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# Chemical Quality of Chicken Sausage with The Addition of Bovine Bone Gelatin As a Binding Agent

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**Abstract:** Sausage is a form of processed meat with the addition of seasonings, binders and other ingredients that are inserted into the sleeve. One of the binders that can be used in making sausages is gelatin, because it has high nutrition, gelling and stabilising emulsions. The purpose of this study was to determine the chemical quality of chicken sausages made with the addition of gelatin from beef bones. In addition, it can be information for the meat processing industry as a chelifier for processed meat. This research method used thigh bone (os femuris) for gelatin production. The experimental design used was a completely randomised design with a unidirectional pattern consisting of 5 treatments without the addition of 0% gelatine, 3% gelatine, 6% gelatine, 9% gelatine and 12% gelatine and 4 replicates with a total of 20 samples. The variables observed were chemical quality such as protein content, carbohydrate content, moisture content, ash content and fat content. The results showed that the protein content of sausages ranged from 14.13%-20.75%; carbohydrate content of sausages ranged from 4.75%-9.07%, fat content ranged from 0.50%-1.10%. Ash content ranged from 1.33% - 1.72%. And moisture content ranged from 68.23% - 76.02%. The best results were found in treatment P4 (12% cow bone gelatin). The use of gelatin up to 12% can be used as a binder in making chicken sausage.

**Keywords:** Beef bone gelatin; Chemical quality; Chicken sausage.

## Introduction

Chicken sausage is one of the most popular processed meat products among the public. This product is not only favored for its delicious taste, but also for its ease of serving and variety of uses in various dishes. However, the quality of chicken sausage is often affected by the composition of raw materials and processing techniques used (Rumansi et al., 2021). Therefore, research on improving the quality of chicken sausage through the addition of certain ingredients is very important to do.

One of the ingredients that can be used to improve the quality of sausages is gelatin. Gelatin, which is obtained from collagen, has good binding properties and can improve the texture and tenderness of processed meat products. The addition of beef bone gelatin in making chicken sausage is expected to have a positive effect on the physicochemical and organoleptic quality of the sausage. Gelatin not only functions as a binder, but can also increase protein content and provide higher nutritional value to the final product (Sompie, et al 2022).

The chemical quality of chicken sausage can be measured through several parameters, such as pH, moisture content, protein content, and fat content. These parameters are very important to determine the freshness and shelf life of the product. Previous studies have shown that the addition of gelatin can affect the moisture content and pH, which in turn can affect the

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stability and quality of the sausage (Mukhlisah et al., 2023). Therefore, it is important to explore the right proportion between chicken meat and beef bone gelatin to achieve optimal sausage quality.

In the context of the food industry, improving the quality of processed meat products such as chicken sausages is essential to compete in the market. With increasing consumer awareness of health and food quality, manufacturers are required to produce products that are not only tasty but also nutritious (Anggraeni et al., 2022.). Therefore, this study aimed to evaluate the chemical quality of chicken sausage with the addition of beef bone gelatin as a binder, as well as its impact on the organoleptic characteristics of the sausage.

This study is expected to contribute to the development of high-quality chicken sausage products, as well as provide new insights into the use of gelatin as an additive in the meat processing industry. The results of this study are expected to be a reference for sausage producers in improving the quality of their products and meeting the increasing needs of consumers.

## Method

*Experimental Design*

The experimental design used was a completely randomised complete block design (CRD) with a unidirectional pattern consisting of 5 treatments and 4 replications with a total of 16 treatment units. The treatments are as follows:
P0 : 0% beef bone gelatin (control), P1: 3% Cow Bone Gelatin, P2: 6% beef bone gelatin, P3: 9% beef bone gelatin, P4: 12% beef bone gelatin.

*Research Procedure*

This research consists of two stages. The first stage was the characterisation of beef bone gelatin using the acid method and the second stage was the application of beef bone gelatin in chicken sausage products.

