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Research Article

# Application of Dayak Onion (*Eleutherine bulbosa Urb.*) as a Preservative for Animal Protein: Chicken Meat

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**ABSTRACT**

The adoption of chicken meat as the primary protein source remains limited in Indonesia due to restrictions on its shelf life. Marinating chicken meat with Dayak onion, known for its antibacterial and antioxidant characteristics, can prolong the meat's shelf life. This research evaluates the efficacy of Dayak onion as a natural preservative for animal protein, specifically chicken meat. The study used a qualitative experimental design featuring both control and treatment groups. The experiment involved testing the pH value and cooking loss value of chicken meat that has been marinated with Dayak onion powder (treatment) and chicken meat that had not been marinated (control). The process of data analysis commenced with the application of the Saphiro-Wilk Test to ascertain the nature of the distribution. If the distribution is found to be normal, the subsequent step involves conducting the Independent-T test. Conversely, if the distribution is determined to be non-normal, the Mann-Whitney Test is employed instead. The research findings indicated that Dayak onion has a notable effect on maintaining the pH level of chicken flesh after 9 hours, as opposed to untreated chicken meat (p0.05). The overall findings demonstrate the capacity of Dayak onion as an organic preservative for chicken meat.

***Keywords***: *Chicken meat, Dayak onions, Preservatives*

## Introduction

Nutrition plays a pivotal role in supporting various physiological functions in the human body, including metabolism, growth, and immune system regulation. Among the essential nutrients, proteins are of utmost importance in improving the quality of human life. As macronutrients, proteins are composed of amino acids linked by peptide bonds, which contribute to immune defense mechanisms, enzymatic and hormonal regulation of metabolism, as well as the maintenance of cellular and tissue integrity. Adults typically require approximately 1 gram of protein per kilogram of body weight per day, while children need around 3 grams

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per kilogram of body weight per day (Virgiansyah, 2019).

There are two types of proteins consumed by humans: animal proteins and plant proteins. Animal proteins possess a more comprehensive set of essential amino acids compared to plant proteins, making them superior in repairing and building human body tissues. However, the utilization of animal proteins in Indonesia remains relatively low, approximately 4% (Oktaviani et al., 2018; Umaroh & Vinantia, 2018), with chicken meat being the most consumed animal protein and expected to increase (Wibowo, 2020). Nevertheless, chicken meat carries the risk of providing an environment conducive to the growth of harmful bacteria. The high water and protein content in chicken meat provide an excellent growth medium for various types of bacteria, such as Salmonella sp., Nevertheless, chicken meat carries the risk of providing an environment conducive to the growth of harmful bacteria. The high water and protein content in chicken meat provide an excellent growth medium for various types of bacteria, such as *Salmonella sp*., *Shigella sp*., *Escherichia coli*, and *Staphylococcus aureus*. Beyond the health implications, an excessive bacterial presence can also affect the shelf life and quality of meat, leading to a slimy, foul-smelling, and unpleasant taste.

As previously mentioned, shelf life is a crucial indicator in preserving the nutritional content of chicken meat. Shelf life is defined as the duration a product has from production to consumption before it degrades or becomes unfit for consumption, relating to food quality. The decrease in protein levels is influenced by the storage duration due to the activity of proteolytic bacteria that thrive optimally at room temperature. The higher the oxygen levels in the environment, the more the growth of proteolytic bacteria increases. Prolonged storage processes can affect the quality of chicken meat. Biological damage to chicken meat can occur at various stages, including livestock rearing, slaughtering, and marketing. Therefore, it is crucial to understand the shelf life of animal protein (Purwantiningsih et al., 2019).

To extend the shelf life, humans often use preservatives, and the use of natural preservatives, such as *Eleutherine bulbosa* (Dayak onion), is the subject of this research. Dayak onion, an endemic plant in East Kalimantan, is known for its antibacterial, antifungal, antiviral, anti-inflammatory, and antioxidant properties (Paramita et al., 2018; da Silva et al., 2024; Shi et al., 2019; Febrinda et al., 2023). Despite its potential as a preservative, there is no specific research on its utilization as a preservative for animal proteins, especially chicken meat. Therefore, this research aims to explore the potential of Dayak onion in preserving the quality and shelf life of chicken meat. The experimental method involves marinating chicken meat with Dayak onion powder, followed by pH measurement and cooking loss tests which were conducted over a total of 9 hours to examine the potential of Dayak onion as a natural preservative.

