bogor Agricultural University. Bogor.

Sasmitaloka, K.S., Miskiya, & Juniawati. (2017). Potential of dry cow skin as a basic material for halal gelatin production. *Bulletin of animal science,* 41(3), 328-337.

Sirikhwantinrat, M., & Sila-asna. (2017). Optimization of gelatin extraction and physic-chemical properties of fish skin and bone gelatin: Its application to panna cotta formulas. *Current Research in Nutrition and Food Science,* 5(3), 263-273.

Ulfa, M., Trisunaryanti, W., Falah, I.I.., & Kartini, I. (2015). Characterization of gelatin extracted from cow bone for carbon synthesis. *IOSR Journal of Applied Chemistry*, 8(8), 57-63.