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THE EFFECTIVENESS OF GELUGUR ACID (*Garcinia atroviridis*) MARINADE ON THE PHYSICAL QUALITY OF CULLED CHICKEN MEAT

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ABSTRACT

A method to improve the physical quality of culled chicken meat is required due to the tough texture and faint color of culled chicken meat. High protein content in culled chicken meat makes it easy to experience quality degradation. One of the methods to maintain the quality of post-harvest chicken meat is using spices. Gelugur acid *(Garnicia atroviridis*) is a spice for cooking spice, sweets, herbs, deodorizing fresh fish, and even cleansing fish before it proceeds into the processing stage. This study aimed to determine the concentration of *Garcinia atroviridis* which is effective to improve the physical quality of culled chicken meat. This study used a randomized design with 4 treatments and 5 replications. The treatments consisted of T0: without marination using *Garcinia atroviridis* (as control), T1: marination in 50 g of *Garcinia atroviridis* + 1000 mL aquadest, T2: marination in 50 g of *Garcinia atroviridis* + 750 mL aquadest, T3: marination in 50 g of *Garcinia atroviridis* + 500 mL aquadest. The parameters were the physical quality of meat consisting of meat pH, water holding capacity, tenderness, cooking loss, drip loss and meat color. Based on the results of the study, *Garcinia atroviridis* marinade had significant effect ($P < 0.05$) on the pH value of the meat, cooking loss, drip loss, tenderness, water holding capacity, and meat brightness. It was concluded that the marination of meat at concentration of 50 g of *Garcinia atroviridis* + 1000 mL aquadest (T1) was effective in maintaining the pH value, reducing meat drip loss, increasing water holding capacity, increasing tenderness, brightening the color of the meat and maintaining the freshness of the refined culled chicken meat. Marination of meat in concentration of 50 g *Garcinia atroviridis* + 750 mL aquadest (T2) was also effective in reducing cooking loss of culled chicken meat.

Key words: Acid; concentration; marination; storage; spices

INTRODUCTION

Culled chicken is poultry that productivity has decreased but still can be used as a food. However, culled chicken meat tends 1to have a tough texture and faint color. Therefore, it is necessary to consider the physical quality of chicken meat before processing it. So that the quality of culled chicken meat needs to be improved in order to increase the satisfaction of consumers. One of the methods that has been known to improve the physical quality of culled chicken meat is using abundant and relatively low priced ingredients. Prasetyo *et al*. (2013) stated that physical properties of meat are very important in the processing because these can determine the quality and type of processing.

A natural ingredient that may improve the quality of meat is gelugur acid (*Garnicia atroviridis*) that is known as a spice and herb in Indonesia. Gelugur acid (*Garnicia atroviridis*) is a spice used as a cooking spice, sweets, herbs, deodorizing fresh fish, and even cleansing fish before it proceeds into the processingstage. According to several previous research sources *Garcinia atroviridis* contains antioxidants (Abdullah *et al.,* 2013; Al-Mansoub *et al.,* 2014). *Garcinia atroviridis* contains citric and ascorbic acid Alisha *et al.* (2020). *Garcinia atroviridis* also has sour taste that could help to break down the protein structure of the meat. Nurwantoro *et al.,* (2012) revealed that acidic marinade can be used for tenderizing meat. Marination with acids can be performed for 6 to 24 h so that acid in marinade can cleave the peptide bonds in the protein fiber of meat.

Physical quality of meat includes pH value of meat, water holding capacity, tenderness, cooking loss, drip loss, and meat color. The pH value of meat depends on the amount of glycogen contain in meat. Wideman *et al.* (2016) stated that chicken meat color variations are related to pH and myoglobin values. The normal pH value of 5.5 meats can be acquired after the rigormortis process. The decrease in pH of meat can cause protein denaturation with strong acid pressure so that the marination time needs to be limited. Normal pH value of meat is 5.4-5.8.

