

Application of Mangosteen Peel Extract (*Garcinia mangostana* L) As Feed Additive in Ration for Performance production and Egg Quality of Sentul Chicken

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Abstract— Sentul chicken is a specific local chicken from the Ciamis region in West Java and a dual-purpose type that can be utilized for eggs and meat production. The use of antibiotics continuously for maintenance to prevent and treat disease in Sentul chicken can lead residues in meat and eggs. To wean farmers for the antibiotic, it is necessary to find a natural antibiotic derived from herbal plants that Mangosteen Peel Extract (MPE). Mangosteen Peel Extract (MPE) is containing xanthone compounds like antioxidants and antimicrobials. This research was held to find out the effect of mangosteen peel extract on feed consumption, hen day production, feed conversion, and egg quality. This research used 40 female chickens aged seven months, which was kept in cages until three months, and each cage contains 2 chickens. The method used was a completely randomized design with four treatments namely P0 (ration without MPE), P1 (ration with 67 ml/kg MPE addition), P2 (addition of 100 ml/kg MPE) and P3 (addition of 133 ml/kg MPE) with five replications. Furthermore, treatment differences were tested using Duncan Multiple Range Test. The measured variables were feed consumption, egg weight, hen day production, feed conversion, thick of shell, egg yolk color, and egg cholesterol. The results showed the addition of MPE 133 ml/kg ration had a significant effect on egg production, egg weight, feed conversion, the thickness of eggshell, the color of egg yolk, and egg cholesterol but not significant to feed consumption, yolk index score and Haugh unit. It can be concluded that MPE can be used as a feed additive until 133 ml/kg ration to gave the best on production and egg quality of Sentul chicken.

Keywords— mangosteen peel extract; feed additive; xanthone; egg quality.

I. INTRODUCTION

Sentul chicken, as in Figure 1, is a local chicken from Ciamis region in West Java, which is a dual-purpose type, can utilize for eggs and meat production. They can adapt to the environment, and it remains productive even though their diets are low in quality. They produce 120-140 eggs per year [1]. Efforts can be made so that chickens can produce optimally and produce quality eggs.



Fig. 1 The Sentul

The egg quality can be produced by optimizing and improving the function of the digestive tract in absorbing nutrients by using feed additives. But the use of additive feeds such as antibiotics continuously can cause residues in livestock products. Because it is necessary to look for substitute materials that can function as an additional feed to improve egg performance and quality and be safe for consumers. One alternative method is the use of herbs, one of which is the mangosteen peel, as in Figure 2.



Fig. 2 Mangosteen Fruit

II. MATERIALS AND METHOD

The mangosteen peel is the largest component of the mangosteen fruit. Mangosteen fruit is divided into several parts consisting of 17% outer skin, 48% inner skin, 31% fruit flesh, and 4% fruit stalks [2]. The nutrient content contained in mangosteen peel is 62.05% water, 1.01% ash, 0.63% fat, 0.71% protein, 1.17% total sugar, and 35.61% carbohydrate [3]. Mangosteen peel contains xanthone compounds that function as antioxidants. The antioxidant content of xanthones is higher than carrots and oranges. Mangosteen peel contains xanthones of 107.76 mg per 100 g [4]. Besides, mangosteen peel functions as an antitumoral, anti-inflammatory, antiallergic, antibacterial, antifungal, and antiviral agent [5]. Xanthone compounds as antioxidants can be used to prevent free radicals. Free radicals are compounds that contain one or more unpaired electrons, so they are very reactive [6]. These free radicals can cause metabolite disorders and cause stress to livestock. The emergence of stress in poultry can be a trigger for the emergence of various diseases. This will affect the disruption of the consumption process and result in a decrease in egg production and quality performance.

Moreover, xanthone compounds function as antibacterial can improve intestinal villi and kill pathogenic bacteria so that the process of absorption of nutrients goes well. Mangosteen skin also contains anthocyanin, a color pigment that can dissolve in water. The colors that can be produced by anthocyanins start from red, blue, to purple, including yellow. Besides, it can also be used as an antioxidant. Besides that, the mangosteen peel also contains minerals, including Magnesium 3.3%, Copper 0.7%, Manganese 1.3%, Calcium 1.1 mg, Phosphorus 1.7 mg, and Iron 0.09 mg [3]. The presence of mineral and anthocyanin as a color pigment in the mangosteen skin, it is expected to increase the color of the egg yolk Sentul chicken.

The provision of mangosteen peel in the ration must be considered because it contains antinutrient substances in the form of tannins. Tanin can cause palatability to decrease because it has a feeling of tightness. Tanin, besides binding to proteins and amino acid acids, it is also related to other macromolecular compounds such as carbohydrates, mainly starch and cellulose, minerals Ca, P, Fe, and Mg, and vitamin B12 [7]. Excessive consumption of tannins will cause the absorption of nutrients to be reduced, which results in decreased production performance. The limit for using tannins in rations is 2.6 g/kg [8]. One way to reduce tannin content is by extraction. Extraction is the process of separating materials from the mixture using the appropriate solvent.

Based on the results of calculations, the administration of 1.5% mangosteen peel meal (15 grams/kg ration) can increase the weight of quail eggs [9], and it is known that mangosteen peel contains xanthones of 3,766 mg/gram [10], then the xanthones found in the ration are 56.49 mg/kg. Assuming xanthone content in mangosteen peel extract is 56.50 ml/100 ml [11], 100 ml /kg ration is needed for Mangosteen Peel Extract. Based on the description, the test is to conduct research on "The Response to the Addition of Extracts Mangosteen Peel (*Garcinia Mangostana L.*) in Rations on Production Performance and Egg Quality of Sentul Chicken."

