**Application of Cinnamon and Gotu Kola Flour as Feed Supplements to Increase Pectoral Meat Weight and Quail Meat Quality (*Coturnix coturnix* *australica*)**

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**ABSTRACT**

Cholesterol in quail meat is one of the factors causing consumers to limit consumption of quail meat. Conversely, the antioxidant content in quail meat attracts consumers to like quail meat. Quail meat that is good to consume is meat found in the chest (pectoralis meat). This research has been carried out in an effort to get the results of low cholesterol quail meat and rich in antioxidants. Cinnamon skin and gotu kola leaves are herbal plants that contain many polyphenol compounds. Polyphenols that have antioxidant activity are flavonoids. This study has a purpose, which is to look for supplemental formulas made from cinnamon skin and gotu kola leaves as a feed supplement to produce low cholesterol quail meat and rich in antioxidants. The method used in this study was a completely randomized design consisting of 6 treatments with 3 replications. The six treatments included controls (quail given standard feed without supplementation made from cinnamon bark and gotu kola leaves), feed supplemented with 5% cinnamon flour, feed supplemented with 5% pegagan leaf flour, feed supplemented combination of cinnamon and gotu kola flour with a concentration ratio (5%: 5%, 5%: 10% or 10%: 5%). The treatment is carried out ad libitum every day 2 times after the quail mother is removed from the acclimation cage to the treatment cage. Giving volume of feed with flour supplement refers to the pattern of giving ideal ration and body weight gain. Treatment is given for 21 days. The results showed that supplements made from cinnamon bark and Centella asiatica leaf in feed could increase body weight, increase antioxidant levels and reduce cholesterol levels in quail meat. Supplements made from cinnamon flour in a diet with a concentration of 5% or a combination of cinnamon bark leaves and gotu kola leaves with a ratio of 5%: 10% give the best influence on levels of antioxidants and cholesterol in meat. Quail pectoralis meat that is rich in antioxidants and low in cholesterol can provide a solution to meeting the needs of animal protein and improving the quality of public health.

*Keywords: supplement, cinnamon, gotu kola, pectoral meat, quail, antioxidant, cholesterol, organoleptic*

**INTRODUCTION**

Community needs for animal protein from year to year are increasing. Data from Dinas Peternakan dan Kesehatan Hewan (2012) shows that quail meat consumption needs over the past three years have increased significantly, in 2009 amounting to 0.040 kg, 2010 amounting to 0.043 kg, and 2011 amounting to 0.052 kg. This condition is supported by the existence of a very high population of Coturnix coturnix australica or Australica quail in Indonesia. Since 2010 the quail population has increased to 7.053.576 tails, in 2011 there were 7.356.648 tails and in 2012 there were 7.840.880 tails.

Quail is one of the birds that continues to be developed to meet the needs of animal protein and improve the quality of public health. Quail meat is known to be savory and more delicious than race chicken and fries, but quail is famous for its high cholesterol content. The results showed that quail meat had a very high cholesterol content reaching 21% of body weight (Sunarno *et al*., 2018). These problems can adversely affect health caused by excessive consumption of quail. High cholesterol can be caused by high cholesterol in feed and characteristics of cholesterol metabolism. Excess cholesterol levels in quail meat can be reduced by adding supplements to feed containing polyphenol compounds. These compounds are known to be found in various medicinal plants, such as gotu kola (Centella asiatica) and cinnamon (*Cinnamomum sp*).

Gotu Kola which is known by the scientific name *Centella asiatica* also has very important benefits for reducing cholesterol levels in addition to increasing the antioxidant content in the body. Evidence of research has shown that ethanol extract from *C. asiatica* can reduce cholesterol levels in animal models of rats and hypercholesterolemic hamsters reaching 79% and a decrease in triglycerides reaching 95%. Besides being able to reduce cholesterol or triglyceride levels, Centella asiatica also has antioxidant activity (Pitella *et al*., 2009). Pegagan (*C. asiatica*) contains various active compounds, including asiaticoside, asiatic acid, madecassoside, madecassic acid and brahmoside (Annisa, 2006). Januwati and Yusron (2010) state that *C. asiatica* plants are known to have essential oils, such as citronelal, linalool, neral, menthol and linalyl acetate. These compounds function as antioxidants which are very beneficial for the health of the body.