Water holding capacity is the ability of meat to hold water. Water holding capacity is influenced by pH value, proteolytic and protein oxidation. In previous research, marinated meat caused an increase in the value of water holding capacity (Kaewthong and Wattanachant, 2018). Cooking loss is the percentage of weight loss in meat due to the cooking process. Cooking loss can be evaluated by changing the sample weight before and after cooking. The higher cooking loss value, the lower quality of the meat will be.

Also the higher cooking loss, the less nutritional content in the meat. Zhang *et al.* (2020) stated that marination can reduce cooking loss in broiler chicken breasts. In general, cooking loss in meatrange from 15-40%. One of the criterias in assessing the quality of meat is tenderness. Differences in meat tenderness can be caused by differences in the size of the myofiber. The Increasing of myofiber diameter has negative potential to meat tenderness. The tenderness of the meat can be seen by measuring the breaking strength of the fiber, the lower breaking power value, the more tender meat becomes and the higher breaking power value, the tougher meat becomes.

Meat tenderness is also associated with the high pH of the meat (Lomiwes *et al.,* 2014). Drip loss is thewater droplets that come out of the meatduring the

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storage process. High drip loss values are associated with low water holding capacity. The high drip loss value can reduce the quality of meat due to the amount of water that drips out with the nutrients in the meat. Meats are measured, hung first and weighed (Berry *et al.*, 2008). The color of free-range chicken meat tends to be dark and yellowish. In general, marination using acids will give the meat a brightening effect. Bright colored flesh is preferred because it looks cleaner. The color of the meat is influenced by the amount of myoglobin and high pH (Wideman *et al.*, 2016).

Improving the meat quality after slaughtering becomes a priority in order to improve quality during processing. The physical quality of meat is also important to know that meat is suitable for consumption. *Garcinia atroviridis* has previously been studied in fish and processed products but has not been applied to livestock products for instance meat. The physical quality of meat can be determined by testing pH, water holding capacity, tenderness, cooking loss, drip loss, and meat color. This study aimed to determine the effective concentration of *Garcinia atroviridis* marinade on the physical quality of culled chicken meat.

MATERIALS AND METHODS

This research was conducted from May to July 2020 at the Animal Husbandry Laboratory, Animal Husbandry Study Program, Universitas Sumatera Utara. This research was carried out in experimental laboratory. The tools and materials used in the study were *Garcinia atroviridis*, culled chicken meat, aquadest, MgO, analytical scales, rope, wire, glass plate, stainless steel pan, gas stove, stopwatch, penetrometer, Amtast AMT16M type pH meter, Konika Minolta colorimeter, cooling rack, whatman paper no 41, load 35 kg, stirring rod, plastic, wire, ruler, thermometer, measuring cup and hanging wire.

Research Design

This study used completely randomized design with 4 treatments and 5 replications. The treatment (T) consists of:

T0: no marination using *Garcinia atroviridis* (as control)
T1: marination in 50 g of *Garcinia atroviridis* + 1000 mL aquadest
T2: marination in 50 g of *Garcinia atroviridis* + 750 mL aquadest
T3: marination in 50 g of *Garcinia atroviridis* + 500 mL aquadest

In this study 80 weeks old culled chicken meats used as samples and each sample weight 20 g. The marinade for each treatment was made by boiling 50 g of *Garcinia atroviridis* + aquadest at 100 °C for 15 min. The sample of culled chicken meat in each treatment was immersed in the marinade for 60 min at room temperature of 27 ° C and then left for 24 h. After 24 h, the physical properties of the meat were observed as to pH, water holding capacity, tenderness, cooking loss, drip loss, and meat color. The data obtained were then analyzed with analysis of variance, if it shows significant results, the data would be analyzed with Duncan test (Steel and Torrie., 1990). The program for data analysis was IBM SPSS statistical 21 License.

