Indonesian Journal of Chemical Science and Technology (IJCST)

State University of Medan, https://jurnal.unimed.ac.id/2012/index.php/aromatika

IJCST-UNIMED 2026, Vol. 09, No. 2, Page; 275 – 281

Received : Nov 6th, 2025 Accepted : Jul 14th, 2026 Web Published : Jul 31st, 2026

Utilization Of Gelatin From Catfish (*Clarias Gariepinus*) Bones Using Acid Method As A Syrup Thickener

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ABSTRACT

This study aims to utilize catfish (Clarias gariepinus) bone waste as a source of gelatin extracted using the acid method and to examine its application as a thickening agent in syrup production. Gelatin is a protein-based hydrocolloid capable of forming gels, stabilizing emulsions, and increasing viscosity, making it widely used in the food industry. Commercial gelatin is generally derived from cattle or pigs, which raises issues regarding health, halal status, and limited raw material availability. Catfish bones are a potential waste source since they contain collagen that can be hydrolyzed into gelatin. The research process involved bone demineralization, acid treatment to break collagen bonds, and extraction under controlled temperature. The resulting gelatin was then applied in syrup formulation with varying concentrations and evaluated for its viscosity, clarity, stability, and organoleptic properties. The results showed that gelatin from catfish bones effectively functions as a natural thickener, with an optimal concentration producing syrup with stable viscosity, good clarity, and acceptable organoleptic characteristics. This study demonstrates that catfish bone waste has the potential to serve as an alternative halal, environmentally friendly, and economically valuable source of gelatin for food industry applications.

Keywords: gelatin, catfish bones, acid method, thickener, syrup

1. INTRODUCTION

Global gelatin production reaches approximately 326,000 tons per year, with most of it derived from bovine and porcine skin and bones. In Indonesia, the demand for gelatin continues to increase; however, reliance on imported gelatin from animal sources such as cattle bones and pig skin raises concerns among consumers who prioritize halal aspects[1]. Therefore, the utilization of alternative raw materials such as catfish (Clarias gariepinus) bones needs to be developed to produce gelatin that is halal and safe for consumption[2].

Gelatin is a protein obtained through the hydrolysis of collagen, which is found in the skin and bones of animals[3]. This process can be carried out using either acid or alkaline solutions, with acid treatment being more effective in hydrolyzing collagen. The resulting gelatin can be categorized into type A and type B based on the processing method; type A is produced through acid treatment and is generally used in food applications. Gelatin has a wide range of applications, particularly in the food industry as a thickener, gelling agent, and stabilizer[4].

In the food industry context, gelatin can be used as a thickener for syrup. It has the ability to bind water up to ten times its weight, thereby increasing the viscosity of the product and improving particle stability in syrup[5]. Catfish bones, as a by-product of the fisheries industry, contain a high amount of collagen that can be utilized to produce high-quality gelatin. Moreover, using gelatin derived from catfish provides an environmentally friendly alternative and helps reduce fishery waste[6].

Another advantage of using gelatin from catfish is its halal nature and safety for consumption by Muslim communities. This makes catfish-based gelatin an attractive alternative compared to mammalian-derived gelatin. With growing awareness of the importance of halal food products, the utilization of gelatin from fish sources can meet the increasing market demand[7].

Based on this background, this study aims to explore the utilization of gelatin from catfish bones using the acid method as a syrup thickener. The results of this research are expected not only to provide an alternative source of halal and high-quality gelatin but also to contribute to reducing fishery waste and increasing the economic value of fishery by-products.

2. EXPERIMENTAL

2.1. Chemicals and Equipment

The equipment used in this research includes a glass funnel, porcelain dish, Erlenmeyer flask, beaker glass, measuring cylinder, hot plate, watch glass, stirring rod, rubber suction bulb, filter paper, baking tray, volumetric flask, magnetic stirrer, oven, pH meter, volumetric pipette, pycnometer, spoon, spatula, analytical balance, and Ostwald viscometer.

The materials used in this study consist of catfish (Clarias gariepinus) bones, glacial acetic acid, distilled water (aquadest), pure syrup formula, and granulated sugar.