Cinnamon (*Cinnamomum sp*) Is one of the plants that is widely used by traditional and modern people as a cooking spice and as a medicine. The results of the research have proven that cinnamon contains many polyphenol compounds which have antioxidant activities that are beneficial for maintaining human health, such as scavinging free radicals, preventing tissue damage due to metabolic diseases, and decreasing body function or syndromes associated with increasing age (Shah and Panchal , 2010). Polyphenols in the stem part of cinnamon plants consist of 90.1% routine, 1.9% catechins, 0.2% quaretin, 0.02% kaempferol 0.02%, and 0.103% isorhamnetin (Yang *et al*., 2012) . Polyphenols are also known to inhibit cholesterol absorption in the digestive tract by forming complex compounds (Ravindran *et al*., 2014).

Based on the potential and the research evidence shows that cinnamon bark and gotu kola leaves can be used to reduce cholesterol levels and increase antioxidants in quail meat. Research on the use of these two ingredients has not been done much in quail, especially the effect of these two ingredients on cholesterol and antioxidant content in quail meat. Quail meat part of the major pectoralis meat is the most preferred by consumers. Therefore, this study has used both of these ingredients in the form of flour (as a feed supplement) and has been observed to influence cholesterol and antioxidant content in the pectoralis meat. This research has succeeded in getting data about quail meat which has the best quality and quantity.

**METHODS**

**Research Design**

This study used a completely randomized design (CRD) consisting of 6 treatments with 4x replications. Treatment in this study included, P0, namely control (feed without supplementation of cinnamon powder and gotu kola leaves), P1 in the form of feed with supplementation of 5% pegagan skin powder, while P2 was feed with supplementation of 5% cinnamon leaf powder. The next treatment is a combination of cinnamon bark flour with gotu kola leaves, respectively with concentration ratios (5: 5%), (5: 10%), and (10: 5%). Treatment of cinnamon bark supplementation, gotu kola leaf flour, and / or its combination is given for 3 weeks after the acclimation period (for 7 days).

The main variables measured were levels of total antioxidants and cholesterol in quail meat. Supporting variables, namely the weight of quail pectoralis meat followed by quantitative analysis. Other variables measured and will be analyzed descriptively qualitatively, including aroma, texture, and color using organoleptic tests involving trained panelists.

**Collection, Drying of Test Materials and Flour Making**

Parts of cinnamon and gotu kola leaves were collected from the Semarang area. The ingredients are separately cut about 3 cm, washed, drained, and then dried using an oven at a temperature between 40-60ºC for 30-36 hours so that the dry matter is obtained with a moisture content of 10%. Heating can reduce the levels of compounds that have a negative effect and evaporate the water content. Cinnamon bark and dried gotu kola leaves are then squeezed and put into a grinder and ground until the powder is obtained. The powder from both ingredients is ready to be used as quail feed supplements.

**Feed Making with the Impact of Cinnamon Flour and Gotu Kola Leaves**

Quail feed with a supplement supplement from cinnamon bark and gotu kola leaves is made by adding flour from both ingredients (both separately / in combination) into standard quail feed according to the percentage needed (according to formula). Cinnamon flour or Centella asiatica leaf which has been determined weighs mixed with quail feed which has been weighed as needed. The food that has been mixed with the supplement ingredients is then stirred until homogeneous, put into the feed in the quail cage. Supplementary feed is given in ad libitum every morning at 07:00 and at 16:00.

**Preparation of Quail Cages**

A good quail cage has a maximum length of 80 cm and a maximum width of 60 cm. The size of the cage can accommodate 24 quail populations. Circulation of the cage is good for the wall of the cage using strimine wire or material from the bamboo hemisphere. The base of the cage uses material with holes for the purpose of excrement from quail, can immediately descend to the shelters and not come into direct contact with quail.

Feed and drink places are placed together with the cage. Placement outside this cage to avoid wasted feed due to quail activity and reduce feed or dirty drinking because it is mixed with quail droppings. The feed place is made along the length of the cage and placed on the front. This is done so that the feed consumption for quail can be evenly distributed, in addition to making it easier to technically feed. Other goals save in providing lighting during the night, while drinking places can be placed on the side or behind the cage.