Measurement of Research ParameterpH of Meat

Measuring pH value using a calibrated Amtast type AMT16M pH meter. The pH meter was inserted into pieces of meat weighing 20 g. The pH value can be read on the screen used (AOAC, 2005). The pH value of the meat will gradually decrease from a value 7 to the range of 5.3 to 5.7

Water holding capacity

The water holding capacity test was intended to determine the ability of the meat to bind free water. The marination was performed by immersing 20 g of meat in gelugur acid marinade. The Water holding capacity used the Hamm method is to prepare a 0.3 g meat sample that was

placed on filter paper between steel plates which are loaded using a 35 kg load for 5 min. To measure water binding capacity canbe used the formula below:

$$\text{Water content} = \frac{wet\ area\ (cm2)}{0.0948} - 8.0 \text{ then measured : WHC} = 1 - \frac{Expresed\ juice}{Water\ content}$$

Cooking loss

Cooking loss is the loss of meat weight after cooking. Cooking loss was calculated using the CSIRO method thatwas meat weighing 20 g and boiled at 80℃ for 30 min then the meat was cooled and dried with a tissue and the final weight is weighed (Prayitno *et al.,* 2020). Cooking loss can be calculated using the formula:

$$Cooking\ loss = \frac{Weight\ before\ cooking - Weight\ after\ cooking}{Weight\ before\ cooking}\ x\ 100\%$$

Meat Tenderness

Meat tenderness was measured organoleptically or using a penetrometer (Hafid *et al*, 2020). Before measuring the cooked meat, then it is calculated using the formula:

$$\text{Tenderness (mm/g/10 s)} = \frac{Average\ measurement\ weight}{10\ second}$$

Meat Drip loss

Drip loss can occur in chicken meat during the storage process. The drip loss test was carried out using the bag method by weighing the meat as the initial weight then stored by tied to a raffia rope and put into a plastic bag and hanging on a storage rack at 4℃ for 24 h then the meat was weighed again as the final weight. Otto *et al.* (2004) states that driploss is calculated using the formula:

$$\text{Drip loss (\%)} = \frac{initial\ meat\ weight - final\ meat\ weight}{initial\ meat\ weight}\ x\ 100\%$$

Meat color

To analyze the color of culled chicken meat, it was carried out objectively at the shelf life of 24 h using a Konika minolta colorimeter. Firstly the equipment must be calibrated then fires light at the meat sample and reads the color value for L as the brightness color, a * as the meat color and b the yellowish color. The data can be L * a *b * (Patriani *et al.,* 2019)

RESULTS AND DISSCUSION

The measurement of the physical quality of culled chicken after marinating for 60 min and 24 can be seen in Table 1.

Table 1. Physical quality of culling chicken after marination using *Garcinia atroviridis*

Parameter	Treatment of *Garcinia atroviridis* Concentration			
	T0	T1	T2	T3
Meat pH	5.94±0.20^{a}	5.77±0.05^{b}	5.74±0.03^{b}	5.77±0.02^{b}
Cooking loss (%)	28.31±0.93^{a}	25.76±0.67^{ab}	21.56±1.53^{b}	26.66±0.59^{a}
Water Hoding Capacity (%)	38.22±1.18^{a}	42.58±1.88^{b}	50.08±1.20^{c}	54.06±3.62^{c}
Drip loss (%)	3.35±0.45^{b}	2.40±0.26^{a}	2.91±0.75^{a}	3.79±0.08^{b}
Tenderness (mm/ g/ 10 ss)	37.83±1.44^{a}	24.63±0.99^{c}	30.55±2.18^{b}	30.76±0.00^{b}

Note : The means with different superscripts showed significant differences (P<0.05)

The pH value of culled chicken after marination using *Garcinia atroviridis*

Based on the research results, it can be seen in Table 1 that the highest average of pH value of laying hens was T0 or control that was 5.94 and the lowest was in T2 or marination using 50 g of *Garciniaatroviridis* + 750 mL aquadest, namely 5.74.The results of analysis of variance showed that the control (T0) was significantly different (P <0.05) with marideconcentrations of T1, T2 and T3. Based on the Duncan test, the marinated meat using *Garcinia atroviridis* had a lower pH value than the control and significantly affected it.