*Preparation of Bovine Bone Gelatin (Rauf et al.,2020.)*

In the first stage, bovine bone gelatine is made by extracting collagen from the bone using a *waterbath* at 55°C until it becomes a dry gelatine sheet. This process starts with cleaning the bones from fat and meat debris, washing them, and then cutting them into small sizes of about 1 x 1 cm. After weighing, the bones were soaked in a 15% HCl solution for 3 days with periodic stirring. After soaking, the bones were washed under running water to pH In the first stage, bovine bone gelatine was prepared by extracting collagen from the bones using a *waterbath* at 55°C until it became dry gelatine sheets. This process starts with cleaning the bones from fat and meat debris, washing them, and then cutting them into small sizes of about 1 x 1 cm. After weighing, the bones were soaked in a 15% HCl solution for 3 days with periodic stirring. After soaking, the bones were washed under running water until the pH of the wash water reached about 6. Extraction was carried out at 60°C for 3 hours, then the extraction results were filtered using a sieve and filter paper. The resulting gelatine solution was poured into a 30.5 x 30.5 cm container, then dried in an oven at 60°C. Before drying, the solution was concentrated at 60°C for 5 hours and cooled in a refrigerator at 5-10°C for 30 minutes. After that, the solution was dried in an oven at 60°C until completely dry. The resulting gelatine sheets were then pulverised using a blender and packed in vacuum plastic containers.

*Sausage making(Mukhlisah et al., 2024)*

Chicken meat that has been cut into small pieces and cleaned from connective tissue is then finely ground using a grinder/food processor. The composition of the ingredients for making sausage dough followed Table 1, where the main ingredients such as meat, seasonings, ice cubes, and treatments with varying concentrations were mixed according to the table. After that, the dough was ground for 1 minute, then cornflour and skimmed milk were added. The mixing and mashing process was done again for 1 minute. In the second smoothing stage, the dough was added with corn oil and smoothed again for 1 minute until evenly mixed, resulting in a smooth and consistent texture before being filled into the sausage casings.

**Tabel 1**. Chicken sausage formula with added bovine bone gelatin

| Variables | Chicken Sausage Formula with Beef Bone Gelatin Addition | | | | |
|---|---|---|---|---|---|
| | P0 | P1 | P2 | P3 | P4 |
| Chicken Meat (g) | 1000 | 1000 | 1000 | 1000 | 1000 |
| Tapioca (g) | 200 | 200 | 200 | 200 | 200 |
| Gelatin (g) | 0 | 30 | 60 | 90 | 120 |
| Garlic (g) | 30 | 30 | 30 | 30 | 30 |
| Red Onion (g) | 20 | 20 | 20 | 20 | 20 |
| Salt (g) | 40 | 40 | 40 | 40 | 40 |
| Skimmed Milk (g) | 200 | 200 | 200 | 200 | 200 |
| STTP (g) | 10 | 10 | 10 | 10 | 10 |
| Pepper (g) | 15 | 15 | 15 | 15 | 15 |
| Ice cubes (g) | 400 | 400 | 400 | 400 | 400 |
| Corn oil (ml) | 160 | 160 | 160 | 160 | 160 |

*Protein Content (AOAC 2005)*

The sample was weighed to 0.25 g and placed in a 100 mL Kjeldahl flask. To the sample was added 0.25 g of selenium and 3 mL of H2SO4, then decomposed for 1 hour until the solution was clear. After cooling, 50 mL of distilled water and 20 mL of NaOH 40% were added to the solution and distilled. The distillate was collected in an Erlenmeyer containing a mixture of 10 mL H3BO3 solution and two drops of Brom Cresol Green-Methyl

Red pink. When the distillate volume was 10 mL and the color was bluish, the distillation was stopped. The distillate was then titrated with 0.1 N HCl until it turned pink. The same treatment was applied to the blank. The protein content was calculated using the formula Protein content = 6.25 × % nitrogen, where the percentage of nitrogen can be calculated by Formula 1.

$$\text{Nitrogen (\%)} = \frac{(S-B)\times N\ HCL \times 14}{W \times 1000} \times 100\% \quad (1)$$

Description:
S : Sample titrant volume (mL)
W : Dry weight of sample (g)
B : Volume of blank titrant (mL)
N : Normality

*Water Content* (AOAC 2005)

Samples were weighed as much as 1 g in a porcelain cup. The samples were placed in an oven at 105 °C for 8 hours, then cooled in an applicator and weighed. Moisture content was calculated in formula 2.