**Preparation and Acclimation of Test Animals**

The test animals used in this study were quail which was 7 days old. Before acclimation, a selection of test animals is carried out, namely selecting good seeds with relatively the same weight, disease free, and normal. Cages for quail are sought with adequate lighting and well cared for by cleaning the cages regularly. Acclimation is carried out for 7 days in individual cages before being used in research. During acclimation, the test animals are given ad libitum feed and drink and health care is carried out, such as routine checks, vitamin supplements and vaccinations.

**Feed Treatment with Cinnamon and Pegagan Leaf Supplements**

Feeds with cinnamon skin supplements and gotu kola leaves are given to quail that has been acclimated (for 7 days) for 3 weeks. Feeds are given in ad libitum 2x a day, namely morning at 07.00 and afternoon at 16.00. Every day measurements of room temperature and humidity are carried out during the research.

**Weighing the weight of pectoralis meat**

After the end of the treatment the pectoralis meat was removed. Next is the weighing of quail pectoralis meat using digital scales.

**Determination of Antioxidant Levels of Quail Meat**

A total of 10 mg of quail meat samples were blended diluted with distilled water into a 10 ml measuring flask to the boundary mark. The sample solution was pipetted with a concentration of 40 µl, 50 µl, 60 µl, and 70 µl into a 5 ml measuring flask. Each of them added 100 µl of Folin Ciocalteu, 10% Na2CO3 and the volume was sufficient with distilled water to the boundary mark. Absorbance is measured by a spectrophotometer at a wavelength of 600 nm.

**Determination of Meat Cholesterol Levels**

Cholesterol was measured from quail pectoralis meat (composite of 14 quails / treatment). Determination of carcass cholesterol levels was carried out based on the Lieberman Burchhard method, namely quail meat each treatment weighed ± 0.2 g and mechanically crushed with a blender then added 1 ml of alcohol KOH, stirring until the precipitate occurred. Store in a bath at 39-40 ° C for 1 hour. Add 2 ml of petroleum ether 40-60 ° C, then add 0.25 ml H2O and shake for 1 minute. Standard pipettes and samples of 200 pl each, plus boiling stones, then stored in a bath at 80 ° C for 5 minutes. Store in the oven to dry at a temperature of 105-110 ° C for 30 minutes. Cooled at room temperature. Plus 4 ml of acetic acid anhydrad, sulfuric acid, acetic acid, then shaken and left for 35 minutes. Then read with a spectrophotometer at a wavelength of 630 nm and a gap of 0.5 nm.

**Meat Organoleptic Test**

Organoleptic parameters were tested involving 10 trained panelists. The organoleptic parameters tested included aroma, texture, and color followed by qualitative descriptive analysis. The odor test is carried out by smelling the scent of fresh quail pectoralis meat, and then symbolizing (+) very fishy meat, (++) for fishy meat, (+++) for slightly fishy meat, and (++++) profit from the distinctive aroma of fresh meat or not fishy. The texture test is done by observing and touching the surface of quail pectoralis meat in fresh condition, then symbolizing (+) very rough meat, (++) for coarse meat, (+++) for meat that is rather rubbery, and ( ++++) for chewy meat. Color testing is done by involving panelists to see and assess the color of quail pectoralis meat samples in fresh condition, then give a symbol (+) if it is yellowish white, (++) for pink, (+++) for color red, and (++++) for very red colors (Hajrawati et al., 2016). Data obtained from organoleptic tests were then analyzed qualitatively.

**Data Collection and Analysis**

The data obtained were tested for distribution patterns and homogeneity. Data on pectoralis meat weight, antioxidant levels and total cholesterol from the results of the study were analyzed using One Way Analysis of Variant (ANOVA) with a significance of 5%. If the results of the variance analysis show a significant effect, it is tested further by using the Duncan’s Multi Range Test (DMRT) test at a significance of 5%. Data were analyzed using SPSS 16. Organoleptic parameters were analyzed qualitatively descriptive. From this test it was known the effect of cinnamon and gotu kola powder on total antioxidant levels and cholesterol and the quality of quail pectoralis meat from organoleptic tests and found the best formula from cinnamon supplements, gotu kola, and / or a combination thereof.

