

## Preparation And Characterization Of Halal Gelatin From Broiler Chicken Feet Using Hydrolysis Method

Mufidah Nur Jannah<sup>1</sup>, Dessy Ratna Sari<sup>2\*</sup>, Pramita Yuli Pratiwi<sup>3</sup>

<sup>1,2,3</sup> Department of Pharmacy, Poltekkes Kemenkes Surakarta, Indonesia

| Article Info                                                                                                                                                                                                                                                                                                      | ABSTRACT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Article history:</b><br/>           Received Ags 22, 2025<br/>           Revised Okt 10, 2025<br/>           Accepted Okt 20, 2025</p> <p><b>Keywords:</b><br/>           Chicken feet;<br/>           Gallus domesticu);<br/>           Gelatin; Hydrolysis,<br/>           Physicochemical Properties</p> | <p>Chicken feet are an underutilized by product rich in collagen, making them a potential raw material for halal gelatin. This study explores the use of whole broiler chicken feet to improve efficiency in gelatin production. The effect of different soaking times (8, 10, and 12 days) in 5% citric acid and 0.2% NaOH on gelatin quality was evaluated. Results showed that soaking time significantly affected all measured parameters. The 8 day treatment produced gelatin with the most favorable properties: pH 4.73, moisture content 9.71%, ash content 2.15%, and positive protein test. Longer soaking for 12 days resulted in protein loss and lower quality. All gelatin samples appeared as fine yellowish powder with characteristic smell, complying with Indonesian quality standards. This study confirms that whole chicken feet are suitable for making halal gelatin, with 8 days being the ideal soaking duration to maintain good quality without excessive breakdown.</p> |

Corresponding Author:  
 dessy.rs97@gmail.com

### INTRODUCTION

The poultry processing industry generates large amounts of underutilized by-products, particularly chicken feet, which are often considered waste despite their nutritional value (Miskiyah, 2022). In 2023, chicken meat production reached 791,997,100 tons, resulting in approximately 1,319,995,166 chicken feet (Badan Pusat Statistik, 2023). Chicken feet consist of skin, bones, muscles, and collagen, and are rich in protein (19.8 g/100 g) with collagen content reaching 22.94% (Aulia, 2022). These properties make chicken feet a promising alternative raw material for gelatin production.

Gelatin is a heterogeneous mixture of polypeptides produced through the hydrolysis of collagen [4]. It has wide-ranging applications as a gelling agent, emulsifier, stabilizer, capsule material, and additive in cosmetics, pharmaceuticals,

and food products (Syahputra, et al., 2022). However, commercial gelatin is primarily derived from porcine skin (46%), bovine skin (29.4%), and bovine bones (23.1%) (Suwarjoyowirayatno, et al, 2019). For Muslim communities worldwide, including Indonesia, porcine derived gelatin is religiously prohibited (haram), creating a significant demand for certifiably halal alternatives. While bovine-derived gelatin is permissible (halal), its production remains costly and time-intensive due to complex processing requirements and concerns about cross-contamination. Therefore, developing alternative gelatin sources that are inherently halal, economically viable, and readily available represents a critical need for the global halal industry (Miskiyah, 2022).

Previous studies on chicken feet gelatin have primarily concentrated on isolated components, such as separate extraction from either skin or bones (Niu, Xiong & Zhao, 2013). The current study addresses this research gap by employing whole broiler chicken feet in their complete form, presenting a more efficient and commercially viable approach that reduces pre-processing waste. This investigation systematically examines how hydrolysis duration critically affects the physicochemical properties of the resulting gelatin, with particular attention to the balance between extraction efficiency and collagen degradation. The study aims to produce gelatin from whole broiler chicken feet through hydrolysis at varying soaking durations and to assess its organoleptic and physicochemical characteristics.

## METHODS

This study employed an experimental design involving three variations of gelatin production with different soaking durations. A Completely Randomized Design (CRD) was applied with three treatments, namely F1 (8 days), F2 (10 days), and F3 (12 days). The primary data were obtained from laboratory experiments. Data were analyzed using bivariate analysis. The physical quality tests conducted included organoleptic evaluation, pH measurement, moisture content, ash content, and protein analysis (AOAC, 2016).

