



Addition of Garlic Solution (*Allium sativum*) and Isolate *Pediococcus pentosaceus* N6 Strain on Chemical Quality and Shelf Length of Goat Meat

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ABSTRACT

Goat meat is one of the food ingredients of animal origin that is very beneficial for humans, because it is rich in protein, fat, vitamins and minerals. Preservation aims to protect goat meat from damage caused by various microbes such as bacteria, fungi, and so on. The use of chemical preservatives in food products is harmful to health. Therefore, research on natural preservatives that are safe for consumption by the public is needed. One natural ingredient that can be used is a garlic solution combined with *Pediococcus pentosaceus* strain N6. The experimental design for this study employs a Complete Randomized Design (CRD) with a 3x3 factorial pattern and three replications. As a result, there are a total of 27 experimental units. Factor I: Concentration of Garlic Solution + *Pediococcus pentosaceus* strain N6 P0: No Treatment, P1: Spraying using 30 ml of garlic solution + 10 ml of *Pediococcus pentosaceus* strain N6, P2: Spraying using 60 ml of garlic solution + 20 ml of *Pediococcus pentosaceus* strain N6. Factor 2: Storage time at room temperature (27°C), J1: 0 hours, J2: 24 hours, J3: 48 hours. Different doses and storage times resulted in the best meat quality in treatment P2 (60 ml garlic solution + 20 ml *Pediococcus pentosaceus* strain N6) with the highest average protein content of (21.88c ± 2.15) and the highest code in P2J1 (24.19g), the lowest fat content of (8.92 ± 1.59) with the lowest code in P2J3 (7.72), the lowest TPC value of (2.7 ± 1.39) with the lowest code in P2J1 (1.3), and the best color and aroma. In conclusion garlic solution combined with *Pediococcus pentosaceus* strain N6 could preserve goat meat.

Keywords: Goat Meat, Garlic, *Pediococcus pentosaceus* Strain N6 isolate, Meat Chemical Quality.



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1. Introduction

The community's meat needs are increasing every year. One of the meats that can be consumed and is easy to get is goat meat. Goat meat is one of the food ingredients of animal origin that is very beneficial for humans, because it has a high nutritional value, which is rich in protein, fat, vitamins and minerals. According to BPS (Central Statistics Agency), goat meat production, especially in North Sumatra in 2020 (848.87 tons), in 2021 it was 900.98 tons and in 2022 it increased by 927.47 tons. Goat meat production continues to increase but has not been able to meet the meat needs of the community, especially on big days such as Eid al-Fitr and Eid al-Adha. This is because goat meat has a hard and tough texture, the smell of prengus and people think that goat meat has a high fat content as a cholesterol trigger so that it limits the form of

processing and people do not like to consume goat meat. Goat meat has a tough texture depending on the age and location of the meat on the carcass. The meat of the thighs will be tougher than the back. This difference is because the thighs have more activity compared to the back, so the connective tissue on the thighs is tighter and tougher [1].

Preservation is an effort to maintain the quality of meat so that it can be stored longer. Preservation aims to defend meat from damage caused by various microbes such as: bacteria, fungi and so on. The use of chemical preservatives in food products is harmful to health. Therefore, it is necessary to research on natural preservatives that are safe for consumption for the public. One of the natural ingredients that can be used is a solution of garlic and *Pediococcus pentosaceus* Strain N6 isolate. Garlic can be used as a preservative because its nutritional content has antimicrobial activity. Garlic contains allicin which functions to prevent the growth of various microbes that can cause meat spoilage [2]. Garlic is very multifunctional for the community in addition to being a preservative and antibacterial in meat, garlic can also be used as a kitchen spice and a cure for various diseases. [3] The use of garlic extract with a concentration of 12% is able to inhibit the growth of bacteria. The typical compounds found in garlic are compounds such as essential or commonly called allicin which in addition to functioning as an antibacterial also function as a strong anti-inflammatory [4].

Pediococcus pentosaceus Strain N6 isolate is a Lactic Acid Bacteria (BAL). This isolate was isolated from the Rimbo Panti Hot Springs in West Sumatra. This isolate has high antimicrobial activity against pathogenic bacteria such as *Listeria monocytogenes*, *Salmonella Typhimurium*, and *E. coli* O157:H7. H7, can grow at 45-50 °C and can grow at pH 2-7 [5]. The most important factor and what needs to be considered when you want to produce meat is the quality of the meat itself, one of the quality of meat is determined by the chemical quality of the meat and the shelf life of the meat. The quality of meat includes moisture content, protein content, fat content, in goat meat. Based on the explanation above, the author has carried out research related to the addition of garlic solution and *Pediococcus pentosaceus* N6 strain isolate to the chemical quality and shelf life of goat meat.