**RESULTS AND DISCUSSION**

Analysis of the average pectoral meat weight, total antioxidant levels, and total cholesterol in quail of Australian strains after treatment can be seen in Table 1. The results of further analysis of the weight of pectoralis meat in quail after treatment with analysis of variance (ANOVA) at 5% significance showed significantly different results (P <0.05). Further analysis with the Duncan test at a significance of 5% showed no significant difference in pectoral meat weight between P3, P4 and controls, whereas there was a significant difference in pectoralis meat weight between P1, P2, and P5 with controls. Other data shows that the pectoral meat weight between P1 is not significantly different from P2 and P5, while P2 is different from P5. Sequentially the weight gain of pectoralis meat at P1, P2, and P5 is 66.48; 70.43; and 63.35 g. Pectoralis meat weight in P2 is a supplement made from 5% highest gotu kola flour, higher than other treatments and controls.

Table 1 The average value of variable weights, antioxidant levels and total cholesterol in pectoral meat of quail after treatment for 21 days

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Supplements of cinnamon and gotu kola in feed (%) | | | | | |
| P0 | P1 | P2 | P3 | P4 | P5 |
| Pectoralis meat weight (g) | 58.95a±5,30 | 66.48cd±5,90 | 70.43d±6,80 | 62.70ab±6,10 | 60.63ab±5,82 | 63.35bc±6,12 |
| Total antioxidant (%) | 38,08a±3,70 | 49,19b±4,70 | 40,61a±4,05 | 49,90b±4,85 | 38,49a±3,82 | 41,11a±4,10 |
| Total cholesterol  (%) | 4,12b±0,41 | 6,12c±0,58 | 2,49a±0,23 | 2,00a±0,18 | 4,20b±0,39 | 2,24a±0,22 |

Keterangan: Angka yang diikuti *superscript* yang berbedapada baris yang samamenunjukkanberbeda nyata (P<0.05). P0, P1,

P2, P3, P4, and P5 secara berurutan adalah kontrol (0%), suplemen tepung kulit kayu manis kadar 5%, suplemen

tepung daun pegagan kadar 5%, suplemen berbahan kombinasi tepung kulit kayu manis dengan daun pegagan

(5:5)%, (5:10)%, dan (10:5)%.

Figure 1. Quail pectoral meat weights after treatment for 21 days

Pectoral quail meat weights at P1, P2, and P5 were significant, significantly different from controls and other treatments due to the effect of polyphenol compounds (flavonoids) contained in supplements used as feed additives (Figure 1). Flavonoids are thought to have an important role in metabolic processes that are oriented towards increasing the weight of quail pectoralis meat. In addition to flavonoids, the composition of the active ingredients from cinnamon bark flour, gotu kola leaf and or cinnamon powder flour combination with gotu kola leaves plays a role in determining the orientation of the metabolic process. The active ingredients of the two ingredients are thought to work in synergy in increasing metabolic activity which leads to increased weight of pectoral meat in quail.

Ravindran *et al*. (2014) states, various active components in cinnamon, especially polyphenol compounds have an important role in the process of protein biosynthesis which causes an increase in biomass in body tissues. Proteins are building blocks in the body, in sufficient quantities protein has an important role in the addition of extracellular and intracellular matrices. Both enzymatic or non-enzymatic proteins are involved in metabolic processes that regulate and catalyze processes that produce energy products. The energy produced from the metabolic process is then used to increase the weight of body tissues, such as pectoralis meat. Sunarno (2018) states, gotu kola leaves containing polyphenols can trigger the production of neurotransmitters, such as dopamine, norepinephrine, epinephrine and serotonin in the body of animals. These various compounds have the effect of increasing the process of catabolism in the body. Increased catabolism will be followed by an increase in energy which is directly correlated with increased cell volume (hypertrophy), increased tissue biomass, and quail body weight gain. Sunarno and Djaelani (2018) state that the increase in pectoral meat weight is related to increased haematological status, including hemoglobin levels, hematocrit values, and the number of erythrocytes. Increasing these parameters is an important indicator of increasing oxygen levels in the blood. Oxygen will be transported into the tissues, helping to oxidize organic matter for energy production. Besides carrying oxygen, blood also carries nutrients that will be processed in cells. Nutrition and oxygen will be processed to support the availability of energy which has an important role in supporting the increase in the weight of quail pectoralis meat.