$$\text{Water Content (\%)} = \frac{\text{initial weight} - \text{final weight}}{\text{initial weight}} \times 100\ \% \quad (2)$$

*Fat Content* (AOAC 2005)

The sample was weighed as much as 2 g and spread on a cotton pad with filter paper. The filter paper was rolled up to form a thimble and put into a soxhlet flask. The sample was extracted for six hours with 150 mL hexane solvent. The extracted fat was dried in a temperature oven 100 °C for one hour. Fat content was calculated using the Formula 3.

$$\text{Fat Content (\%)} = \frac{\text{extracted fat weight}}{\text{sample weight}} \times 100\% \quad (3)$$

*Ash Content* (AOAC 2005)

The sample is weighed as much as 1 g in a porcelain cup. The samples were burned or charred in a furnace at 600 °C for 2 hours or until they were smokeless. The samples were then weighed after being cooled in an applicator. Ash content is calculated in the Formula 4.

$$\text{Ash Content (\%)} = \frac{\text{ash weight}}{\text{sample weight}} \times 100\ \% \quad (4)$$

*Carbohydrate content (AOAC, 2005)*

Total *carbohydrate* content was determined by the *carbohydrate by difference* method, namely: 100% - (moisture + ash + protein + fat). *N free* protein content indicates the amount of digestible carbohydrate content of a food ingredient. Determined by 100% - (water content + ash + protein + fat + crude fiber).

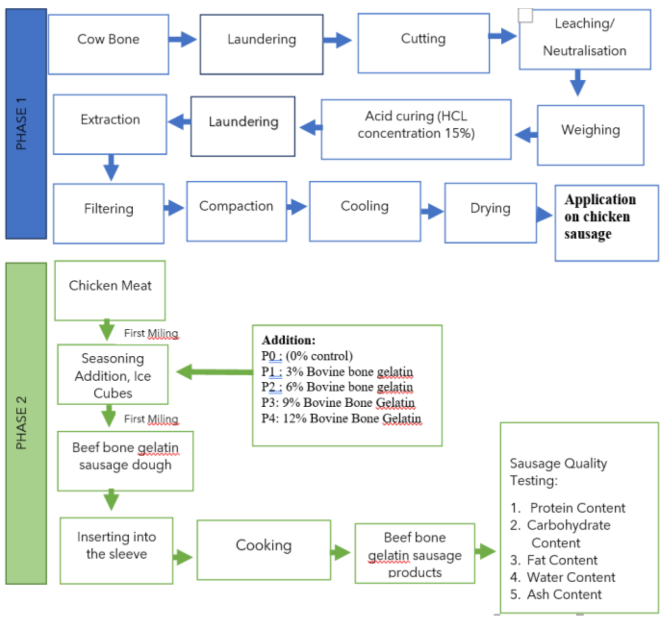


**Figure 1.** Research Flowchart

## Result and Discussion

**Table 2.** Mean Chemical Quality of chicken Sausage with Addition of bovine bone gelatine

| Chemical Quality | P0 | P1 | P2 | P3 | P4 |
|---|---|---|---|---|---|
| Protein | 14.13±0.40[a] | 16.48±1.24[b] | 17.89±0.71[c] | 19.07±0.28[d] | 20.75±0.17[e] |
| Carbohydrate | 7.54±0.43[a] | 5.79±1.13[b] | 7.99±0.57[a] | 4.72±0.27[c] | 9.07±0.94[d] |
| Fat | 0.61±0.20[a] | 1.05±0.43[b] | 0.50±0.34[a] | 1.10±0.08[b] | 0.63±0.09a |
| Ash | 1.71±0.20[a] | 1.72±0.07[a] | 1.72±0.18[a] | 1.65±0.15[a] | 1.33±0.14[b] |
| Water | 76.02±0.66[a] | 74.97±1.28[a] | 71.91±0.89[b] | 73.46±0.07[b] | 68.23±0.63[b] |

Noted: Primary data from the study (2024) Note: different superscripts on the line indicate significant differences (P<0.05). P0 = Control (0% gelatin). P1 = 3% bovine bone gelatin, P2 = 6% bovine bone gelatin, P3 = 9% bovine bone gelatin, P4 = 12% bovine bone gelatin.

