



The effect of marination duration using *Garcinia atroviridis* fruit paste on pH, water-holding capacity, cooking loss and tenderness of spent layer meat

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Abstract

Spent layer meat is less popular than broiler as it has a tough texture. *Garcinia atroviridis* fruit contains three natural acids, namely citric acid, malic acid, and ascorbic acid that can be used as meat tenderizer. The objective of this study was to determine the effect of marination duration using *Garcinia atroviridis* fruit paste on pH, water-holding capacity, cooking loss and tenderness of spent layer meat. The research was conducted using a completely randomized design with 4 treatments (0, 15, 30, and 45 minutes) and 5 replications. The use of *Garcinia atroviridis* fruit paste was 20% of meat weight. Data were analyzed using analysis of variance and followed by Duncan's multiple range test. The results of the study showed that marination using *Garcinia atroviridis* fruit paste for 15 to 45 minutes had significant effect on pH and meat tenderness but did not affect the percentage of water-holding capacity and cooking loss significantly. Among treatment groups, marination for 45 minutes was effective for gaining acceptable physical quality of spent layer meat, with a pH value of 4.50, water-holding capacity of 40.28%, cooking loss of 36.29% and tenderness value of 40.54 mm/g/10 seconds.

Keywords: Gelugur fruit, marination, pH, spent layer meat, tenderness

Introduction

Laying hens are chickens that are kept with the aim of producing eggs as their main product. Spent layers are laying hens that are no longer productive with low egg production of around 20% to 25% at non-productive age (Gillespie & Frank, 2010)^[3]. Generally, the age of culling or the final production period for laying hens is around 72 to 80 weeks (Murtidjo, 2013). According to Kurniawan *et al.*, (2011)^[7] the nutritional content of cull laying hen meat contains water (56%), protein (25.4%), and fat (3-7.3%). However, laying hen meat is less desirable because it has a tough meat texture.

Marination is the process of soaking meat in a substance, before processing it further (Nurohim *et al.*, 2013)^[11]. The soaking process is useful for improving the physical properties of the meat itself, such as the taste, tenderness of the meat, reducing cooking losses, and increasing the shelf life of the meat. Marination can be said to be effective if it fulfills factors such as the type or material of marinade, marination method such as dipping, immersion or injection, marination time and marination temperature during storage (Alvarado & Mckee, 2007). The soaking or marinating method must use ingredients that are safe for meat products (Herlambang, 2018). One of the safe and common natural ingredients used as a marinade ingredient is ingredients derived from fruit (Patriani *et al.*, 2020). Acids from fruit can simultaneously utilize the nutritional content of the fruit and change the texture and quality of the meat. The use of fruit in the marinating process must be carefully considered, because the use of different fruit can affect the composition and changes experienced by the marinated meat.

Gelugur (*Garcinia atroviridis* fruit) is a spice that has long been used by people and is often found on the island of Sumatra. Abdullah *et al.* (2013)^[1] stated that cutting acid contains antioxidant compounds, ascorbic acid, flavonoid compounds which are useful as antibacterials, phenolics and

tannins. Suhardi (2013)^[17] added that cutting acid also contains organic acids such as citric acid, malic acid and ascorbic acid. The acidic nature of the fruit can have an effect on improving the meat quality of tough meat (Purnamasari *et al.*, 2012)^[15]. This is in accordance with research that has been carried out using various fruits that contain organic acids, such as strawberries, pineapple peel, yellow passion fruit and lime (Hermawati *et al.*, 2016; Purnamasari *et al.*, 2012; Kamila *et al.*, 2015; Tiofani, 2014)^[5, 6, 15, 18].

The acid that enters the meat causes the meat to undergo a protein denaturation process which results in the breaking of polypeptide bonds and changes the composition of the meat protein molecules, so that the muscle tissue becomes softer or softer (Hermawati *et al.*, 2016)^[5]. Therefore, this research aims to determine the effect of long marination with gelugur fruit paste on pH, water holding capacity, cooking loss and tenderness of meat from rejected laying hens, as well as to determine the relationship between meat pH and tenderness.

Materials and Methods

Preparation of gelugur fruit paste

Dried gelugur fruit was used as a marinade ingredient. Gelugur fruit was ground with the addition of distilled water as a mixture to make gelugur acid paste with a ratio of 1:2 (w/v). After the grinding was complete, the mixture of gelugur acid and distilled water was heated at a temperature of $\pm 80^{\circ}\text{C}$ for 20 minutes and continued to stir until it thickened and became a paste. Gelugur paste was stored in the refrigerator for 24 hours before being used as a marinade ingredient.