Quail pectoralis meat weight has a relationship with total antioxidant levels and total cholesterol levels. Supplements of cinnamon bark and *Centella asiatica* leaves that are used as feed additives have an important role to play in increasing antioxidants and decreasing quail pectoral meat cholesterol. Figure 2 shows that the treatment given has a variable effect on the antioxidant levels of quail egg yolks. Data Table 1 shows, antioxidant levels in treatments P1 and P3 were higher and significantly different compared to controls and other treatments. This means that the supplement made from cinnamon bark with a concentration of 5% and a combination of cinnamon leaves with gotu kola leaves with a concentration ratio (5: 5)% can increase total antioxidant levels. The total antioxidant levels in treatments P1 and P3 were 49.19% and 49.90%, respectively. The next data showed that P2, P4, and P5, had total antioxidant levels of 40.61% respectively; 38.49%; and 41.11%. The levels of the three treatments were significantly different from the two previous treatments (P1 and P3) and not significantly different from controls. Based on these data it should be suspected that the high levels of antioxidants are closely related to cinnamon skin supplements, especially those with 5% content and gotu kola leaf flour with a concentration of 5%. The combination of percentages of these two ingredients allows the availability of active ingredients such as flavonoids (polyphenols) in conditions that are ideal and optimal for metabolism in the body. Single supplements only from cinnamon with 5% levels and combination supplements (kayumanis-gotu kola) with a ratio (5: 5%) has an active ingredient composition that is more effective in increasing antioxidant levels of quail pectoralis meat than a single supplement of gotu kola or other combinations. Increased levels of antioxidants in quail pectoralis meat are possible related to the synthesis of endogenous antioxidants in the quail body triggered by exogenous antioxidants. The active ingredients, especially polyphenol compounds, have the potential to trigger the synthesis of endogenous antioxidants which ultimately leads to an increase in antioxidant levels in quail pectoralis meat (Sunarno and Djaelani, 2018).

Polyphenol compounds in cinnamon have a role in increasing the synthesis of endogenous antioxidant enzymes such as superoxide dismutase (SOD), catalase and glutathione peroxidase in preventing, inhibiting, breaking and stopping the chain of free radical reactions (Prasetyawati, 2014). Annisa (2016) states, Centella asiatica contains various active compounds, including asiaticoside, asiatic acid, madecassoside, madecassic acid and brahmoside. Januwati and Yusron (2015) stated that *C. asiatica* plants are known to have essential oils, such as citronelal, linalool, neral, menthol and linalyl acetate. These compounds function as antioxidants which are very useful for improving the performance of the body's system, including the muscularis system. Polyphenols are involved in increasing the synthesis of proteins that play a role in maintaining and increasing metabolic processes. The combination of the action of the active ingredients of these two supplements has an effective influence on increasing antioxidant levels in quail pectoral meat.

Antioxidant levels in pectoralis meat are closely related to total cholesterol levels in the same section. The results of the study as shown in Figures 2 and 3 show that the antioxidant levels in pectoral meat are inversely proportional to cholesterol levels. Pectoralis meat with high antioxidant levels will have low cholesterol leve.

Figure 2. Total antioxidant levels of quail pectoralis meat after treatment for 21 days

The results of research on pectoral meat cholesterol levels as shown in Figure 3 show that cholesterol levels in treatments P2, P3, and P5 were lower and significantly different from treatments P1, P4 and controls (P0). Consequently the quail pectoralis meat cholesterol levels in P2, P3, and P5 were 2.49; 2.00; and 2.24%. Other data shows that quail pectoralis meat cholesterol level on P1 is higher than other treatments, which is 6.12%, significantly different from controls and P1.

The results of this study indicate that the supplement of cinnamon flour and gotu kola added to feed has an effect on the reduction of cholesterol in quail pectoral meat. Low cholesterol levels in quail pectoralis meat due to the role of polyphenol active ingredients contained in manisa or gotu kola wood flour. This evidence shows that low cholesterol is related to cholesterol metabolism and the substrate for cholesterol synthesis. Slow cholesterol metabolism can be caused by low substrate availability. The low substrate is caused by the inhibition of absorption of raw materials for cholesterol synthesis in the digestive tract. This is in line with the results of research by Pitella et al. (2009) stated that the active ingredient of *Centella asiatica* polyphenols has an important role in reducing cholesterol levels in addition to increasing antioxidant levels in the body, as well as antioxidant levels in quail pectoral meat. Furthermore it was stated that the active ingredient of polyphenols in gotu kola can reduce cholesterol levels in animal models of rats and hypercholesterolemic hamsters reached 79% and the decrease in triglycerides reached 95%. Besides being able to reduce cholesterol or triglyceride levels, *Centella asiatica* can also increase antioxidant levels in the body (Sunarno *et al*., 2018).