## Methods

### *Time and Place*

This study was conducted from October to December 2023 in Samarinda, East Kalimantan. Dayak onion and chicken meat samples were collected from the market, and sample processing was carried out at the Pharmacology Laboratory, Faculty of Medicine, Mulawarman University. Subsequently, specific experiments were conducted to assess two key parameters: pH measurement and Cooking Loss. These experiments were performed at the Pharmacology Laboratory, which is equipped with state-of-the-art facilities and equipment to support accurate and reliable measurements.

### *Preparation of Chicken Meat*

The chicken meat used in this study was meticulously prepared to ensure consistency and accuracy of results. The skin and attached bones were carefully removed, and the meat was then cut into approximately 2x2x2 cm pieces, weighing a total of 400 grams. These meat pieces were divided equally into two separate containers, with each container containing 200 grams. One container served as the marination/treatment variable, while the other container acted as the non-marination/control variable. To distinguish between the two, labels were assigned to each container, clearly indicating their respective variables (Rahayu et al., 2020).

### *Preparation of* Eleutherine bulbosa *Powder*

A total of 250 grams of *Eleutherine bulbosa* were thoroughly washed and thinly sliced. These sliced *Eleutherine bulbosa* pieces were then subjected to a drying process in a cabinet at a temperature of 50°C for approximately 3 days, or until they were completely dry. Next, the dried *Eleutherine bulbosa* were ground into a fine powder using a blender (Kusuma et al., 2016).

### *Marination Process of Chicken with* Eleutherine bulbosa *Powder*

The chicken breast pieces in the treatment groups were marinated with *Eleutherine bulbosa* powder. The amount of powder used was approximately 6% of the weight of the meat sample. Various marination durations were employed, namely 0 hours (P0), 1 hour (P1), 3 hours (P3), 6 hours (P6), and 9 hours (P9). Following the marination process, pH measurements and cooking loss experiments were conducted (Rahayu et al., 2020).

### *pH Measurement*

The cathode of the pH meter was calibrated until it reached a neutral state. The pH meter was then carefully inserted into the meat, and the displayed number was allowed to stabilize. Afterward, the cathode was rinsed with distilled water and dried thoroughly before reuse (Hajrawati et al., 2016). For this study, the pH measurement was conducted on 5 points of different meat pieces, with each pieces representing one replicates.

### *Cooking Loss Experiment*

The initial weight of the chicken meat was measured, after which it was placed inside a tightly sealed heat-resistant plastic bag to prevent water from entering during the subsequent boiling process in a water bath. The bag containing the meat was then boiled in the water bath at a controlled temperature of 80°C for a duration of one hour. Following this, the chicken meat was cooled by immersing it in a glass beaker filled with cold water at a temperature of 10°C for a period of 15 minutes. Subsequently, the sample was carefully removed from the plastic bag, dried using filter paper, and weighed again. The cooking loss value was determined by calculating the weight difference between the initial weight and final weight (Jaelani et al., 2014).

### *Data Analysis*

Once all the necessary data had been collected, it was subjected to analysis. The Shapiro-Wilk test was employed to determine the distribution type of the data. In cases where the data exhibited a normal distribution, parametric testing, specifically the Independent T-Test, was conducted. Alternatively, if the data displayed a non-normal distribution, non-parametric testing, namely the Mann-Whitney test, was employed. These statistical tests were chosen based on the nature of the data and ensured robust analysis of the results.

## Result and Discussion

### *Impact of* Eleutherine bulbosa *(Dayak onion) Marinade on the pH Stability of Chicken Meat*

The pH value is a crucial indicator of food suitability, including chicken meat, as it determines the degree of spoilage and meat quality (Triyannanto et al., 2021). Various standards define the acceptable pH range for chicken meat consumption, such as the Indonesian National Standard, which specifies a pH range of 6-7. Other studies suggest a minimum pH range of 5.1-7.2, with the caveat that the meat should retain its brightness and demonstrate enhanced stability against microbial deterioration (Nitiyacassari et al., 2021). Previous study has revealed that a pH lower than 5.3 can indicate yeast contamination due to increased glycolysis processes, making the meat overly acidic and unsuitable for consumption. Conversely, a pH higher than 7 may signify microbial activity, resulting in the breakdown of amino acids within the meat and the subsequent formation of alkaline compounds like ammonia ($NH4$), leading to protein degradation (Jaelani et al., 2014; Ginting et al., 2014).

