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Cinnamon and Gotu Kola Supplementation to Produce High Antioxidant and Low Cholesterol of Quail Pectoral Meat

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Abstract

Cholesterol in quail meat is one of the factors causing consumers to control consumption of quail meat. On the other hand, the antioxidant content in quail meat could attracts the consumers. Cinnamon (*Cinnamomum* sp.) bark and gotu kola (*Centella asiatica*) leaves are medicinal plants that contain many polyphenol compounds. The objective of this study was to obtain the most optimum formula made from cinnamon and gotu kola as a feed supplement to produce the quail meat which has low cholesterol but rich in antioxidants. This study used a completely randomized design which consisting of six groups with three replications. The six groups included one control (P0), 5 treatments consisted of 5% cinnamon (P1), 5% gotu kola (P2), combination of cinnamon and gotu kola powder with ratio 5%:5% (P3), 5%:10% (P4) and 10%:5% (P5). The results showed that food supplements made from cinnamon bark and gotu kola leaves could increase the body weight, antioxidant levels, and reduce cholesterol levels in quail meat. Cinnamon as feed supplement with a concentration of 5% or a combination of cinnamon and gotu kola with a ratio of 5%: 10% provided the best effect on antioxidants and cholesterol level in meat. The use of cinnamon and gotu kola supplementation to produce high antioxidant and low cholesterol of quail met have not studied yet. The result of the study would be beneficial for developing the healthy, safe and good quality of quail meat.

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INTRODUCTION

The needs for animal protein are increasing from year to year. Data from Falasifah et al., (2018) shows that the need of quail meat consumption over the past three years have increased significantly, from 0.040 kg in 2009, 0.043 kg in 2010, to 0.052 kg in 2011. This condition is supported by the high population of *Coturnix coturnix* quail of Australia strain in Indonesia. Since 2010, the quail population has increased to 7,053,576 individual. In 2011 and 2012, there were 7,356,648 and 7,840,880 individuals respectively (Sunarno, 2018).

Quail is one of the birds that increasing intensely to bred in order to fulfill 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. Quail meat had a very high cholesterol content reaching 21% of body weight (Sunarno, 2018). High cholesterol content can adversely affect health caused by excessive consumption of quail. High cholesterol in blood can be caused by high cholesterol food and characteristics of cholesterol metabolism. Malini et al. (2017) suggested that 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 and cinnamon. High versatility of medicinal plants could also indicate a higher diversity of active compounds contained by the species.

Gotu kola which is known by the scientific name *C. asiatica* also has very important benefits for reducing cholesterol levels in addition to increasing the antioxidant content in the body. Antioxidants are compounds that can prevent the oxidation of other compounds which occurs either in the body or interaction of other compounds which are easily oxidized (Fitmawati et al., 2017). The previous research show that ethanol extract from Gotu kola can reduce cholesterol levels in animal models of rats and hypercholesterolemic hamsters up to 79% and a decrease in triglycerides up to 95%. Besides being able to reduce cholesterol or triglyceride levels, Gotu kola also has antioxidant activity (Pitella et al., 2009). Gotu kola contains various active compounds, including asiaticoside, asiatic acid, madecassoside, madecassic acid and brahmoside (Roy et al., 2013). Sunarno (2018) 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 is one of the plants that is widely used by traditional and modern people as a cooking spice and as a medicine. The previous study had proven that cinnamon contains many polyphenol compounds which have antioxidant activities that are beneficial for human health, such as scavenging free radicals, preventing tissue damage due to metabolic diseases, and decreasing body function or syndromes associated with aging (Shah & Panchal, 2010). Yang et al. (2012) stated that 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. Polyphenols are clases of compounds group from natural materials that possess the potency as antioxidants (Fitmawati et al., 2017). Polyphenols are also known to inhibit cholesterol absorption in the digestive tract by forming complex compounds (Falasifah et al., 2018).

Based on the previous study, cinnamon bark and gotu kola leaves can be used to reduce cholesterol levels and increase antioxidants in quail meat (Sunarno, 2018) However, the administration of these two ingredients on quail has not been studied yet, especially the effect of these two ingredients on cholesterol and antioxidant content in quail meat. The pectoralis mayor is the most preferred quail meat part by consumers. Therefore, this study has used both ingredients in the form of powder (as a feed supplement) and their effect on cholesterol and antioxidant content in the pectoral meat was observed.

The purpose of this study was to analyze the effect of feed supplements made from cinnamon and gotu kola in reducing cholesterol levels and increase antioxidant levels in quail pectoral meat in the Australian strain. The information about alternative feed supplement in producing high antioxidant and low cholesterol of quail meat is important for developing food safety, especially sources of animal protein.

