Physical quality characteristics of lamb meat using *Pangium edule* extract at different storage times

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Abstract. *Pangium edule* or by other names, kluwak, kluwek, picung, or kepayang are traditional spices used for cooking. *Pangium edule* (kluwak) contains antimicrobial compounds, flavonoids, antioxidants, and tannins that function as anti-bacteria so that it inhibits bacterial pathogens that cause a decrease in the quality of meat. This study aims to determine the effect of *Pangium edule* extract at different storage times on the quality of lamb meat. The method used in this study was a Factorial Complete Randomized Design with three replications. The material used was *Pangium edule* (kluwak) and lamb meat soaked at the level of *Pangium edule* extract 0%, 3%, 6% 9%, then stored for 12, 24, and 36 hours at room temperature 27˚C to 30˚C. Parameters in this study are pH, cooking loss, and water holding capacity. The results of this study showed that the level of *Pangium edule* extract and storage time had a significant effect on pH, Cooking loss and water holding capacity (P<0.05. In conclusion, the extraction of *Pangium edule* level 3% to 9% effectively maintains the quality of meat during storage for up to 36 hours.

1. Introduction
Meat is a livestock product that contains high protein, so it is perfect for microbial growth. Many interrelated factors affect the storage time and freshness of meat, such as holding temperature, atmospheric oxygen (O2), endogenous enzymes, humidity, light, and, most importantly, microorganisms [1]. Meat damage and spoilage can be prevented using various methods such as using borax, formaldehyde, and chemicals, but it can be dangerous to health. Some problems also arise if the slaughtering of meat done in an area that often has a power outage problem so that it cannot use a cooling machine, and it is difficult to get ice cubes. Preservation is an effort to extend the time of meat storage by inhibiting enzymatic, chemical, and physical reactions caused by microbial activity. Damage caused by microbes causes meat spoilage, changes in colour, physical properties, and chemical content of meat.

*Pangium edule* (kluwak) is one of the germplasm of flora that produces edible fruit and has benefits as a traditional spice. The results of previous studies on the content of antibacterial compounds in fish
that *Pangium edule* (kluwak) contains antioxidant compounds that function as anticancer including vitamin C, β-carotene, and flavonoid compounds that function as antibacterial including cyanide acid, hydrocarpat acid, acid khulmograt, gorlat acid and tannins [2]. *Pangium edule* at levels 4%, 6%, and 8% effectively inhibits the growth of the bacteria *Staphylococcus aureus*, *Bacillus cereus*, *Pseudomonas aeruginous*, and *Escherichia coli* [3]. From the results of this research, preservation using different levels of *Pangium edule* is needed to determine the durability of meat products. Kluwak seeds contain antimicrobial compounds so they can categorize as preservatives [4]. *Pangium edule* or kluwak seed could be a potential source of antioxidants and antibacterial [5].

Declining meat quality is a significant problem in handling animal products, especially fresh products after harvest. A decline in meat quality caused by enzymatic and microorganism activity that occurs in meat. Meat preservation method using natural ingredients that are safe, easy to obtain, and inexpensive is the solution to overcome these problems. One ingredient that can be used to extend the shelf life of meat that is natural, safe, inexpensive, and easy to obtain is to use kluwak (*Pangium edule*) as a local spice in Indonesia.

2. **Method**

The study was conducted from March to July 2019 at the Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara Laboratory of Animal Husbandry and Laboratory of Food Sciences, Universitas Sumatera Utara. The research design used was an experimental method using a Factorial Complete Randomized Design with three replications, followed by Duncan's multiple range test to find out the levels in the samples that were significantly different.

The material used was male lamb with Longissimus dorsi which was immersed in the level of *Pangium edule* extract 0% (P0), 3% (P1), 6% (P2) and 9% (P3) and then stored for 12 hours (T1), 24 hours (T2) and 36 hours (T3) at room temperature 27˚C to 30˚C. The treatment in each study was carried out with three replications, so that as a whole produced 36 treatment combinations. Test parameters and methods are as follows:

2.1 **pH of meat**

Meat pH is the level or degree of acidity of meat after lamb slaughtered; the principle of measuring pH is knowing the acidic and basic conditions. The pH meter is calibrated with buffers 7 and 4. The tip of the pH meter is inserted into a 10-gram meat sample. Meat pH measurement can use a pH meter [6].

2.2 **Cooking loss**

Cooking loss on lamb meat sample: lost weight or shrinkage of meat sample during cooking. Done using the CSIRO method [7].

2.3 **Water Holding Capacity (WHC)**

The ability of the meat to retain its water or added water as long as there are external influences such as cutting meat, heating, grinding, and pressure. WHC is the method [8].