### Equipment and Materials

The equipment used in this study included aluminum foil, a 100-mesh sieve, small basins, glass rods, a blender, beaker glass (Pyrex), measuring cylinders (Pyrex), oven trays, a magnetic stirrer hotplate, a moisture analyzer, an oven, a pH meter, knives, cloth filters, cutting boards, crucible tongs, test tubes, a furnace, a digital scale, glass jars, and a water bath. The materials consisted of broiler chicken feet (*Gallus domesticus*), citric acid, NaOH, HNO<sub>3</sub>, and distilled water (Kurniawan, Sari & Fitriani, 2019).

### Sample Collection

Samples of broiler chicken feet (*Gallus domesticus*) were obtained from Sayyidul Ayam in Tegalsari Village, Delanggu District, Klaten Regency, Central Java, Indonesia.

## Preparation of Gelatin from Broiler Chicken Feet

A total of 500 g of chicken feet were cleaned, washed, and soaked in warm water for 30 minutes, then drained. The samples were subsequently immersed in 0.2% NaOH solution and 5% citric acid solution according to the treatment groups (8, 10, and 12 days) at room temperature (28–30°C). The chicken feet were soaked in 1.5 L of 0.2% NaOH solution and rinsed with distilled water until reaching a neutral pH (6.0–7.0). The neutralized samples were then soaked in 1.5 L of 5% citric acid solution, followed by another neutralization step. The extraction process was carried out using a magnetic stirrer hotplate for 1 hour. The extract was filtered using a cloth filter, and the filtrate was collected. The lipid-free extract was concentrated at 70°C using a water bath, then dried in an oven at 90°C. The dried gelatin sheets were ground into powder using a blender before further testing (Niu, Xiong & Zhao, 2013; Mariod & Fadul, 2013).

## Organoleptic Test

Organoleptic evaluation was conducted using sensory analysis to assess the physical characteristics of the gelatin, including appearance, color, aroma, taste, and texture (Setiani, Pramono & Amalia, 2020).

## pH Test

The pH value was measured using a pH meter. The electrode was standardized with buffer solution, rinsed with distilled water, and dried. A total of 0.2 g of gelatin was dissolved in 20 mL of distilled water, and the electrode was immersed in the solution until the reading stabilized (AOAC, 2016).

## Moisture Content Test

Moisture content was determined using a moisture analyzer. Approximately 2 g of gelatin was placed in the instrument at an initial temperature of 105°C and heated until a constant weight was achieved. The result was expressed as a percentage (AOAC, 2016).

## Ash Content Test

Ash content was determined using a muffle furnace. About 2 g of gelatin was placed in a porcelain crucible and incinerated at 600°C for 1 hour. After the indicator light signaled completion, the furnace was gradually cooled to 25–30°C. The sample was then placed in a desiccator for 10 minutes before weighing. The ash content was calculated using the following formula (AOAC, 2016):

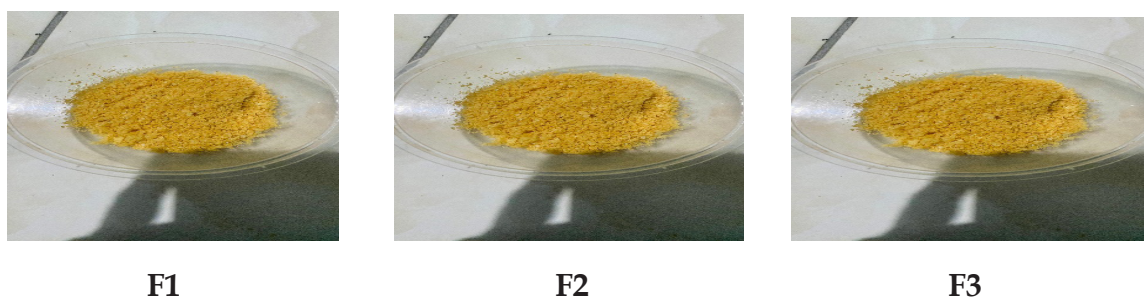
$$\% \text{ Ash content} = \frac{(\text{Weight of sample + crucible after ashing} - \text{Weight of empty crucible})}{\text{Weight of sample before ashing}} \times 100\%$$

## Protein Test

Protein analysis was conducted using the ninhydrin method. Two milliliters of gelatin solution were mixed with 10 drops of 0.1% ninhydrin solution and heated until boiling. A positive reaction was indicated by the appearance of a blue or purple color (Sutopo, Rahayu & Widyastuti, 2018).