2. Method

This research was carried out at the Research and Technology Laboratory of the Faculty of Agriculture and the Livestock Production Laboratory, Faculty of Agriculture, University of North Sumatra in April 2024 – May 2024.

2.1. Tools

The equipment used in this study, includes: blender, knife, cutting board, analytical scale, tray, plastic basin, pan, strainer, spatula, spoon, plastic plate, tissue, oven, plastic, container, label paper, questionnaire paper, stationery, erlenmeyer, test tube, petri dish, durham tube, bent rod, oyster needle, measuring pipette, drip pipette, measuring cup, beaker cup, micro pipette, measuring flask, spatula, incubator, Kjeldahl tubes, Soxhlet, desiccant, filter paper, Beaker glass, measuring cups, Erlenmeyer, porcelain cups, Soxhlet extraction, condensers, fat gourds, and electric heating or steam baths.

2.2. Ingredients

The ingredients used in this study are goat meat, garlic, aquadest, *Pediococcus pentosaceus* strain N6.

2.3. Data Analysis Methods

The experimental design of this study used a Complete Random Design (RAL) factorial pattern of 3 x 3 with 3 repetitions. As a result, there are a total of 27 experimental units. Each experimental unit used 70 grams of goat meat sprayed with garlic liquid and *Pediococcus pentosaceus* strain N6 isolate each according to the treatment of all sides of the meat until evenly distributed which was then drained for 20 minutes. The type of muscle tested was the active muscle, namely the biceps femoris (BF) which was taken in the thigh [6].

Factor I: Garlic Solution Concentration + *Pediococcus pentosaceus* strain N6

P0 : No Treatment P1 : Spraying using 30 ml of garlic solution + 10 ml *Pediococcus pentosaceus* strain N6
 P2 : Spraying using 60 ml of garlic solution + 20 ml *Pediococcus pentosaceus* strain N6

Factor 2: Storage time at room temperature (27°C)

D1: 0 Hours D2: 24 Hours D3: 48 Hours

3. Result and discussion

3.1. Moisture Rate

The moisture content of goat meat treated with garlic solution (*Allium sativum*) and *Pediococcus pentosaceus* strain N6 isolate with different doses and storage times is presented in Table 1.

Table 1. Moisture content of goat meat at the interaction of dose and shelf life (%)

Garlic Solution & Isolate	Storage Length			Mean
	D1	D2	D3	
P0	78.04	77.56	70.94	75.51b ± 7.36
P1	77.92	77.14	73.66	76.24b ± 2.51
P2	77.34	77.09	66.98	73.80A ± 6.12
	77.76b ± 1.02	77.26b ± 0.88	70.53A ± 7.93	

Remarks: Different superscripts on the lines show noticeable differences at the level (P<0.05)

The results of the diversity analysis tested with SPSS, showed that the interaction had no real effect as well as the effect of increasing the dose of garlic solution. The storage time has a real effect (P<0.05), on the decrease in the moisture content of goat meat. Where the lowest average value during the study shown in P2D3 was 66.98% while the highest average value was located in P0D1 at 78.26%. The results of this study are still in accordance with the quality standards of goat meat according to SNI where the good moisture content of meat should not exceed 80%.

The moisture content of meat is one of the quality indicators in meat that will affect the physical quality of meat such as shrinkage [6]. The decrease in moisture content in goat meat is caused by the addition of marinade liquid which initially increases the water content in the meat. However, after storage for two days, the moisture content decreases drastically due to the evaporation process during storage, which can be seen from the formation of water droplets or sweat on the surface of the storage container. In addition, the activity of microorganisms also contributes to the decrease in water content. The fermentation process carried out by lactic acid (BAL) bacteria causes meat to lose its ability to retain water. This is in line with previous research [7], which stated that the longer the fermentation lasts, the enzyme's activity increases in degrading the starch, so more bound water is released, causing the texture of the material to become softer and more porous. In addition, other research also revealed that the longer the meat is stored, the ability to bind water decreases and more water is released. This decrease occurs due to the evaporation process during storage, which affects the physical and chemical properties of the meat [8].

3.2. Protein Levels

The results of the analysis of protein content from goat meat treated with garlic solution (*Allium sativum*) and *Pediococcus pentosaceus* strain N6 isolate with different doses and storage times are presented in Table 2.