2.4 **Extraction of fresh Pangium edule**

*Pangium edule* fruit that is ripe is taken and broken down using a hammer. The contents of Pangium seeds are removed from the shell and then allowed to stand in running water for 12 hours [3]. *Pangium edule* seeds that have sliced are dry for five days. Then mashed using a grinder and stored in a dry container. *Pangium edule* seed extract made by maceration [3]. 150-gram *Pangium edule* powder is put into an Erlenmeyer tube and maceration using ethanol, covered with aluminum foil for 24 hours.

3. **Results and discussion**

Extending the storage time of livestock products can be done by various ways of adding natural ingredients, namely local herbs in Indonesia. The preservation method has the same goal, which is to inhibit the growth of spoilage microbes. Maceration results from 500-gram Pangi seed powder in 2
litres of ethanol in the form of the yellow filtrate. After evaporating using a rotary evaporator, a thick extract of 39.56 grams were obtained. Then centrifuged and filtered using a separating funnel, dried in an oven at 60°C for three days. The resulting extract is brown [3]. The results of the preservation research using *Pangium edule* are as follows:

### 3.1 pH of lamb meat
Meat pH is the degree of acidity. The results of the meat samples tested in the study obtain as follows:

| Storage Time | Pangium edule extract level (%) | Average |
|--------------|--------------------------------|---------|
| T1 (12 Hour) | P0 (0%) 6.14±0.3 P1 (3%) 5.67±0.3 P2 (6%) 5.70±0.2 P3 (9%) 5.70±0.2 | 5.94±0.2a |
| T2 (24 Hour) | P0 (0%) 5.70±0.2 P1 (3%) 5.66±0.2 P2 (6%) 5.83±0.2 P3 (9%) 5.76±0.1 | 5.73±0.1b |
| T3 (36 Hour) | P0 (0%) 5.43±0.1 P1 (3%) 5.60±0.2 P2 (6%) 5.70±0.2 P3 (9%) 5.73±0.2 | 5.61±0.1ab |

Note: Different letter notations on the same line show significant differences at the 5% level according to the DMRT test.

The interaction between the addition of the extraction level of *Pangium edule* at different storage times has a significant difference (P <0.05). It can conclude that the interaction between samples at the level of extraction of *Pangium edule* and the difference in storage time has a significant effect on pH. Table 1 shows that at the treatment time storage, the highest pH value in control was P0. The highest pH value is at T1 (6.14), and the lowest value is T3 (5.43), where T1 is significantly different from T3. The addition of *Pangium edule* extract level to pH has a significant effect. The storage time of T1, T2, and T2 at P0 and P1 has a higher pH value compared to T1, T2, and T2 at P2 and P3. A decrease in meat pH can occur due to the accumulation of lactic acid, and the pH will gradually decrease from 7.0 to 5.6 and 5.7 within 8 hours until it will reach the ultimate pH of 5.6. The addition of Panggium edule extract to samples P1, P2, and P2 with a storage time of T1, T2, and T3 shows that the pH of lamb meat is still normal. The addition of *Pangium edule* extract is suspected that the pH value in meat influence by *Pangium edule* extract. The content of tannin compounds in *Pangium edule* seeped into the meat through the osmosis process and acted to prevent the development of microbes so that the pH of the meat remains within the normal range compared to the control (P0) with a storage duration of 36 hours (T3). Normal lamb meat pH ranges from 5.5 to 5.9 after 24 hours [10]. A pH of lamb meat longissimus dorsi at 45 minutes after cutting 6.21 and decreased at 24 hours storage to 5.57 while in the semitendinosus muscle at 45 minutes after slaughtering 6.01 and after 24 hours at 5.62 [11]. This means that the pH of lamb meat up to the level of 9% (P3) at the preservation of 36 hours still shows a normal range.

### 3.2 Cooking loss
Cooking losses are the weight of the meat is reduced during the cooking process. Lamb meat cooking loss in this study presented in Table 2. The interaction between meat samples with *Pangium edule* level and storage time has a significant effect on cooking loss (P <0.05). There was a significant difference from the treatment level of extraction of *Pangium edule*, so Duncan test was performed to find out the level of *Pangium edule* in the meat sample that was significantly different from the cooking loss presented in Table 2.