## RESULT AND DISCUSSION

Gelatin extracted from whole broiler chicken feet (*Gallus domesticus*) was prepared with three soaking durations: F1 (8 days), F2 (10 days), and F3 (12 days) as shown in Figure 1. The physical quality of the gelatin was evaluated through organoleptic testing, pH measurement, moisture content, ash content, and protein analysis. Organoleptic testing was performed using sensory assessment of color, odor, taste, and texture across the three formulations.



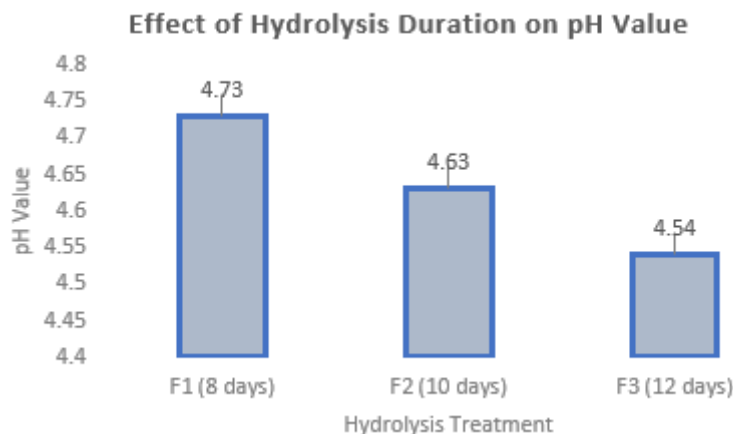
**Figure 1.** Gelatin from whole broiler chicken feet (*Gallus domesticus*)

Organoleptic testing was performed using sensory assessment of color, odor, taste, and texture across the three formulations in Table 1.

**Tabel 1.** Gelatin from whole broiler chicken feet (*Gallus domesticus*)

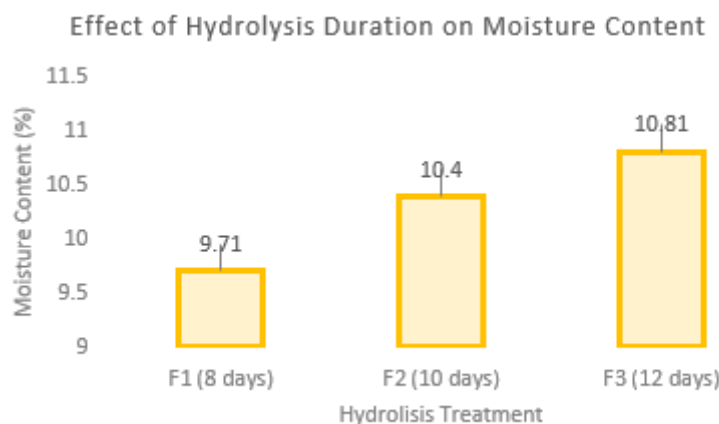
| Formula | Color     | Odor                   | Taste           | Texture     |
|---------|-----------|------------------------|-----------------|-------------|
| F1      | Yellowish | Characteristic gelatin | Slightly acidic | Fine powder |
| F2      | Yellowish | Characteristic gelatin | Slightly acidic | Fine powder |
| F3      | Yellowish | Characteristic gelatin | Slightly acidic | Fine powder |

Organoleptic analysis determines whether the gelatin meets the required quality standards in terms of color, odor, taste, and texture. According to SNI 01-3735-1995, gelatin should appear as sheets or powder with pale yellow, yellowish, or transparent color, have a characteristic or odorless smell, and be tasteless. The results showed that all samples fulfilled the standards for color, odor, and texture, although a slightly acidic taste was observed, likely due to the citric acid soaking treatment.