The comparison of pH measurement results between chicken meat variables (without marinade) and treatment (marinated with *Eleutherine bulbosa*) at 5 different probe points over different time intervals is illustrated in Figure 1.

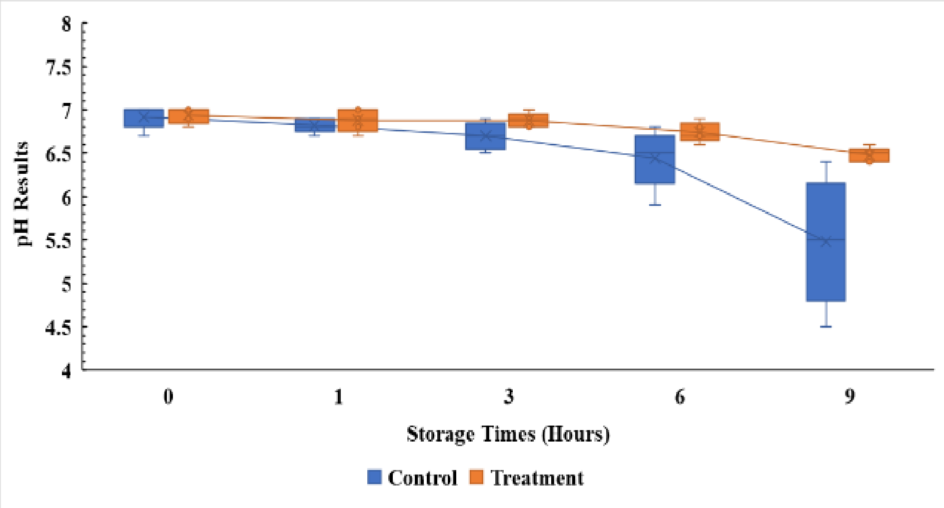


*Figure 1. pH measurement results. The x-mark represents the average of pH data, and information on maximum, minimum, quartile 1, median, and quartile 3 values is provided in the box-plot. The pH values of the meat exhibit a varied range*

Table 1 presents the average pH values of the samples throughout the study, indicating the mean pH for each control and treatment group at predetermined storage times: 0 hours, 1 hour, 3 hours, 6 hours, and 9 hours. Statistical analysis reveals no significant differences ($p>0.05$) between control and treatment samples at 0, 1, 3, and 6 hours. However, a significant difference occurs at 9 hours observation ($p<0.05$).

*Table 1. Mean pH of chicken meat with various treatments*

| Hours | Control | Treatment |
|---|---|---|
| 0 | 6.92±0.13 | 6.94±0.09 |
| 1* | 6.82±0.08 | 6.88±0.13 |
| 3* | 6.70±0.16 | 6.88±0.08 |
| 6 | 6.44±0.34 | 6.74±0.11 |
| 9 | 5.48±0.73 | 6.48±0.08p |

Note: * tested using Independent T-Test, others tested using Mann-Whitney Test. p indicates a significant difference ($p<0.05$).

The research findings suggest that over 9 hours, both marinated and non-marinated chicken meat experiences a decrease in pH. This aligns with previous research indicating that prolonged storage affects chicken pH due to microbial activity triggering glycolysis processes, leading to lactic acid production (Jaelani et al, 2014; Arbain et al., 2022; Sun et al., 2024). The reduction in oxygen levels increases hydrogen ion release during glycolysis and the citric acid cycle, resulting in the accumulation of lactic acid from pyruvate. This research also aligns with a study on chicken meat marinated with seduduk leaf extract, which showed a similar pH decrease with prolonged storage for both control and treatment groups. The pH reduction can potentially impact the physical properties of the meat, as rapid muscle pH reduction can lower water binding capacity due to increased actomyosin contraction, causing fluid to exit the meat and reducing its pH value (Afrianti et al., 2013).

### *Impact of* Eleutherine bulbosa *(Dayak onion) Marinade on the Cooking Loss of Chicken Meat*

One critical parameter reflecting changes in meat quality is cooking loss. Typically, cooking loss values for meat range from 1.5% to 54.5%, with an average range of 15-40%. Meat with lower cooking loss values tends to be superior compared to those with higher cooking loss values. This is because, during the heating process, fats in the meat release a significant number of fluids containing nutrients. Several factors influencing meat cooking loss include water-holding capacity (WHC), pH, myofibril contraction status, sarcomere fiber length, meat size, meat thickness, and cooking duration. Similar cooking loss values between treatments align with similar water-binding capacities in the meat. Cooking loss is highly affected by the amount of water lost during cooking, with meat proteins playing a role in water retention. The more water retained by meat proteins, the less water is released, resulting in lower cooking loss (Kartikasari et al., 2019; Lapase, 2016). In this study, the cooking loss test results for chicken meat marinated with *Eleutherine bulbosa* (treatment) and without marination (control) indicate the amount of water released from chicken meat after boiling by comparing the initial/before boiling weight and final/after boiling weight of the chicken meat. The comparison of cooking loss values is shown in Figure 2.