The pH value that had decreased with the increasing concentration *Garcinia atroviridis* is thought to be caused by the content of organic acids, namely citric acid and ascorbic acid, which hydrolyze the protein of culled chicken meat. Organic acids in *Garcinia atroviridis* can break down meat proteins by breaking peptide bonds to produce simpler proteins. Organic acids also catalyze hydrolysis reactions that involve water element. Citric acid contained in *Garcinia atroviridis* can hydrolyze peptide bonds in proteins into simpler amino acids. According to Hilmiati *et al.* (2016), marinade with organic acid-based materials can lower pH value of meat so that the number of bacteria would reduce thus extend the shelf life of meat

The decrease in the number of bacteria due to acid-based marinade is caused by the accumulation of Hydrogen (H +) ions which are toxic to bacteria. Hydrogen ions will be released by bacterial cells that need adenosine triphosphate. The more accumulations of Hydrogen ions in bacterial cells, the more adenine triphosphate has to remove these ions so that the bacteria will be short of adenine triphosphate that ultimately inhibits bacterial growth. There are several reasons that cause the decrease of pH value in meat such as microbial activity and acid-based marinade.

The higher concentration of organic acid-based marinade, the lower pH of the meat, although it is not too low. Purnamasari *et al.* (2013) stated that the pH value of culled layer hens immersed in an acid-based marinade, namely pineapple peel extract, was in the range of 5.76-5.56.

Pearson and Dutson (2004) stated that the pH value of meat 5.6. Lyon *et al.* (1991) stated that the pH value of chicken meat at 24 h was around 5.75. Meat can be categorized as moderate DFD or dark, compact and dry if it is above normal pH. The normal pH value of meat is 5.5-5.8, it means that the pH of the treated meat in this study was included in the normal category. In this study, the marinade of 50 g of *Garcinia atroviridis* + 1000 mL of aquadest (T1) was the most effective way in maintaining the pH value of culling chicken meat.

Cooking loss* in culled chicken meat after marination using *Garcinia atroviridis

Cooking loss percentage value is the weight loss of meat after it went through the cooking process. The results showed that the control (T0) was significantly different (P<0.05) with T2 but not significantly different from T1 and T3. The results showed that the highest cooking loss value was in culled chicken meat after marinating *Garcinia atroviridis* on the control (T0), namely without marination using *Garcinia atroviridis* and the smallest cooking loss value for marination in 50 g of *Garcinia atroviridis* + 750 mL aquadest (T2), namely 21.56% T1, namely marination in 50 g of *Garcinia atroviridis* + 1000 mL aquadest amounting to 25.76%. Based on the Duncan test, the result of cooking loss value of meat marinated using *Garcinia atroviridis* was lower than the control.

The concentration of *Garcinia* essentials containing organic acids has an effect on cooking loss. It is associated with a lower pH value in the treatment compared to the control (T0). A low meat pH value absorbs higher moisture and binds to proteins above or below the isoelectric point (approximately pH 5.2). This resulted in the marinade-based organic acid would absorb

more moisture during marination resulting in a lower cooking loss (Aktas *et al.*, 2003). Marination would make the culled chicken meat juicier. Seus and Martin (1993) stated that low levels of hydration of myofibrillar proteins at isoelectric points can cause a decrease in cooking loss during cooking. Cooking loss in T1 and T2 treatments were lower than T0 and associated with lower pH values. According to Rao *et al.*, (1989), the effect of acid on meat muscle tissue depends on the type of fiber as well as final acidification. Marinade with weak acids causes swelling of collagen surrounding the bundles of muscle fibers (perimysium) and single fibers (endomysium).

This means it relates to electrostatic and osmotic theories about muscle swelling. The addition of organic acids as a marinade in meat muscleswill result in the protonation of carboxyl groups. According to electrostatic theory, the addition of acids below the isoelectric point of meat proteins will gradually protonate negatively charged carboxyl groups that should sever electrostatic bonds with adjacent protein chains. The increases in the positive charge are estimated to resultin repulsion between the two protein groupswith the same charge, thus creating room for immobilization and water addition.

Whereas in the osmotic theory, acid anions form ionized salts with available cationic groups on protein molecules resulting in an uneven distribution of free ions between proteins and surrounding acid solutions. This causesdifferences in osmotic pressure. Water will flow into the protein structure of the meat and eventually cause the occurrence of muscle swelling (Seus and Martin., 1993). T3 is the maximum limit for the concentration of marinade that enters the protein structure of the meat so that after the swelling of the muscle fibers, the water will come out faster and cause higher cooking loss than T1 and T2.