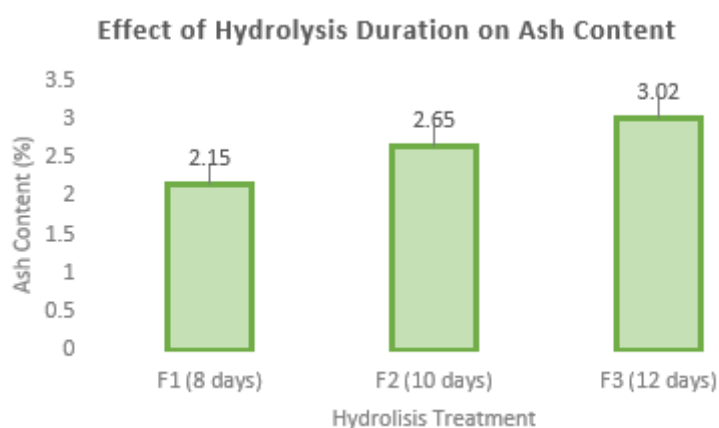
**Figure 1.** Effect of Hydrolysis Duration on pH Value

The pH test aims to determine the acidity level of gelatin when consumed or formulated into preparations. The acidity of gelatin is influenced by the rinsing process of broiler chicken feet or depends on the solvent used during the soaking process (Suryati, et al, 2017). The observed decrease in pH with increasing hydrolysis duration (F1: 4.73, F2: 4.63, F3: 4.54) can be attributed to the progressive incorporation of citric acid into the collagen matrix. During extended hydrolysis, citric acid molecules penetrate the collagen fibrils, facilitating the breakdown of cross-links. Even after neutralization, residual carboxyl groups from citric acid remain bound to the gelatin polypeptides, releasing hydrogen ions into solution and thus lowering the pH (Mariod & Fadul, 2013). This inverse relationship between hydrolysis duration and pH demonstrates the critical role of acid concentration and exposure time in determining the final acidity of gelatin. The soaking duration affects the pH of the resulting gelatin, as the longer the chicken feet are soaked, the more acid becomes trapped within the feet, thereby lowering the gelatin's pH (Arifin, 2020). According to SNI 01-3735-1995, the acceptable pH standard for gelatin ranges between 4.5 and 6.5. As shown at Figure 1 the pH values of the gelatin samples fall within the range specified by the Indonesian National Standard.



**Figure 2.** Effect of Hydrolysis Duration on Moisture Content

Moisture content testing was carried out using a moisture analyzer. The moisture analyzer heats the sample until the water content evaporates to determine its moisture level. Moisture content testing is an important parameter in food products, as the water content also determines the shelf life of the material (Fransiskha, et al, 2020). Based on Figure 2, the results show that with longer soaking durations, the moisture content of gelatin also increased. The positive correlation between hydrolysis duration and moisture content (F1: 9.71%, F2: 10.40%, F3: 10.81%) suggests structural modifications in the gelatin matrix. Prolonged acid exposure leads to more extensive cleavage of collagen triple helices into random coils, increasing the number of hydrophilic groups (-OH, -COOH, -NH $\square$ ) available for water binding through hydrogen bonding. Consequently, gelatin from longer hydrolysis treatments retains more water despite the drying process, potentially affecting its shelf life and functional properties. This is because more water is bound within the gelatin compounds, making it more difficult to evaporate (Fernianti, et al, 2020). According to the requirements of SNI 01-3735-1995, the acceptable moisture content of gelatin is <16%, and the results indicate that the moisture content of the gelatin samples falls within the range specified by the Indonesian National Standard.