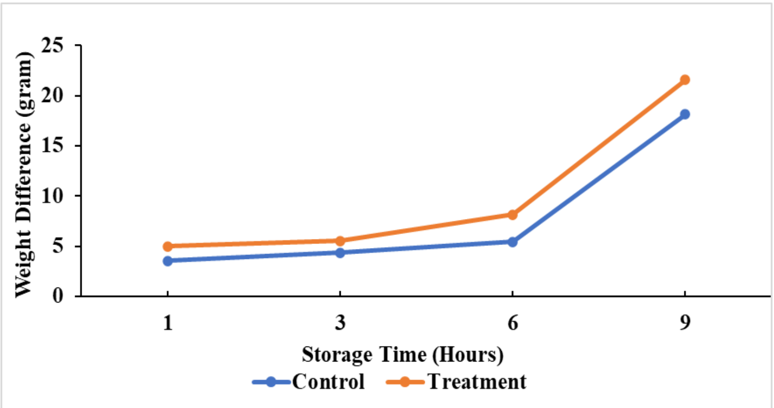


*Figure 2. Cooking loss results of Eleutherine bulbosa marinated chicken meat and non-marinated chicken meat before and after boiling*

Table 2 shows the mean cooking loss values with p=0.247 (p>0.05), indicating no significant difference in cooking loss values between the control and treatment groups. These results demonstrate that the cooking loss values for *Eleutherine bulbosa*-marinated chicken meat from 1 to 9 hours are comparable to those of non-marinated chicken meat (p>0.05). Thus, marinating chicken meat with 6% *Eleutherine bulbosa* does not have a significant impact on the cooking loss value. This finding is consistent with previous research that employed garlic as a marinade for chicken meat (Rumondor et al., 2023). The acidic nature of *Eleutherine bulbosa*, with a pH of approximately 4, contributes to its marinating properties, which in turn reduces the meat's water-holding capacity. A decrease in water-holding capacity leads to an increase in the percentage of cooking loss. This statement aligns with this study as *Eleutherine bulbosa* has a pH of 4, resulting in acidic marination that reduces the water content in chicken meat. Therefore, after marinating chicken meat with *Eleutherine bulbosa*, the cooking loss value increases. However, this study contradicts previous research stating that the addition of 10-15% *Eleutherine bulbosa* extract resulted in a significantly different percentage, namely a decrease of 1.40±0.20%. Nevertheless, when *Eleutherine bulbosa* extract was added at around 5%, a slight change in cooking loss values was observed (Ismanto et al., 2014). These results suggest that the concentration of *Eleutherine bulbosa* powder added to chicken meat also influences the cooking loss values.

*Table 2. Mean Cooking Loss Weight Change*

| | Average |
|---|---|
| **Control** | 7.86±6.90 |
| **Treatment** | 10.05±7.79 |

Notes: Mann-Whitney Test p = 0.248 (p>0.05)

## Conclusion

Based on the research findings, it can be concluded that marinating chicken meat with *Eleutherine bulbosa* has the potential as a natural preservative. This is evidenced by its ability to maintain pH stability in chicken meat simultaneously exhibiting antimicrobial effects against pathogenic or spoilage bacteria. The application of *Eleutherine bulbosa* powder on chicken meat effectively maintains pH stability at the 9th hour, which is in contrast to untreated chicken meat. Furthermore, the addition of *Eleutherine bulbosa* powder to chicken meat does not have a significant impact on cooking loss values when compared to the control group.

To gain a more comprehensive understanding of the potential acceptance of marinated chicken meat by the public, future evaluations should focus on organoleptic aspects such as taste, aroma, and texture. These evaluations will provide valuable insights into the sensory experience of consuming marinated chicken. Additionally, further research is needed to assess the long-term effectiveness of *Eleutherine bulbosa* as a preservative and to investigate the effects of varying *Eleutherine bulbosa* concentrations in the marination process on chicken meat quality parameters.

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