Marination with 50 g of *Garcinia atroviridis* + 750 mL aquadest (T2) was effective to reduce the value of cooking loss in culled meat. According to Obuz *et al.* (2004), a high cooking loss value is related to muscle fibers and collagen tissue shrinkage in meat. Cooking loss may be influenced by pH value, sarjomer length, sample size and weight and heating (Dewayani *et al.*, 2015). The value of cooking loss in this study was still in the normal category and was lower than the study conducted by Pelicano *et al.* (2003) that the cooking loss in chicken carcasses ranged from 28.82% to 29.90%.

Drip loss of culled chicken meat after marination using *Garcinia atroviridis*

Drip loss is the liquid meat that comes out along with meat nutrients that dissolve and lost during the storage process where the meat is usually hung (Patriani *et al.*, 2020). Dripping meat surface liquid (drip). Otto *et al.* (2004) stated that the drip loss had an average percentage of 4.97%. The results showed that (T0) was significantly different ($P < 0.05$) with T1 and T2 but and not significantly different ($P > 0.05$) with T3. The highest drip loss value was (T3), namely 3.79%, followed by control (T0), namely 3.35% and (T2) with a value of 2.91. The lowest value on marination in 50 g of *Garcinia atroviridis* + 500 mL aquadest (T1) was 2.40%. In T3 the drip loss had increased because the acid concentration was more concentrated so that it can dissolve the fat on the surface of the meat that drips altogether with meat water.

The organic acid content in the marinade will dissolve fat, therefore the fat on the surface of meat will drip alongside meat water during hanging process. Nolsoe and Undeland (2009) reported that acids can reduce fat in meat. It is because organic acid solution is strong enough to break the bonding structure of proteins, which will bind fat molecules until the fats are wasted and the fat contentsc decrease. Storage and cooling time in the refrigerator can also affect drip loss. The T3 treatment had the highest drip loss because the concentration of Garcinia atroviridis was higher than the other treatments so that the organic acid content was stronger in breaking the protein

bond structures that bind the fat molecules thus the fat in meat fibers were reduced more than the other treatments.

In the T1, T2, and T3 treatments, it can be seen that the higher concentration of *Garcinia atroviridis* marinade, then the higher drip loss in the culled chicken meat. The drip loss in the study was included in the normal level. In addition to that, the drip loss in this study was lower than the one reported by Wiklund *et al.* (2008) that drip loss of meat in the first week of withering was 4.1%. According to Dufal *et al.* (1999) stated that the average drip loss during postmortem 3-10 d can reach 2.04 - 5.19. Marination in 50 g of *Garcinia atroviridis* + 1000 mL aqua dest (T1) was effective in reducing meat drip loss. Overall, the drip loss values in the treatments were still in a good range.

Water Holding Capacity of culled chicken meat after marination using *Garcinia atroviridis*

Water holding capacity is the ability of meat to retain water content in meat against external influences. WHC is the ability of meat to bind water because the electrolyte of water molecules is not neutral but has positive and negative charges, so that water molecules can bind to protein groups. The results showed that the control (T0) was significantly different ($P < 0.05$) with T1 on WHC. The control (T0) was also significantly different ($P < 0.01$) with T2 and T3. The highest water holding capacityvalue was at T3 and the lowest water holding capacity value was at T0 that is without marination.

Based on the Duncan test that the higher concentration of *Garcinia atroviridis* will increase Water Holding Capacity of culled chicken meat. Level of *Garcinia atroviridis* concentration may increase water holding capacity because the higher level of *Garcinia atroviridis* concentration, that would mean the more organic acids work and ion diffusion occurs in meat protein. Consequently marinades using *Garcinia atroviridis* can increase the ability of the meat to bind free water. In linewith the Lemos *et al.* (1999) study that immersion techniques can increase water content in poultry meat. Water holding capacity has increased gradually, namely at T1 of 42.58%, then there was an increase inT2 that was 50.08% and continued to increase until T3, namely 54.06%. It is because marination using acids, especially *Garcinia atroviridis* in T1, T2 and T3 can increase water holding capacity and acidcontent in the marination method causing the meat to absorb more water. Most of the meat is in the muscles and trapped in the cell structure including the intra-cell space. Therefore, changes in intracellular cells affect the ability of muscle cells to retain water. The higher water holding capacity, then the better meat quality.