**Figure 3.** Effect of Hydrolysis Duration on Ash Content

Ash content testing was carried out using a furnace, as it provides controlled and uniform heat to incinerate the sample. The determination of ash content is a method used to assess the purity of a material. The high or low ash content of a substance is influenced by the mineral content of the raw material. Ash content is one of the parameters that determine the quality and the success rate of the gelatin extraction process (Pertiwi, et al, 2018). Figure 3 shows that the soaking duration affects the ash content of gelatin. The increasing ash content with extended hydrolysis (F1: 2.15%, F2: 2.65%, F3: 3.02%) indicates mineral concentration in the final product. As acid hydrolysis progresses, organic matter solubilizes and is removed during processing, while inorganic minerals become relatively more concentrated. Additionally, prolonged exposure to acid may facilitate the release of bound minerals (particularly calcium phosphates from bone components) from the collagen-hydroxyapatite complex in the whole chicken feet, which are then retained in the final gelatin product (Pertiwi, et al, 2018). This is due to the dissolution of

minerals in the food material, leaving residues that do not combust and form ash (Miskiyah, 2022). According to the requirements of SNI 01-3735-1995, the acceptable ash content of gelatin is <3.2%, and the results indicate that the gelatin samples fall within the range specified by the Indonesian National Standard.

Protein testing was carried out by adding 10 drops of ninhydrin solution to the gelatin sample, followed by heating until a color change was observed. The protein test results are presented in Table 2

**Table 2.** Ash content of gelatin from whole broiler chicken feet

| Formula | Rep. 1           | Rep. 2           | Rep. 3           | Result   |
|---------|------------------|------------------|------------------|----------|
| F1      | Bluish purple    | Bluish purple    | Bluish purple    | Positive |
| F2      | Purple-yellowish | Purple-yellowish | Purple-yellowish | Positive |
| F3      | Pale yellow      | Pale yellow      | Pale yellow      | Negative |

The qualitative protein test aims to determine whether the sample contains protein. The principle of the ninhydrin test begins with the hydrolysis of protein into amino acids. If the gelatin sample contains protein, hydrolysis produces amino acids that subsequently react with ninhydrin to form a blue-purple or bluish complex compound. Table 5 shows that F1 (8 days) and F2 (10 days) met the established standard, indicated by a blue-purple color, which confirms the presence of protein. In contrast, F3 (12 days) exhibited a pale yellow color, indicating the absence of protein. The qualitative ninhydrin test results reveal a crucial aspect of collagen degradation kinetics. The bluish-purple color in F1 and F2 indicates the presence of free amino acids and short peptides, which are primary amines that react with ninhydrin. However, the pale yellow color in F3 suggests the absence of detectable primary amines. This phenomenon can be explained by the Maillard reaction and strecker degradation during prolonged acid hydrolysis and subsequent thermal processing (drying at 90°C). These reactions between amino groups from hydrolyzed collagen and carbonyl compounds can form brown pigments and nitrogen-containing heterocycles that no longer react with ninhydrin (Sutopo, Rahayu & Widyastuti, 2018). This result is attributed to the longer soaking duration, which causes most collagen to hydrolyze into gelatin, thereby reducing the detectable protein content in the ninhydrin test (Dwi, et al, 2022).

## CONCLUSION

This study demonstrates that soaking duration influences the physical quality of gelatin derived from whole broiler chicken feet, as reflected in variations in pH, moisture, ash, and protein content. Gelatin from 8 and 10 days of soaking (F1 and F2) met quality standards and contained protein, while 12 days of soaking (F3) resulted in higher moisture and ash contents, lower pH, and loss of detectable protein.