METHODS

Research Design

This study used a completely randomized design consisting of 6 treatments with 4 replications. The treatment groups of this study included P0 (control, feed without supplementation of cinnamon and gotu kola), P1 (feed with supplementation of 5% gotu kola leaves powder), while P2 (feed with supplementation of 5% cinnamon

leaf powder). The next treatment was (P3) a combination of cinnamon bark flour with gotu kola leaves, respectively with concentration ratios of 5: 5% (P3), 5: 10% (P4), and 10: 5% (P5). Treatment of cinnamon bark supplementation, gotu kola, leaf flour, and their combination was given for three weeks after the acclimation period (for seven days).

The Collection, Drying of Test Materials and Powder Making

Parts of cinnamon and gotu kola leaves were collected from the Semarang area. The ingredients were 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 was 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 were then squeezed and put into a grinder and ground until the powder was obtained. The powder from both ingredients was ready to be used as quail feed supplements.

Feed Making with the Addition of Cinnamon and Gotu Kola

Quail feed with a supplement from cinnamon and gotu kola was made by adding powder from both ingredients (separately/in combination) into standard quail feed according to the percentage needed (according to formula). Cinnamon and gotu kola powder which their weight had been determined were mixed with quail feed which had been weighed. Those mixed food was then stirred until homogeneous, and was put into the feed in the quail cage. Supplementary feed was given in *ad libitum* every morning at 07:00 and at 16:00.

Feed Treatment with Cinnamon and Gotu Kola Supplements

Feeds are given in *ad libitum* two times a day, i.e., at 07:00 a.m. and afternoon at 4:00 p.m. Room temperature and humidity measurement were carried out every day during treatment**.** At the end of the treatment, the pectoral meat was removed and weighed using digital scales.

Determination of Antioxidant/Cholesterol Levels of Quail Meat and Meat Organoleptic test

A total of 10 mg of quail meat samples were blended and 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. Then, 100 µl of Folin Ciocalteu and 10% Na_2CO_3 were added to each flask with distilled water. Absorbance was measured by a spectrophotometer at a wavelength of 600 nm.

Cholesterol was measured from quail pectoral meat (consisted of 14 quails/treatment). Determination of carcass cholesterol levels was carried out based on the Lieberman Burchhard method. Quail meat in each treatment was weighed ± 0.2 g and mechanically crushed with a blender then 1 ml of alcohol KOH was added and the solution was stirred until the precipitation occurred and stored in a waterbath at 39-40 ° C for 1 hour. Petroleum ether 40-60 ° C was added followed by 0.25 ml H2O and shook for 1 minute. Both standard solution and samples boiled in waterbath at 80°C for 5 minutes and then stored in the oven to dry at a temperature of 105-110 ° C for 30 minutes. Standard solution and samples then cooled at room temperature. After that, 4 ml of acetic acid anhydride, sulfuric acid, acetic acid were addedthen shaken and left for 35 minutes. The absorbant was read with a spectrophotometer at a wavelength of 630 nm.

Organoleptic parameters were tested involving ten trained panelists. The organoleptic parameters tested included odor, texture, and color followed by qualitative descriptive analysis (Hajrawati et al., 2016).

Data Analysis

The data obtained were tested for distribution its patterns and homogeneity. Data on pectoral meat weight, antioxidant levels and total cholesterol from the results of the study were analyzed using One Way Analysis of Variant with significance level of 5%, and followed by Duncan's Multi-Range Test test at significance levels of 5%. Data were then analyzed using SPSS 16. Data obtained from organoleptic parameters test were analyzed descriptively.

RESULTS AND DISCUSSION

According to the results of ANOVA test, the weight of quail pectoral meat among all groups are significantly different ($P<0.05$). Further analysis with the Duncan test shows no significant difference in pectoral meat weight between P3, P4, and controls, whereas there is a significant difference 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 pectoral meat of P1, P2,

and P5 is 66.48; 70.43; and 63.35 g. The weight of pectoral meat in P2, which is a supplement made from 5% gotu kola flour, is higher than other treatments and controls.

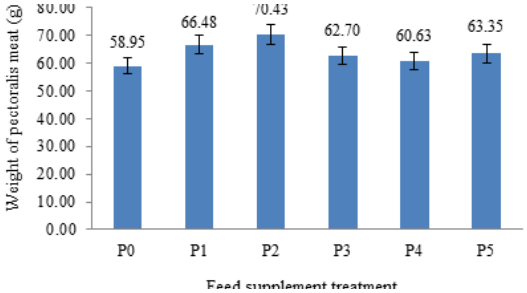

Figure 1. Quail pectoral meat weights after treatment for 21 days

The weight of quail pectoral meat weights of P1, P2, and P5 were significantly different compared to controls and other treatments due to the effect of polyphenol compounds (flavonoids) as additives (Figure 1). Flavonoids have an important role in metabolic processes that could increase the weight of quail pectoral meat. In addition to flavonoids, the composition of the active ingredients from cinnamon and gotu kola powder as well as the combination of both materials plays a role in determining the orientation of the metabolic process. The active compounds of both ingredients seems could work in synergy in increasing metabolic activity which leads to the increased weight of pectoral meat in quail.