*Protein*

The protein content of chicken sausage increased with the increase of beef bone gelatin flour. Based on Table 2, there was a significant effect (P<0.05) of using beef bone gelatin to significantly contribute to increasing the protein content of chicken sausage. In the treatment of 3% gelatin addition, the protein content was recorded at 16.48±1.24%. This showed an increase of up to 2.35% compared with no addition of beef bone gelatin. This is because beef bone gelatin is a protein obtained from collagen hydrolysis. The protein content of gelatin in cow bone ranges from 98-99% based on its dry weight (Sugita et al., 2021).

The value of protein content in all treatments in this study has met the standard quality requirements for sausage protein content, which is at least 13.0% (Nasional, 2015). The high protein content in chicken sausage in this study was due to the content of chicken meat of more than 70%. The protein content in this study was higher than the protein content of research with the addition of 3% carrageenan and 4ml transglutaminase, namely the protein content of 14.88%. Beef bone gelatin is also a source of animal protein compared to carrageenan from red algae. Furthermore, (Jridi et al., 2015) conducted research on the addition of gelatin derived from cuttlefish to turkey meat sausages, which gave a significant effect with the addition of gelatin being able to increase the protein content of turkey meat sausages, but the protein value in this study remained higher at 20.75%. (Sompie & Siswosubroto, 2021) have conducted research on the use of gelatin derived from chicken feet skin which resulted in increased protein levels in chicken meat sausages. The protein content of the sausage is determined by the amino acids contained in the gelatine (Sompie et al., 2023).

*Carbohydrate*

The analysis showed that the addition of beef bone gelatin had a significant effect ($P<0.05$) on the carbohydrate content of chicken sausage. Table 2 shows that the highest carbohydrate content was found in the P4 treatment which amounted to 9.07%, the difference or influence could have occurred due to the contamination of carbohydrates in the gelatin, either during the manufacture of gelatin or ingredients during the sausage making process. The addition of gelatin to chicken sausage should not cause a significant increase in carbohydrates because gelatin itself is a protein obtained from collagen (Hasdar, 2017), not as a source of carbohydrates.

The highest carbohydrate value is found in the P4 treatment or the addition of 12% gelatin. The carbohydrate content of sausages is influenced by several factors such as the type of raw material, fillers and additives as well as the type of sausage (Sofyan, dkk., 2018). The sausages in this study used the same type of meat, namely chicken meat and the same ingredients and amount of fillers. One of the factors that cause the increase in carbohydrate content value is the addition of fillers such as tapioca flour. The SNI quality requirement for sausage in carbohydrate content is a maximum of 8% (Nasional, 2015). This value shows that this study only has 1 treatment that exceeds the SNI quality requirements.

*Fat*

Fat content in chicken sausage with the addition of beef bone gelatin had a significant effect ($P<0.05$). Based on Table 2, the highest fat content was found in the P3 treatment or the addition of 9% gelatin. The addition of gelatin to chicken sausage does not directly add fat, but affects fat retention and emulsion stability. The nature of gelatin as a gelling agent and emulsifier (Pertiwi et al., 2018).

The source of fat in sausage products mostly comes from the basic ingredients of chicken meat used. Based on the results of this study, it is in accordance with the requirements of the national standard of sausage fat content, which is a maximum of 20% (Nasional, 2015), while in this study it was only around 1%. Research on the addition of 20% beef skin gelatin concentration to beef sausage fat content gave greater results than this study, namely 7.03%. While this study was only 0.63% at the addition of 12% gelatin. Furthermore, in the research of (Rumansi et al., 2021), the addition of chicken feet skin gelatin increased the fat content of chicken sausages as the gelatin increased. This is due to the addition of fat from chicken feet skin gelatin. Furthermore, (Sompie et al., 2021)conducted research on making beef sausage with the addition of gelatin from cowhide which resulted in a fat content of 7.03%. Research by sompi(Park etal., 2016)conducted research on the addition of gelatin to pork sausage, resulting in a fat content of 21.05%, this is because the basic ingredients of the meat used are different. Saturated fat content in pork is 7.7 g per 100g, while chicken meat has saturated fat of 3.1g (Sri Maiyena & Elvy Rahmi Mawarnis, 2022). Fats that are only loosely bound or not bound at all to proteins will become free in the dough and can be easily released into boiling water. The addition of gelatine as an additive can influence sausage characteristics, although this influence depends on the type of raw material used (Pereira et al., 2020).