## REFERENCES

- AOAC. (2016). *Official Methods of Analysis of AOAC International*. 20th ed. AOAC International, Gaithersburg, MD, USA.
- Arifin, M. (2020). *Sifat-sifat gelatin kulit ceker ayam yang dihidrolisis menggunakan beberapa metode* (pp. 1–23)
- Arziyah, R., Yusmita, D., & Wijayanti, L. (2022). Analisis mutu organoleptik sirup kayu manis dengan modifikasi perbandingan konsentrasi gula aren dan gula pasir. *Jurnal Penelitian dan Pengkajian Ilmiah Eksakta*, 1(2), 105–109.
- Aulia, M. P. (2022). *Optimasi produksi gelatin halal ceker ayam dengan hidrolisis enzim papain pada konsentrasi berbeda terhadap karakteristik fisik dan kimia* [Unpublished undergraduate thesis, Universitas belum disebutkan].
- Badan Pusat Statistik. (2023). *Produksi daging ayam ras pedaging menurut provinsi – Tabel Statistik – Badan Pusat Statistik Indonesia*. <https://www.bps.go.id>
- Badan Standardisasi Nasional. (1995). *SNI 3735:1995 – Uji mutu dan cara uji gelatin* [National Standard]. Jakarta: BSN.
- Dwi, H., Nuralang, Fitri, A., & Dyah, R. (2022). *Bundelan praktikum makromolekul*. In *Kimia: Sains dan Teknologi*, 36.
- Fernianti, D., Juniar, H., & Adinda, N. D. (2020). Pengaruh massa ossein dan waktu ekstraksi gelatin dari tulang ikan tenggiri dengan perendaman asam sitrat belimbing wuluh, *JUMPJurnal Trunojoyo*, 5(2), 1–9. <https://doi.org/10.32502/jd.v5i2.3027>
- Fransiskha, T. (2016). Optimasi ekstraksi gelatin dari tulang ikan tuna (*Thunnus albacares*). *Jurnal Wiyata*, 3(1), 11–16.
- Kurniawan, D., Sari, N., & Fitriani, T. (2019). Extraction and characterization of gelatin from chicken feet. *Indonesian Journal of Food Science and Technology*, 2(1), 15–22.
- Mariod, A. A., & Fadul, H. (2013). Gelatin, source, extraction and industrial applications. *Acta Scientiarum Polonorum Technologia Alimentaria*, 12(2), 135–147.
- Miskiyah, D. (2022). Pengaruh lama waktu perendaman terhadap karakteristik gelatin ceker ayam. *Agrointek: Jurnal Teknologi Industri Pertanian*, 16(2), 186–192.
- Niu, L., Xiong, Y. L., & Zhao, S. (2013). Gelatin extracted from chicken byproducts as a potential source for food applications. *Food Hydrocolloids*, 33(2), 300–308.
- Pertiwi, M., Atma, Y., Mustopa, A., & Maisarah, R. (2018). Karakteristik fisik dan kimia gelatin dari tulang ikan patin dengan pre-treatment asam sitrat. *Jurnal Aplikasi Teknologi Pangan*, 7(2), 83–91. <https://doi.org/10.17728/jatp.2470>.
- Priatni, H., Kurniasari, N., & Wiryani, A. (2020). Identifikasi asam amino dan protein pada bahan makanan dengan menggunakan uji ninhidrin dan uji biuret. *Sains Indonesia: Jurnal Ilmiah Nusantara*, 1(5), 20–23.
- Santosa, H., Abyor, N., Guyana, N., & Handono, D. (2018). Hidrolisa kolagen dalam ceker ayam hasil perendaman dengan asam asetat pada proses pembuatan

- gelatin. *Gema Teknologi*, 20(1), 32–38.
- Setiani, B. E., Pramono, Y. B., & Amalia, R. (2020). Organoleptic and physicochemical quality of gelatin from chicken feet. *Jurnal Teknologi dan Industri Pangan*, 31(1), 27–35.
- Suryati, S., Meriatna, M., & Suryani, S. (2017). Pembuatan dan karakterisasi gelatin dari ceker ayam dengan proses hidrolisis. *Jurnal Teknologi Kimia Unimal*, 4(2), 66–72.
- Sutopo, B., Rahayu, W., & Widyastuti, E. (2018). Protein determination using the ninhydrin method: Application for food analysis. *International Food Research Journal*, 25(3), 1123–1130.
- Suwarjoyowirayatno, S., Sakir, S., Inthe, M. G., Rhenislawaty, R., & Fatimah, S. (2019). Karakteristik fisika-kimia gelatin dari sipou (*Siphonosoma australe-australe*) asal Sulawesi Tenggara. *Journal Fish Protech*, 2(2), 280–287.
- Syahputra, D., Muarif, A., Suryati, Azhari, & Mulyawan, R. (2022). Pembuatan gelatin dari tulang ikan bandeng dengan metode ekstraksi dan variasi konsentrasi asam sitrat. *Chemical Engineering Journal Storage*, 2(4), 91–98.