2.2. Research Procedure

2.2.1 Degreasing Stage

The degreasing stage functions to remove fat and any remaining flesh attached to the bones. After the catfish bones are cleaned with fresh water, the degreasing process is carried out by soaking them in boiling water for 30 minutes while stirring continuously. The ratio of bones to water is 1:1.5. Afterward, the catfish bones are drained and dried under the sun.

2.2.2 Demineralization Stage

The demineralization stage aims to remove mineral salts and calcium from the catfish bones. The bones are cut into small pieces measuring about 1–3 cm to increase the surface area. A total of 20 grams of raw material is soaked in sulfuric acid solutions of 2%, 4%, and 6% concentrations for 10, 20, and 30 hours until soft bones (ossein) are formed. The ossein is then rinsed with distilled water (aquadest) until a neutral pH is achieved.

2.2.3 Ossein Extraction Process

e-ISSN : 2622-4968, p-ISSN : 2622-1349

In the ossein extraction process, the neutral pH ossein is placed into an Erlenmeyer flask and mixed with distilled water (aquadest) at a stirring speed of 520 rpm with a ratio of 1:2. The extraction is then carried out on a hot plate at a temperature of 60°C for 4 hours. After extraction, the ossein is filtered using filter paper. The resulting gelatin extract, which is a thick liquid, is then dried in an oven using a baking tray at 60°C for 12 hours. The dried gelatin obtained is then ground to produce gelatin powder.

2.2.4 Application Stage

The application stage in syrup production aims to determine the effect of gelatin addition on the pH and viscosity of each variation. Gelatin powder (0.4 grams) is added to 5 mL of syrup with different concentrations of gelatin variations. A total of 10 samples are prepared, with nine samples containing added gelatin and one sample serving as a control without gelatin addition.

2.2.5 Analysis Stage

The analysis stage consists of the following steps:

1. Yield

The following formula is used to determine the yield:

$$\% = \frac{Dry\ gelatin\ weight}{Shin\ bone\ weight}\ x\ 100\%$$

2. pH

The **pH meter** is used to measure the pH value. The purpose of the pH analysis is to determine the acidity level of the gelatin mixed into the passion fruit syrup.

3. Viscosity

Viscosity analysis is conducted by determining the flow time of distilled water using an Ostwald viscometer. The analysis is performed by measuring the time required for the gelatin solution to flow through the capillary tube from the upper to the lower mark. The formula used to calculate viscosity is as follows:

$$P_x = \frac{\Upsilon}{V}$$

Where ρx is the density of the gelatin, **y** is the weight of the gelatin in grams, and **v** is the volume of the gelatin in milliliters.

$$\mu = \mu_0 \frac{t.\rho}{t_0.\rho_0}$$

Where μ is the viscosity of the gelatin sample, μ_0 is the viscosity of the reference liquid, ρ is the density of the sample liquid, t is the flow time of the sample, ρ_0 is the density of the reference liquid, and t_0 is the flow time of the reference liquid.

3. RESULTS AND DISCUSSION

3.1. The Effect of Sulfuric Acid Concentration and Soaking Time on Catfish Bones

In the process of producing gelatin from catfish bones, the first parameter analyzed is the yield. The yield serves to determine the percentage of production results by comparing the amount of product obtained with the amount of raw material used. In this case, the gelatin yield is calculated based on the weight of

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gelatin obtained from catfish bones, with dried bones serving as the raw material. The yield results of gelatin extracted from catfish bones can be seen in Figure 4.1.