Figure 3. Total cholesterol content of quail pectoralis meat after treatment for 21 days

The research results of Ravindran *et al* (2014) also stated that the active ingredient of polyphenols is known to inhibit cholesterol absorption in the digestive tract by forming complex compounds. Cinnamon plants have been known to contain high levels of polyphenol compounds. Cinnamon bark contains polyphenols, namely oleoresin with levels of 8.48%, routine (90.1%), catechins (1.9%), quarsetin (0.2%), kaempferol (0.02%), and isorhamnetin (0.103%). In this condition, polyphenols play a role in regulating fat / cholesterol absorption by intestinal cells and have an important effect on fat regulation in the muscularis system. Khan *et al*. (2013) prove that the administration of cinnamon bark extract with doses of 1, 3 and 6 g per day can cause a decrease in fat / cholesterol levels of pectoralis meat in quail. Other studies have shown that cinnamon bark can inhibit the formation of advanced glycation end products (AGEs) (Peng *et al*., 2018). The results of several of these studies corroborate the results of research that has been carried out that in cinnamon and pegagan leaves contains many active ingredients of polyphenols which can inhibit the absorption of fat and cholesterol in the digestive tract which ultimately affects the low cholesterol level in quail pectoral meat.D

Quality quail meat has a correlation with good organoleptic indicators, such as indicators of aroma, taste, texture, and color. The organoleptic test results on pectoral meat meat involving 10 selected panelists are presented in Table 2.

Table 2 The average value of organoleptic variables including aroma, texture, and color of pectoralis meat after treatment for 21 days

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Organoleptic parameters | Supplements of cinnamon and gotu kola in feed (%) | | | | | |
| P0 | P1 | P2 | P3 | P4 | P5 |
| Aroma | ++++ | ++++ | ++++ | ++++ | ++++ | ++++ |
| Texture | ++++ | ++++ | ++++ | ++++ | ++++ | ++++ |
| Colour | ++ | ++++ | +++ | +++ | ++++ | +++ |

Keterangan: Smeel; 1) very fishy, 2) fishy, 3) a little fishy, 4) no fishy (a distinctive aroma of fresh meat)

Texture; 1) very rough, 2) rough, 3) rather chewy, 4) chewy

Colour; 1) yellowish white, 2) pink, 3) red, 4) very red

The data in Table 2 shows that organoleptic parameters which include aroma and texture have no significant difference between the five treatments with control. The aroma parameters for all five treatments were not fishy (a distinctive aroma of fresh meat), as well as the taste parameters which were all savory and had a thick texture of pectoralis meat. The results of this study indicate that cinnamon and / or gotu kola starch supplements or their combination in general do not affect the three organoleptic parameters, namely aroma, texture, and taste. According to Bintoro (2018), normal meat has a distinctive aroma which is not fishy. Northcutt (2009) states, feed does not affect the aroma of poultry meat. Furthermore, it was stated that the aroma of meat, especially in poultry, was not affected by poultry orders or nations, environmental conditions, temperature, cooling, packaging or storage. Among these chemical compounds, which give a distinctive aroma to quail pectoralis meat are fats found in meat. Fresh meat has a distinctive aroma (not fishy) as a result of interactions between carbohydrates and amino acids, fat and thermal oxidation and thiamine degradation (Soeparno, 2009).

The organoleptic texture parameters showed no significant difference between treatment and control. This means that cinnamon, gotu kola and / or a combination thereof have the same effect on the texture of pectoral meat in quail. Hajrawati *et al* (2016) stated that the texture of meat is influenced by feed besides being influenced also by age, activity, and gender. This is indicated by the condition of meat that is almost the same in each treatment, which is chewy. Chest meat or quail pectoralis meat in each treatment has normal meat characteristics which have long, smooth fleshy fibers, between fibers that have no yellowish-white fat deposits, are slippery and fatty (Marlina *et al*., 2012). The thick texture of meat has a close relationship with the binding of muscle fibers (fascia), which is wrapped in rough and soft perimisium. Texture size is determined by the amount of muscle fibers, size and number of perimisium wrapping (Fitri *et al*., 2016). The results of the study by Soeparno (2009) show that there are three factors that have a strong influence on the elasticity of the flesh, namely the presence of connective tissue, muscle fibers, and adipose tissue.