Meat marination

The meat came from 10 spent layers of ISA Brown aged 72-80 weeks which were kept under similar management. Culled laying hens had an average body weight of 1.75 kilograms with a coefficient of diversity of 6.32%. The samples used were left and right breast meat (*Pectoralis major*) so that a total of 20 samples were obtained.

Gelugur fruit paste as much as 20% of the weight of the meat was smeared on the surface of the meat. The meat was marinated for 15 minutes, 30 minutes and 45 minutes at room temperature. After the marination time was complete, the meat samples were rinsed with distilled water, then continued with testing for pH, water-holding capacity, cooking loss, and tenderness.

pH measurement

pH measurement was performed using a digital meat pH meter (YY-1030) in triplicates. The pH meter electrode/probe was calibrated with buffer pH 10, 4, and 7 sequentially before use. The pH meter electrode/probe was inserted into the meat until digital numbers appeared on the screen and the data was recorded when it was stable.

Water-holding capacity measurement

Method of Soeparno (2005) [16] was used to measure water-holding capacity in this research. A meat sample weighing 0.3 grams was placed on a Whatman filter paper No. 42 and pressed between two glass plates loaded with a load of 35 kg for 5 minutes. After that, the total wet area and meat area were measured. Meat moisture content was determined according to the method of Muchtadi *et al.* (2010) [9] using an oven at a temperature of 105 °C. Until the weight loss (%) was obtained which was used as water content. Water-holding capacity was measured using the following formula:

$$WHC = \text{moisture content (\%)} - \frac{mg H_2O}{300 mg} \times 100\%$$

Cooking loss measurement

Cooking loss was measured using the weight loss percentage method (Soeparno, 2005) [16] in triplicates. The sample was weighed at 30 grams, then put in a zipper bag and boiled in water bath at 80– 82°C for ± 30 minutes. Once finished, samples were cooled at room temperature until the weight was stable then weighed. The cooking loss percentage was calculated using the following formula

$$\text{Cooking loss (\%)} = \frac{\text{Initial weight (g)} - \text{Final weight (g)}}{\text{Initial weight (g)}} \times 100\%$$

Tenderness measurement

Determination of meat tenderness was carried out using a Pearson and Dutson (1994) [13] penetrometer method. Meat samples were cut uniformly weighing 30 grams. Next, the meat was boiled for 30 minutes at a temperature of 80–82°C, then cooled to room temperature. The meat was placed directly under the penetrometer needle. Ten measurements of each sample were carried out at different points and then averaged in units of mm/g/10s.

Statistical analysis

Data were analyzed using one-way analysis of variance (ANOVA). If the results showed a significant effect, then the analysis was continued with Duncan's multiple range

test to separate the means at the 95% confidence level. Simple linear regression analysis was used to determine the relationship between the pH value of meat and its tenderness.

Results and Discussion

pH value

The results of research regarding the effect of marination time using gelugur acid paste on the pH of the meat of cull laying hens showed that the average pH value of the various treatments was in the range of 4.50 – 5.82 (Table 1). The results of ANOVA analysis showed that there was a significant effect (P<0.05) on the pH of the meat of cull laying hens. Further tests were carried out, namely Duncan's multiple range test with significantly different results for each treatment.

Table 1: pH value of cull laying hen meat before and after marinating using gelugur acid paste

Marinating Duration (minutes)	pH value
0	5.82±0.05 ^d
15	4.75±0.27 ^c
30	4.63±0.16 ^b
45	4.50±0.14 ^a

Data are presented as mean±standard deviation. Different letters in the superscript indicate significant differences (P<0.05).

The pH value continues to decrease gradually. The longer the marinating time, the lower the pH value of the meat. This is because the longer the gelugur acid paste is used for marinating, the more it will absorb into the meat. Tiofani (2014) [18] stated that the decrease in the pH of the meat of rejected laying hens was caused by the acid content contained in gelugur acid such as citric acid and ascorbic acid which diffused into the meat of the rejected laying hens and caused protein denaturation in the meat of the rejected laying hens. Protein denaturation results in decreased solubility, increased viscosity, loss of biological activity and the protein is easily attacked by proteolytic enzymes (Oktavia, 2007) [12]. One of the causes of protein denaturation is changes in temperature and also a decrease in the pH value (Marfira *et al.*, 2018) [8].