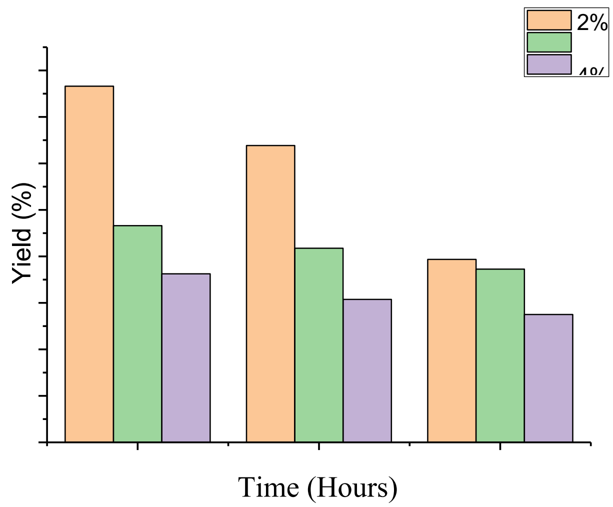

Figure 4.1 Gelatin Yield from Catfish Bones

Figure 4.2 shows that the yield of gelatin extracted from catfish bones (*Clarias gariepinus*) using the acid method is influenced by the concentration of acid and soaking time. The highest yield was obtained at a 2% acid concentration with a soaking time of 10 hours, reaching approximately 15%, while the lowest yield occurred at a 6% acid concentration and a soaking time of 30 hours, around 6%. In general, increasing the acid concentration and soaking time tends to decrease the yield, likely due to excessive degradation of collagen protein, which inhibits gelatin formation.

This indicates that the optimal condition for obtaining a high gelatin yield is at a lower acid concentration and shorter soaking time. Gelatin produced under these conditions has the potential to be used as a natural thickening agent in syrup products, as it provides good viscosity-forming ability and is environmentally friendly.

3.2 The Effect of Sulfuric Acid Concentration and Soaking Time on the pH of Pineapple Syrup Containing Gelatin

pH is one of the important parameters used to determine the acidity level of pineapple syrup mixed with gelatin derived from catfish bones. In this study, pH measurements were carried out using a pH meter. This parameter plays a crucial role because it can affect both the yield and the viscosity level of pineapple syrup containing gelatin. The pH values of gelatin obtained from catfish bones are shown in Figure 4.2.

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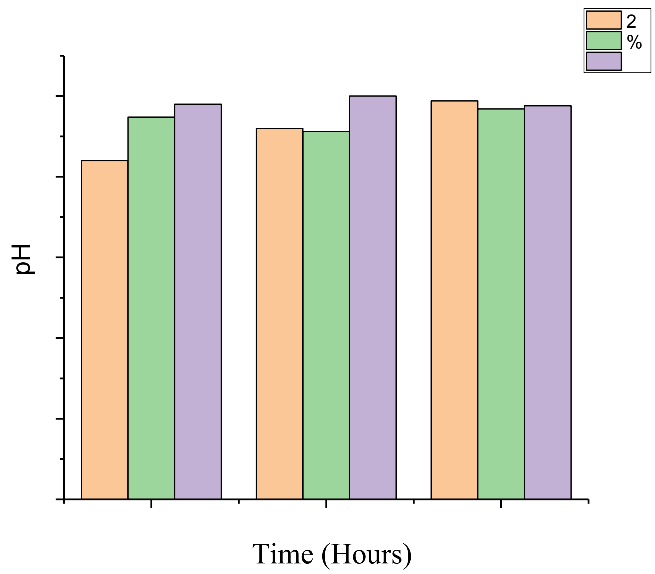

Figure 4.2 pH Results of Gelatin from Catfish Bones

Figure 4.2 shows the pH values of pineapple syrup mixed with gelatin derived from catfish bones at various acid solution concentrations (2%, 4%, and 6%) and soaking times (10, 20, and 30 hours). In general, the pH tends to increase with higher acid concentrations and longer soaking times. At a soaking time of 10 hours, the lowest pH was observed at a 2% acid concentration, while the highest pH was achieved at a 6% concentration. This phenomenon indicates that as the acid concentration and soaking time increase, the residual acid absorbed into the gelatin decreases due to the washing or neutralization process, resulting in a higher pH value.

This relative increase in pH stability plays an important role in determining the quality of the produced syrup, as pH affects the shelf life and texture of the final product. According to the Indonesian National Standard (SNI) 06-3735 (1995), the pH values obtained in this study already meet the quality standard, as the maximum standard pH is 6, while the highest pH of the catfish bone gelatin in this study reached 2.47.

3.3 The Effect of Sulfuric Acid Concentration and Soaking Time on the Viscosity of Pineapple Syrup Containing Gelatin

Viscosity is a parameter used to measure the thickness level of a liquid. In this study, the viscosity of pineapple syrup mixed with gelatin was tested using an Ostwald-type viscometer. According to Pertiwi (2018), the viscosity of a substance is influenced by its molecular weight. The molecular weight of gelatin is closely related to the length of its amino acid chains; the longer the amino acid chains, the higher the resulting viscosity value.