*Ash*

The results of data analysis in Table 2 show that the level of beef bone gelatin addition treatment had a significant effect ($P<0.05$) on the ash content of chicken meat sausage. The ash content tended to decrease as the gelatin level increased. In the Duncan's further test, there was a treatment difference at the level of 12% gelatin. Gelatin helps form the gel matrix in sausages, but can sometimes affect mineral retention during cooking. For example, some inorganic minerals may dissolve or escape with the liquid lost during the cooking process, especially if the gelatin does not function optimally in retaining moisture (Damodaran S et al., 2017).

The ash content produced in this study still meets the quality standard of meat sausage ash content according to BSNI, which is a maximum of 3%

(Nasional, 2015) while in this study it was only around 1.7%. The results of this study showed a low ash content compared to (Ismanto et al., 2020.) who added carrageenan and transglutaminase to chicken sausage to produce ash content of up to 3.36%. In the research of (Rosmawati et al., 2023), the use of 3% cork fish skin gelatin resulted in a sausage ash content of 1.86%. This indicates that beef bone gelatin can be used as an excellent alternative as a binder in making chicken sausage without affecting the quality of the ash content of the chicken sausage produced.

*Water*

The moisture content of chicken sausage decreased along with the increase of bovine bone gelatin. Based on Table 2, there was a significant effect (P<0.05) the use of beef bone gelatin significantly decreased the moisture content of chicken sausage. The decrease in moisture content in sausages is due to gelatin having hydraulic properties or being able to absorb and bind water molecules. This is in accordance with the opinion of (Chanchal & Elesela, 2014)which says that gelatin at 40 ºC will have multifunctional characteristics such as gel formation, film formation, elasticity, water binding.

The smallest water content in this study was in the treatment of 12% gelatin addition, which was 68%. The results of this moisture content still exceed the quality requirements of meat sausages according to (Nasional, 2015), which is a maximum moisture content of 67%. This is due to the raw material for making this research sausage is chicken meat, it is known that the water content in chicken meat ranges from 70-80%.

The results of research using carrageenan and transglutaminase enzyme produced lower water content than this study (Ismanto et al.,2020 ). This is due to the addition of wheat flour in the study so that it can capture more water. In (Lee & Chin, 2016), the use of powdered gelatin from pig skin produced sausage moisture content ranging from 67.7% - 69%. Research using gelatin from cork fish showed the moisture content of the sausage was 63.95% (Rosmawati et al., 2023). Changes in sausage moisture content were in line with the increase in gelatin concentration. The difference in moisture content of sausages is related to the ability of the dough to bind water, and this depends on the type of gelatin with hydrophilic properties and its ability to form a gel (Kim et al., 2014). The function of gelatine is to bind excess free water contained in the dough so that the water content that will be released during the cooking process is relatively low compared to sausages without the addition of gelatine (0%) (Nurilmala et al., 2022).

## Conclusion

In terms of chemical quality, the chicken sausage produced with the addition of gelatin meets the quality standards for meat sausage based on SNI 01-3820-2015. The use of gelatin as a binder in the production of chicken sausage does not reduce the quality of the sausage produced. The best results were found in treatment P4 (12% cow bone gelatin). The use of gelatin up to 12% can be used as a binder in making chicken sausage. Gelatin is very important for food diversification, due to of the high levels of protein and low levels of fat.


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### Author Contributions

Conceptualization, A.N.M., S.P.S; methodology, A.N.M., W.D.N., M.I.; validation, S.P.S., W.D.N., R.V.,; formal analysis, A.N.M., S.P.S.; investigation, W.D.N., M.I., R.V.; resources, A.N.M., S.P.S., M.I.; data curation, A.N.M.: writing - original draft preparation, A.N.M., S.P.S.,; writing - review and editing, A.N.M., W.D.N., M..I; visualization, A.N.M., dan R.V.


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### Conflicts of Interest

The authors declare no conflicts of interest.

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