Water-holding capacity

The research results show that the average water holding capacity produced in this study from various treatments ranges from 40.28% - 42.95% (Table 2). The ANOVA analysis test showed that there was no real effect between the concentrations given on the water holding capacity of the meat of the cull laying hens.

Table 2: Water holding capacity of cull laying hen meat before and after marinating using gelugur acid paste

Marinating Duration (minutes)	Percentage of Water Holding Capacity
0	42.956±2.56
15	41.911±1.89
30	41.023±3.53
45	40.282±3.42

Data are presented as mean±standard deviation.

This is because the water holding capacity of meat is greatly influenced by the acidity value of the meat, so that a low pH

value tends to have a decreased ability to bind the water it contains (Soeparno, 2005) [16]. Soaking the meat in gelugur acid paste for a longer time may produce a significantly different impact on the water holding capacity of the meat of cull laying hens. This is in accordance with the statement by Yusop *et al*, (2011) [19] the optimal marination time usually lasts 1 to 24 hours.

Cooking loss

The research results showed that the average cooking loss produced in this study from various long marination treatments using gelugur acid paste ranged from 34.96%-36.29% (Table 3). The ANOVA analysis test showed that there was no real influence between the length of marination time given on the cooking loss of the meat of the cull laying hens.

Table 3: Cooking loss laying chicken meat is removed before and after marinating using gelugur acid paste

Marinating Duration (minutes)	Cooking Loss Percentage
0	34.96±4.17
15	36.61±3.11
30	35.23±1.87
45	36.29±2.69

Data are presented as mean±standard deviation.

This happens because the natural acid contained in the sour gelugur fruit cannot prevent water from coming out of the meat. Purnamasari *et al*. (2013) [14] stated that if the water content is low then cooking loss will decrease. Hermawati *et al*. (2016) [5] added that low water content results in the meat's ability to bind water being low, which causes the amount of water to decrease during cooking.

Tenderness

The tenderness value obtained after soaking for different times obtained an average value of 27.92 - 40.54 mm/g/10 seconds (Table 4). The results of the ANOVA analysis showed that there was a significant effect (P<0.05) of the treatment on the tenderness of the meat of the cull laying hens, followed by Duncan's multiple test.

Table 4: Tenderness of meat from cull laying hens before and after marinating using gelugur acid paste

Marinating Duration (minutes)	Tenderness Value
0	27.92±0.71 ^a
15	36.50±0.86 ^b
30	39.16±1.12 ^c
45	40.54±0.48 ^d

Data are presented as mean±standard deviation.

Different letters in the superscript indicate significant differences (P<0.05).

Duncan test results show that there are real differences between each treatment, the longer the marination time, the more tender the meat. This is because the natural acid content in gelugur acid paste seeps into the meat of the cull laying hens, causing the breakdown of polypeptide bonds and changes in the composition of protein molecules. According to Haikal *et al*. (2021) [4] adding acid causes the protein hydrolysis process in meat. Figure 1 shows that lower pH increases tenderness value of spent layer meat. A lower pH supports the activity of proteolytic enzymes in meat, thereby breaking down proteins in meat followed by

the activation of the cathepsin enzyme in meat and causing an increase in tenderness value (Elsässer & Goettig., 2021) [2].

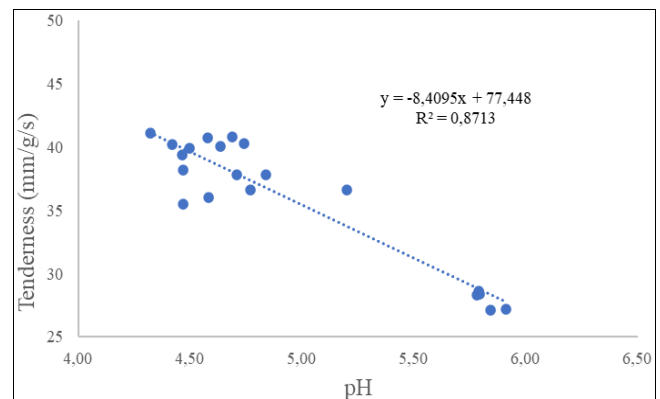


Fig 1: Linear regression between pH value and tenderness of laying meat soaked using gelugur acid paste.

Conclusion

The length of marination using gelugur fruit paste on the meat of spent layer showed significant effect on tenderness and pH, while did not alter water-holding capacity and cooking loss. The most effective time for marinating spent layer meat using gelugur fruit paste was 45 minutes with a pH value of 4.50, water-holding capacity of 40.28%, cooking loss of 36.29% and tenderness value of 40.54 mm/g/10 seconds.

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