Table 2. Protein content of lamb meat at each treatment (%)

Garlic Solution & Isolate	Storage Length			Mean
	D1	D2	D3	
P0	18.6c	16.63b	14.67a	16.63A ± 1.72
P1	22.2f	20.03th	18.15d	20.13b ± 1.79
P2	24.19g	22.1f	19.33d	21.88c ± 2.15
	21.67c ± 2.47	19.59b ± 2.42	17.38a ± 2.87	

Remarks: Different superscripts in rows and columns show noticeable differences in levels (P<0.05)

The results of diversity analysis tested with SPSS. The length of storage and treatment of garlic (*Allium sativum*) and *Pediococcus pentosaceus* strain N6 isolate had a significant effect ($P < 0.05$), on the reduction of goat meat protein levels. Where the average value of goat meat protein content was lowest during the study shown at P0D3 at 14.67% and then highest at P2D1 at 24.19%. [9] The protein content of meat ranges from 16- 22% and other studies mention [10] the protein content of goat meat at 18.72%.

The average result of the protein content of goat meat in this study was higher because there was an addition of a solution of garlic and isolate solution by spraying where the garlic solution and isolate contain protein where the cells of the isolate break down proteins into amino acids which are the main constituents of protein, as well as garlic solutions that contain protein even in small amounts. Lactic acid bacteria (BALs) do not directly produce proteins in the sense of synthesizing them as a result of primary metabolism but instead, they are primarily known for their ability to degrade proteins into smaller peptides and amino acids through proteolysis, a process that is particularly important in food fermentation [11]. That garlic contains little protein but does not produce it actively, one clove of raw garlic contains about 0.57 grams of protein [12].

3.3. Fat Rate

The results of the analysis of fat content from goat meat treated with garlic solution (*Allium sativum*) and *Pediococcus pentosaceus* strain N6 isolate with different doses and shelf life are presented in Table 3.

Table 3. Fat content of goat meat at each treatment (%)

Garlic Solution — & Isolate	Storage Length			Mean
	D1	D2	D3	
P0	13.03e	10.84d	9.64bc	11.17c \pm 1.57
P1	11.15d	9.4BC	9.02b	9.86b \pm 1.07
P2	10.22cd	8.83b	7.72a	8.92A \pm 1.59
	11.47c \pm 1.32	9.69b \pm 1.02	8.79a \pm 1.4	

Remarks: Different superscripts on the lines show noticeable differences at the level ($P < 0.05$)

The results of diversity analysis tested with SPSS. The length of storage and treatment of garlic (*Allium sativum*) and *Pediococcus pentosaceus* strain N6 isolate had a significant effect ($P < 0.05$), on the fat content of goat meat where the fat content tended to decrease significantly as the storage time increased. Where the lowest average value of goat meat fat content is found at P2J3 at 7.72% and the highest goat fat content is found at P0J1 at 12.03%. The fat content in this study was lower than the results in the previous study which stated that the chemical composition of goat meat per 100 g was 30.97% fat [13].

At the beginning of 0-hour storage (D1), the average fat content was recorded at 11.47%. At this stage, the meat is still fresh, so the fat content has not undergone significant degradation. This is due to the low activity of microorganisms and the absence of the fat oxidation process due to a very short storage time. The fat content in fresh meat is more stable compared to meat cured by certain methods, indicating that fresh meat is more resistant to oxidative damage [14].

At 24-hour storage (D2), the average fat content decreased to 9.69%. This increase is likely due to lipodystrophy in meat tissue as a result of the initial autolysis process, in which the enzymes in the meat begin to actively break down cellular components which may also cause significant damage to fat. Autolysis is a natural process after an animal is slaughtered, in which enzymes such as proteases and lipases work to break down proteins and fats in meat tissues [15].

At 48-hour storage (D3), the average fat content decreased to 8.46%, but it was not significantly different from D1. This decline is caused by increased activity of microorganisms, which utilize fat as an energy source for growth and metabolism. In addition, the process of fat oxidation by the lipase enzyme also contributes to fat degradation, resulting in simple compounds such as free fatty acids and other volatile compounds. Storage of meat for a long time can accelerate fat degradation due to microbial activity and oxidation, as measured by the peroxide number parameter [16].

4. Conclusion

4.1 Conclusion

The administration of garlic solution and *Pediococcus pentosaceus* strain N6 isolate and the shelf life has a positive effect and can increase protein levels and reduce the moisture content, fat content of goat meat. The best treatment is obtained in the P2J3 treatment (spraying using 60 ml of garlic solution + 20 ml of *Pediococcus pentosaceus* strain N6 and a storage time of 48 hours).

4.2 Suggestions

The need to increase the treatment dose and increase the spraying dose by more than 5 ml aimed at obtaining a more even result to all parts of the meat and it is hoped that the shelf life of goat meat will last longer than this study, as well as the need for organoleptic testing to determine the level of preference.

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