e-ISSN : 2622-4968, p-ISSN : 2622-1349

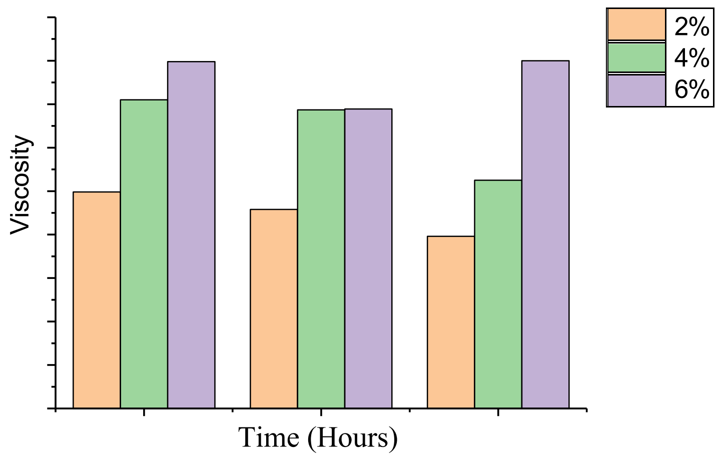

Figure 4.3 Viscosity Results of Gelatin from Catfish Bones

The graph above shows the relationship between soaking time (10, 20, and 30 hours) and acid solution concentration (2%, 4%, and 6%) on the viscosity (thickness) of pineapple syrup mixed with gelatin derived from catfish bones. It can be seen that, at each soaking time, viscosity tends to increase with higher acid concentrations, with the highest values consistently observed at 6%. The highest viscosity was achieved at a 6% acid concentration and soaking times of 10 and 30 hours, reaching approximately 8 cP.

This indicates that gelatin produced at higher acid concentrations possesses longer and more complex molecular structures, which provide a stronger thickening effect on the syrup. Conversely, at a 2% acid concentration, viscosity values were the lowest across all soaking times. This phenomenon aligns with the theory that viscosity is strongly influenced by the molecular weight of gelatin, which is related to the length of its amino acid chains. Therefore, acid concentration and soaking time are crucial factors in producing gelatin with optimal thickening properties for application in food products such as syrup.

According to the Indonesian National Standard (SNI 06-3735, 1995), the viscosity obtained in this study meets the required quality standards. This research is expected to be applicable in gelatin production to reduce fish bone waste and decrease the dependence on imported gelatin.

4. CONCLUSION

Based on the results of the study on the effect of sulfuric acid concentration and soaking time on the characteristics of gelatin derived from catfish bones, it can be concluded that both variables have a significant effect on the yield, pH, and viscosity of the resulting gelatin. The highest yield was obtained at a 2% acid concentration and a soaking time of 10 hours, with a value of approximately 15%, while increasing the acid concentration and soaking duration decreased the yield due to excessive collagen protein degradation.

For the pH parameter, the results showed that the higher the acid concentration and the longer the soaking time, the higher the pH value of the gelatin. This occurs because residual acid in the gelatin decreases after

e-ISSN : 2622-4968, p-ISSN : 2622-1349

the washing process. The highest pH value obtained was still within the standard range of SNI 06-3735-1995, which requires a pH below 6, indicating that the produced gelatin meets quality standards.

Meanwhile, the viscosity of pineapple syrup mixed with gelatin increased along with higher acid concentrations, with the highest value of around 8 cP observed at a 6% acid concentration and soaking times between 10 and 30 hours. This indicates that gelatin produced under higher acid concentrations has a greater molecular weight and longer amino acid chains, resulting in a stronger thickening effect. Overall, the optimum conditions for producing gelatin with high yield, stable pH, and viscosity within standard limits are at a low acid concentration (2%) and a soaking time of 10 hours.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to the Almighty God for His blessings and guidance throughout the completion of this research. Appreciation is extended to the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Medan, for providing the facilities and support necessary to conduct this study. Gratitude is also given to all lecturers, laboratory staff, and fellow students who offered assistance and cooperation during the experimental process, including the demineralization, extraction, and characterization of gelatin from catfish bones. Lastly, heartfelt thanks are extended to our families and friends for their continuous encouragement and support, which greatly contributed to the success of this research on utilizing *Clarias gariepinus* bone waste as an alternative halal gelatin source and its application as a natural thickener in syrup production.

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e-ISSN : 2622-4968, p-ISSN : 2622-1349