Table 2 shows that at the treatment time storage, the highest cooking loss in control was P0. The highest cooking loss is at P0 (34.56), and the lowest cooking loss is P2 (24.78), where P0 is significantly different from P1, P2, and P3. The addition of the *Pangium edule* extract level to cooking has a significant effect. The storage time of T1 at P0 has a higher cooking loss compared to T2 and T3.
Table 2. Effect of *Pangium edule* extract on the cooking loss with a different storage time

| Storage Time | Level of extract *Pangium edule* (%) |
|--------------|-------------------------------------|
|              | P0 (0%)                | P1 (3%)                | P2 (6%)                | P3 (9%)                | Average   |
| T1 (12 Hour) | 35.66±3.00             | 31.33±4.00             | 25.00±4.50             | 28.77±3.50             | 30.19a     |
| T2 (24 Hour) | 31.33±3.00             | 27.33±3.50             | 24.00±4.50             | 25.78±4.00             | 27.11b     |
| T3 (36 Hour) | 36.00±1.00             | 25.33±4.50             | 25.33±2.50             | 25.00±2.50             | 27.91b     |
| Average      | 34.56 a                | 28.00 b                | 24.78 b                | 26.78 b                |

Note: Different letter notations on the same line show significant differences at the 5% level according to the DMRT test.

Cooking loss in research on treatment is still in the normal range. Some studies present the average value of cooking loss in sheep with good value, for example, cooking loss of lamb on sheep done by [12] cooking losses on meat ranges from 25.57% and 29.54%. Cooking loss lamb 28.65% to 33.34% [13]. According to [14] that cooked shredded lamb generally ranges from 15% to 40%. Cook losses in the study were highest in controls between 31.33% to 36% while in the treatment of the *Pangium edule* level, cooking losses in meat reached 25% to 31%. Cooking loss in lamb with the *Pangium edule* level between 3% to 9% in this study is included in the quite good category. Cook loss can be influenced by several factors, including muscle fibres, length of cross cuts of meat, the weight of meat, and cooking time.

3.3 Water Holding Capacity (WHC)

Water holding capacity is the ability of meat to hold water. The results of the study for the water holding capacity of sheep meat using *Pangium edule* extraction levels at different storage time represented in Table 3.

Table 3. Effect of *Pangium edule* extract on water Holding Capacity with a different storage time

| Storage Time | Level of extract *Pangium edule* (%) |
|--------------|-------------------------------------|
|              | P0 (0%)                | P1 (3%)                | P2 (6%)                | P3 (9%)                | Average   |
| T1 (12 Hours)| 26.98±4.78             | 33.93±3.57             | 30.85±1.93             | 34.68±1.50             | 31.61b     |
| T2 (24 Hours)| 28.81±3.55             | 40.53±4.99             | 40.79±3.80             | 33.46±4.28             | 35.89a     |
| T3 (36 Hours)| 27.64±2.55             | 32.97±2.02             | 32.99±2.02             | 33.45±2.24             | 31.76b     |
| Average      | 27.81 b                | 35.81 a                | 34.87 a                | 33.86 a                |

Note: Different letter notations on the same line show significant differences at the 5% level according to the DMRT test.

A high WHC indicates that meat has good quality. WHC is one of the leading quality characteristics of fresh meat because it can affect drip loss, technology quality, appearance, and sensory [15]. The highest WHC is at P1 (35.81), and the lowest cooking loss is P0 (27.81), where P1 is significantly different from P0, P2, and P3. The addition of the *Pangium edule* extract level to cooking has a significant effect. The storage time of T2 has a higher cooking loss compared to T1 and T3. *Pangium edule* extraction level and storage time in the study had a significant effect on the WHC of meat. The type of sample that was significantly different from WHC at a 5% level was between P0 with P1, P2, and P3. While Duncan test results during storage can see in Table 3. Storage time in the experiment (Hours) is significantly different from WHC at the 5% level between T1, T3, and T2. If seen from an average value of between 27% to 35% with the lowest water holding capacity in control (P0) and storage time (T1), it means that *Pangium edule* extract can increase the water holding capacity. This is thought to be the ability to bind water in muscle flesh that has been quenched with *Pangium edule* extract. Besides that, it is suspected that the protein in meat is good enough so that the meat can bind the water contained therein. The water holding capacity of the study is in the normal range according to [16] Average holding a capacity of the water is around 20% to 60%. The
decreasing value of water holding capacity, the ability of protein in meat to bind water will also decrease.

4. Conclusion
The results of this study showed that the level of *Pangium edule* extract and storage time had a significant effect on pH, Cooking loss and water holding capacity (P<0.05). In conclusion, the extraction of *Pangium edule* level 3% to 9% effectively maintains the quality of meat during storage for up to 36 hours. In conclusion, the extraction of *Pangium edule* level 3% to 9% effectively maintains the quality of meat during storage for up to 36 hours.

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