Histologically the connective tissue consists of three types, namely the epimisium, which is the outermost layer of meat and is linked to the bone with the help of tendons. The second connective tissue is perimysium, which is a connective tissue that branches in the muscle. The third connective tissue is endomisium, the connective tissue that wraps muscle fibers (Abustam, 2012). Several reports on research results show that intramuscular connective tissue has an important role in aspects of meat quality and elasticity. In the connective tissue there are proteins called collagen and elastin and several other components that make up the meat. One of the musty that is used as an indicator in evaluating good quality meat is its elasticity. According to Abustam (2012), that elasticity is a major component in the assessment of meat texture. Meat elasticity correlates with the composition of the meat itself, including the amount of fat cells contained between meat fibers and collagen (Tambunan, 2009). Collagen is a glycoprotein which is the main component of intramuscular connective tissue which can contribute relatively high to the elasticity of meat and the amount increases with increasing age of livestock (Soeparno, 2011). Collagen is often found in perimisium and endomisium connective tissue (Mobini, 2013). Endomisium is a connective tissue that wraps muscle fibers (miofibril protein) which is estimated to amount to about 55% of total muscle protein. Increasing the thickness of the endomisium and perimisium layer will increase the elasticity of the meat (Voutile, 2009). Dark colored muscles contain more perimisical collagen and reticular layers than light colored muscles (Mobini, 2013). It was further stated that perimysium connective tissue was less developed in light-colored muscles. Therefore light-colored meat has a higher tenderness than dark-colored meat in broilers (Mobini, 2013).

Different data are shown in organoleptic color parameters. As shown in Table 2, the color of quail pectoralis meat in treatments P1, P2, P3, P4, and P5 was significantly different from the control, which was very red in color. The next data shows that the color parameters of pectoralis meat on P1 and P4 are very red and significantly different from P2, P3, and P5. Pectoralis meat on P2 is red and not significantly different from the pectoral flesh on P3 and P5. This means that the supplements of cinnamon flour and / or gotu kola or a combination of these affect the color of quail pectoralis meat. The red color in meat is thought to be influenced by the active ingredients contained in cinnamon flour and gotu kola leaves plays an important role in the process of forming myoglobin pigments in meat. Mas'adah *et al.* (2019) states that the very red color of meat is an indication that the meat has very good quality. Further stated, the red color in meat is closely related to the myoglobin pigment. The higher the concentration of myoglobin in the meat, the higher the color intensity of the meat or the flesh will have a very red color. Meat pigments consist of two proteins, namely hemoglobin (blood pigment) and myoglobin (muscle pigment). Determination of the color of meat is the meat pigment of myoglobin, its concentration is influenced by several factors, such as the type of livestock, nation's gender, age, muscle type, level of muscle activity, feed, pH and oxygen. The difference in myoglobin content causes the meat to have a color difference. The difference in myoglobin is caused by the type of fiber in the muscle (Abustam, 2012). Hajrawati *et al* (2016) states, the color of poultry meat is influenced by several factors such as age, sex, nation, cage environment, cutting environment, conditions before cutting, cutting and storage conditions, intramuscular fat, meat water content and feed given. Qiao *et al* (2011) stated that the color of meat is influenced by the water content and pH of the meat. The results of this study prove that the color of quail pectoralis flesh is very closely related to feed or supplements added to the feed.

Based on the results of organoleptic tests which include aroma, texture, taste, and color it can be concluded that the quality of pectoralis meat in quail is influenced by various factors, namely intrinsic and extrinsic. Intrinsic factors include the origin of the quail order or nation, gender and age. The dominant extrinsic factor is feed and various additional ingredients such as cinnamon supplements, gotu kola or a combination as in this study. Feed ingredients with good nutritional quality will produce good quality meat, otherwise the quality of poor nutrition will not produce quality meat.

**CONCLUSIONS**

Supplements of cinnamon bark and Centella asiatica leaves in feed can increase the weight and content of antioxidants, reduce cholesterol and the quality of pectoral meat in quail. Cinnamon flour supplement in feed with a concentration of 5% or a combination of cinnamon bark leaves and gotu kola leaves with a ratio of 5%: 10% giving the best influence on the quality of pectoralis meat. This formula can then be applied as a supplement in feed as an effort to develop quail cultivation to produce quality quail meat. Quality quail meat will contribute to improving public health and the welfare of farmers.

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