Lonergan and Lonergan (2005) stated that the decrease in pH, proteolytic, and oxidation during storage may affect water holding capacity. Most of the water in the muscles is also trapped in the cell structure including the intra and extra myofibrillar spaces that ultimately affect the muscle cells to hold water. In the study the higher concentration of *Garcinia atroviridis* increased the water holding capacity. This means that the marinade concentration treatment using *Garcinia atroviridis* resulted in higher waterholding capacity because a lot of bound water is retained from the meat protein.

The Increase of water holding capacity in marinated meat can be caused by the abilityof muscle types to bind water and differences in protein solubility in each type of muscle. Lawrie (2015) stated that the ability of the meat to bind water is influenced by the protein content in the veins of meat/ tendon, intrinsic differentiation factors in the tendon, and the content of water-soluble sarcoplasm proteins. In this study, the pH values of the treatments from T1 to T3 in the range of 5.74 - 5.77 indicated that the pH values were higher than the isoelectric pH of meat (5.0-5.1). The more pH value approaches an isoelectric point, the value of water holding capacity gets smaller and vice versa, if the

pH value of meat above the isoelectric pH value, then the higher value of water holding capacity (Haq *et al.,* 2015).

The pH value ofthe meat that remains high and slow declines can also lead water holding capacity to increase (Lawrie., 2015). According to this study Marination in 50 g of *Garcinia atroviridis* + 1000 mL aqua dest (T1) was effective in increasing the Water Holding Capacity of culled chicken meat.

The tenderness of the culled chicken meat after marination using *Garcinia atroviridis*

The tenderness of the meat can be tested using a tool or organoleptic test that involves the sense of taste, but in this study, a penetrometer was involved. Meat tenderness can be an indicator to determine meat quality. In addition to that, tender meat is easier to be masticated and digested by the body. The results showed that the control (T0) was significantly different ($P < 0.05$) against T2 and T3 was significantly different ($P<0.01$) from T1 for tenderness. The value of the tenderness of the culled cicken meat in the control was lower that was 37.83 g / 10 ss than T3 treatment that was 30.76 g / 10 ss, T2 was 30.55 g / 10 ss and T1 was 24.63 g / 10 ss.

Garcinia atroviridis marination can increase the value of tenderness compared to control. Apart fromthis, the acid contained in *Garcinia atroviridis* is thought to reduce bacterial growth. According to Burke and Monahan (2003), marinade that contains vitamin C and malic acid can optimally increase meat tenderness. *Garcinia atroviridis* contains *citric acid, malic acid,* and *ascorbic acid* so that it has the potential to become an acid- based marinade. The tenderness values at T2, T3 and T1 were lower than T0. It is due to the fact that the organic acid concentration in *Garcinia atroviridis* at the right concentration was able to break the peptide bonds in the protein fiber of meat.

Aligned with Burke and Monahan (2003) These acids can reduce the peptide bonds in meat fiber protein so that the meat is more tender. The lower breaking power value of the meat, the more tender meat will be and the higher breaking power value, more tough the meat will be. In the study, the lowest value on T1 was marination in 50 g of *Garcinia atroviridis* + 1000 mL aquadest (T1) which was effective in increasing the tenderness of the culled chicken. Burke and Monahan (2003) that marinating meat in lemon juice, orange juice and aquadest can change meat tenderness.

The color of the culled chicken meat after marinating using *Garcinia atroviridis*

The color of the meat can be tested using a color tester tool, a colorimeter. The results of this study can be seen in Table 2. Fresh poultry has a different color than those that are no longer suitable for consumption. Color characteristics used the L*, a* and b* methods to distinguish dark and light colored poultry meat (Boulianne and King, 1998).