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 (Falasifah et al., 2018) Sunarno (2018) stated that gotu kola leaves which contain polyphenols can trigger the production of neurotransmitters, such as dopamine, norepinephrine, epinephrine and serotonin in the body of animals. These various compounds increase the process of catabolism in the body. Increased catabolism will be followed by an increase in energy which is directly correlated with an increase in hypertrophy and tissue biomass as well as quail body weight gain. Sunarno and Djaelani (2018) suggested that the increase in pectoral meat weight is related to increased haematological status, including hemoglobin levels, hematocrit values, and the number of erythrocytes. Increase in 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 (Sunarno and Djaelani, 2018).

Quail pectoral meat weight has a relationship with total antioxidant levels and total cholesterol levels. Supplements of cinnamon bark and *C. asiatica* leaves that are used as feed additives have an important role to play in increasing antioxidants and decreasing quail pectoral meat cholesterol (Sunarno, 2018). Figure 2 shows that the treatment given has a variable effect on the antioxidant levels of quail egg yolks. Table 1 shows that antioxidant levels in treatments P1 and P3 are 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 bark with gotu kola leaves with a concentration ratio of 5: 5% can increase the total antioxidant levels. The total antioxidant levels in treatments P1 and P3 are 49.19% and 49.90%, respectively. Meanwhile, the total antioxidant levels of P2, P4, and P5 are 40.61%; 38.49%; and 41.11%, respectively. The level of the latter treatments (P2, P4, and P5) are 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 bark supplements, especially those with 5% content and gotu kola leaves with a concentration of 5%. The combination of percentages of these two ingredients allows the availability of active ingredients such as flavonoids in optimum conditions for body metabolism. Increased levels of antioxidants in quail pectoral meat are possibly related to the synthesis of endogenous antioxidants in the quail body triggered by exogenous antioxidants. The active ingredients, especially polyphenol compounds, are potential to trigger the synthesis of endogenous antioxidants which ultimately leads to an increase in antioxidant levels in quail pectoral meat (Sunarno & Djaelani, 2018).

Polyphenol compounds in cinnamon play

a role in increasing the synthesis of endogenous antioxidant enzymes such as superoxide dismutase (SOD), catalase and glutathione peroxidase that play a role in preventing, inhibiting, breaking and stopping the chain of free radical reactions (Qotbi, 2016; Simsek et al., 2013; Mehdipour et al., 2013). Francis and Thomas (2016); Roy et al. (2013) indicated that gotu kola, contains various active compounds, including asiaticoside, asiatic acid, madecassoside, madecassic acid, and brahmoside. Falasifah et al. (2018) stated that gotu kola plants are known to have essential oils, such as citronella, 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 active ingredients' action of both supplements has an effective influence on increasing antioxidant levels in pectoral quail meat (Sunarno, 2018).

Antioxidant levels in pectoral 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. Pectoral meat with high antioxidant levels will have a low cholesterol level.

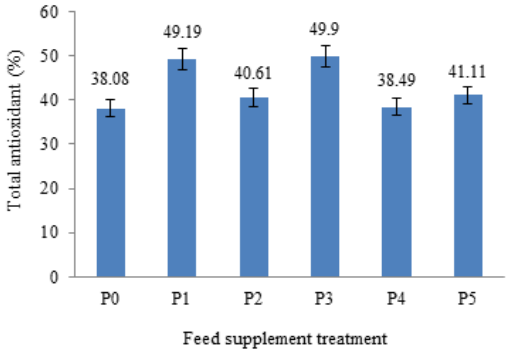

Figure 2. Total antioxidant levels of quail pectoral meat after 21 days of treatment

Figure 3 shows that cholesterol levels in treatments P2, P3, and P5 were lower and significantly different from treatments P1, P4, and controls (P0). The quail pectoral meat cholesterol levels in P2, P3, and P5 were 2.49; 2.00; and 2.24% respectively. Meanwhile, the quail pectoral meat cholesterol level on P1 is higher than other treatments, which is 6.12% and significantly different from controls and P1.

The results of this study indicate that cinnamon and gotu kola affect on the reduction of cholesterol in quail pectoral meat. Low cholesterol levels in quail pectoral meat due to the role of polyphenol active ingredients contained in 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 in the digestive tract (Sunarno, 2018). Pitella et al. (2009) that stated that the active ingredient of *C. asiatica* polyphenols play 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 could reduce cholesterol levels in animal models of rats and hypercholesterolemic hamsters up to 79%, and the decrease in triglycerides reached 95%. Besides being able to reduce cholesterol or triglyceride levels, *C. asiatica* can also increase antioxidant levels in the body (Sunarno, 2018).

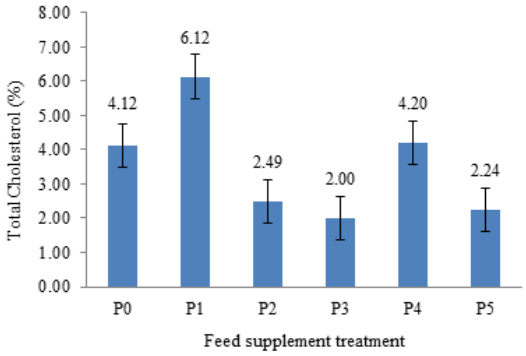

Figure 3. Total cholesterol content of quail pectoral meat after treatment for 21 days

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 oleoresin with levels of 8.48%, routine (90.1%), catechins (1.9%), quercetin (0.2%), kaempferol (0.02%), and isorhamnetin (0.103%) (Sunarno and Djaelani, 2018). 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) proved 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 pectoral meat in quail. Ot-

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

Organoleptic parameters	Supplements treatment					
	P0	P1	P2	P3	P4	P5
Aroma	++++	++++	++++	++++	++++	++++
Texture	++++	++++	++++	++++	++++	++++
Colour	++	++++	+++	+++	++++	+++

Note: Aroma; (+) very fishy, (++) fishy, (+++) a little fishy, (++++) not fishy (a distinctive aroma of fresh meat); Texture; (+) very rough, (++) rough, (+++) rather chewy, (++++) chewy; Colour; (+) yellowish white, (++) pink, (+++) red, (++++) bright red

her studies have shown that cinnamon bark can inhibit the formation of advanced glycation end-products (Peng et al., 2018).

The quality of quail meat correlates with good organoleptic indicators, such as indicators of aroma, texture, and color. The result of organoleptic test on pectoral meat involving ten selected panelists are presented in Table 2.

The data in Table 2 shows that organoleptic parameters which include aroma and texture have no significant difference among the five treatment groups with the control group. The aroma parameters for all five treatments were not fishy, as well as the taste parameters which were all savory and had a thick texture of pectoral meat. The results of this study indicate that supplements consist of cinnamon, gotu kola and their combination, in general, do not affect the three organoleptic parameters (aroma, texture, and taste). According to Bintoro (2018), normal meat has a distinctive aroma which is not fishy. Northcutt (2009) suggested that the feed does not affect the aroma of poultry meat.

Cinnamon, gotu kola and their combination had the same effect on the texture of pectoral meat in quail. Hajrawati et al. (2016) stated that the texture of the meat is influenced by feed besides being also influenced by age, activity, and gender. This is indicated by the condition of meat that is almost the same in each treatment, which is chewy. The normal quail pectoral meat has the characteristics of long, smooth fleshy fibers, between fibers have no yellowish-white fat deposits, shinny 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 perimysium. Texture size is determined by the amount of muscle fibers, size and number of perimysium wrapping (Fitri et al., 2016; Nishimura, 2015). The results of the study by Yin et al. (2011) showed 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.

Different results 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 showed in red color. The next data shows that the color of pectoralis meat on P1 and P4 are bright 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 cinnamon, gotu kola and their combination affect the color of quail pectoral meat. The red color in meat seems to be influenced by the active ingredients contained in cinnamon and gotu kola which play an important role in the process of myoglobin pigments formation in meat (Sunarno and Djaelani, 2018).

Mas'adah et al. (2019) suggested that the very red color of meat is an indicator that the meat has very good quality. Moreover, 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 (red) of the meat or the flesh will have. Meat pigments consist of two proteins, i.e., hemoglobin and myoglobin (muscle pigment) in which the myoglobin plays a role in determination of the color of meat. Its concentration is influenced by several factors, such as the type of livestock, taxon, 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 (Suman & Joseph, 2013; Yin et al., 2011; Genchev et al., 2008). Hajrawati et al. (2016) stated that the color of poultry meat is influenced by several factors such as age, sex, taxon, cage environment, cutting environment, conditions before cutting, cutting and storage conditions, intramuscular fat, meat water content and feed. 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 pectoral flesh

is very closely related to feeding or supplements added to the feed.

This formula could be applied as a feed supplement as an effort to produce better quality of quail meat which in turn it would contribute to improve the public health and the welfare of farmers.

CONCLUSIONS

Cinnamon bark and gotu kola leaves supplementation in feed can increase the weight and content of antioxidants, reduce cholesterol of pectoral meat in quail. Cinnamon bark powder supplement in the feed with a concentration of 5% or a combination of cinnamon bark and gotu kola leaves powder with a ratio of 5%:10% giving the best influence on the quality of quail pectoral meat

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