Table 2. Color of culled chicken meat after marination using *Garcinia atroviridis*

Parameter	Treatment of *Garcinia atroviridis* Concentration				Average
	T0	T1	T2	T3	
Meat Color					
(L*)	55.33 ± 4.19^{a}	65.55 ± 2.10^{b}	62.44 ± 6.46^{b}	63.98 ± 2.96^{b}	61.82 ± 5.46^{b}
(a*)	13.04 ± 2.57^{a}	3.99 ± 0.47^{b}	4.71 ± 0.41^{b}	5.93 ± 2.38^{b}	6.92 ± 4.06^{b}
(b*)	21.40 ± 2.26	18.42 ± 0.37	17.10 ± 1.42	17.48 ± 1.19	18.60 ± 2.16

Note: The means with different superscripts showed significant differences ($P<0.05$)Lightness (L*); redness (a*); yellowness (b*)

The results of the analysis of variance showed that the T0 treatment was significantly different (P<0.05) with T1, T2 and T3 on brightness. The average brightness (L*) or Light of culled chicken meat in both T1, T2 and T3 treatments had higher brightness when compared to meat samples without treatment or control. The brightness level (L*) of the meat in the marinated meat used *Garcinia atroviridis* was higher than the control. Lawrie (2015) stated that proteindenaturation and physical appearance of meat depend on postmortem temperature and pH that affects the amount of light reflected from the inside to the outside of the meat. This is due to the scattering of light which is directly proportional to the degree of denaturation of proteins.

The scattering of light can affect L (Light) or the brightness ofthe meat. Rimini *et al.,* (2014) specified thatthe brightness of chicken meat that was marinated using orange and thyme essentialoil was between 50.61-50.57. In this study, the value of Light rangedfrom 55.33-63.98. The range fell into the fairly bright category. Chicken meat is considered as white meat and marinating meat using *Garcinia atroviridis* willincrease the brightness of meat color.Marination in 50 g of *Garcinia atroviridis* + 1000 mL aquadest (T1) effectively lightenedthe meat color.

The results of analysis of variety showed that the T0 treatment had a significant effect (P<0.05) to T1, T2 and T3 on the reddish color (a*) of the culled chicken meat on (T0) or the control was higher than other treatments, namely T1, T2 and T3. In chicken, the higher the red color (a*) showed that the meat was less fresh. In this study, the meat of the culled chicken in sample T0 has a redder color than the meat in samples T1, T2 and T3.

This means that marination using *Garcinia atroviridis* can maintain the freshness and quality of meat because the acid in *Garcinia atroviridis* is presumed to contain anti-microbial compounds. Rahayu *et al.,* (2020) stated that the color of the meat at the yellowish level (b *) for marination treatment using kecombrang stem flour was between 4.44-5.59. Whereas the sample in this study had yellowish levels of 5.74-5.77. Marination in 50 g of *Garcinia atroviridis* + 1000 mL aquadest (T1) is effective in maintaining the freshness of the meat. The content of b* color or yellowish color did not show a significant difference (P>0.05) on the color of the meat.

The results of the analysis of variance showed that the treatment of T0 was significant (P<0.05)with T1, T2 and T3 on color b*. The yellowish color of fresh chicken meat ishigher than carcass chicken. Marination canaffects the higher L *, a * and b* colors during storage (Zhang *et al.,* 2016) The color intensity in the treatment was lower than the control, presumably because the effect of the acid contained in *Garcinia atroviridis* greatly affected the color of the meat which was cleaner, brighter, and fresher than the control.

CONCLUSION

According to the results derived from the research and discussion, it can be inferred that the concentration in the *Garcinia atroviridis* marinade has an influence on pH, cooking loss, water holding capacity, drip loss, tenderness and color brightness (L), reddish color of the meat (a*) but does not affect the yellowish color of the meat (b*). The optimal concentration of *Garcinia atroviridis* that can be used as marinade for chicken meat is 50 g of *Garcinia atroviridis* + 750 mL of aquadest.

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