Livestock study used 40 female chickens aged seven months, which was kept in cages until 12 weeks, and each cage contains two chickens, and each group is repeated five times. The average body weight 1244.1 grams, with the coefficient of variation in body weight 7.03 %. The cage is used as many as 40 cages, measuring 110 cm long, 42 cm wide, and 35 cm high, for 1 Chicken. The basal diet for the Sentul layer phase contained 15.0% CP and 2,750 kcal/kg of ME, [12] recommendations (Table 1). The experiment was performed with 4 dietary treatments use of Mangosteen Peel Extract (MPE), ie: (1) P0 = 0 ml MPE/kg feed, (2) P1 = 67 ml MPE/kg feed, (3) P2 = 100 ml MPE/kg feed and (4) P3 = 133 ml MPE/kg feed.

TABLE I
NUTRIENT COMPOSITION OF BASAL DIET

Ingredients	%
Yellow corn	51.85
Rice bran	18.52
fish meal	6.48
soybean meal	13.89
bone meal	5.56
Ca CO ₃	3.70
Chemical composition (Calculated)	
Crude Protein (%)	15.63
Crude Fat (%)	5.14
Crude Fiber (%)	4.16
Calcium (%)	3.28
Phosphorus (%)	1.39
Lysine (%)	1.06
Methionine (%)	0.35
Metabolizable Energy (kcal/kg)	2757

Experimental design. Completely Randomized Design (CRD) was used with four treatments, and each treatment was replicated five times. Furthermore, treatment differences were tested using Duncan Multiple Range Test. The analysis of egg yolk color was carried out using a nonparametric test, namely the Kruskal-Wallis test, if there were differences between treatments, then continued with the Mann-Whitney test. The measured variables are as follows:

- Feed consumption, Feed intake was recorded in each 7-day interval.
- Egg production was evaluated by dividing the average number of eggs laid per bird per week by the average number of birds multiplied by seven, and the result was multiplied by 100.
- Feed conversion ratio (FCR) was calculated by dividing the feed consumption by the egg mass-produced during the time that feeds consumption was measured.
- Egg weight
- Egg Yolk color, as a measure of egg quality, was determined using a Roche colorimetric fan, with scores varying between 1 and 15.
- Eggshell thickness was determined using the same eggshells used to the determined eggshell percentage. Eggshell thickness was measured in three points at the

egg equator using a pachymeter and calculating the average among the three points.

- Haugh units were calculated using the HU formula, based on the height of the albumen determined by a micrometer and egg weight. The Haugh unit was calculated using the following formula: $\text{Haugh unit} = 100 \log \text{HA} + 7.57 - 1.7 \text{WE}^{0.37}$ Where, HA is albumen height, and WE are egg weight [13].
- Yolk index was calculated by dividing the yolk height by the yolk diameter.
- The cholesterol values were obtained by the enzyme method solubilized samples [14].

III. RESULTS AND DISCUSSION

A. Effect of Treatment on Sentul Chicken Performance of Laying Phase

1) *Feed Consumption:* In Table 2, it can be seen that the average consumption of rations ranges from 77.74 - 79.10 grams, and protein consumption 12.15 - 12.36 g. Analysis of variance showed that the addition of mangosteen peel extract (MPE) in the basal ration was no significant effect ($P > 0.05$) on feed consumption and protein consumption. This means that the addition of MPE until 133ml / kg in the ration does not have a negative effect on the consumption of rations.

TABLE II
EFFECT OF MANGOSTEEN PEEL EXTRACT ON SENTUL CHICKEN OF LAYING PHASE

Variables	P0	P1	P2	P3
Feed Consumption (g/day/bird)	79.74 a	77.30 a	77.81 a	76.10 a
Protein Consumption (g/day/bird)	12.46 a	12.08 a	12.16 a	11.89 a
Egg Production (%)	40.14 a	42.24 ab	45.86 b	47.35 b
FCR	5.24 a	4.29 b	4.10 b	4.08 b

Description: The same letter in the direction of the rows shows no significant difference ($P > 0.05$)

Notes:

- P0 = 0 ml MPE/kg feed
- P1 = 67 ml MPE/kg feed
- P2 = 100 ml MPE/kg feed
- P3 = 133 ml MPE/kg feed

The above Table II can be visualized in the form of a diagram as in Figure 3.

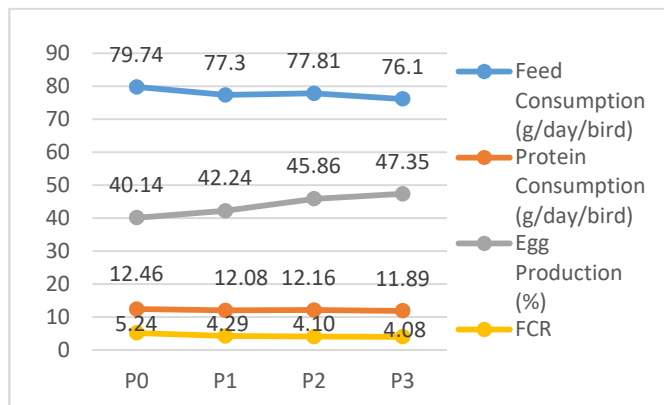


Fig. 3 Average Effect of Treatment on Sentul Chicken Performance of Laying Phase

Xanthenes in mangosteen peel extract are polyphenolic groups that have several functions, including antioxidant, antibacterial, antitumoral, antiinflammation [15]. The content of xanthenes in mangosteen peel extract as an antioxidant serves to maintain the health of the chicken's body well so that the chicken becomes healthy and does not affect the consumption of rations. The content of tannins in mangosteen peel is 16.8% [16], which is the limiting factor, and anti-nutritional substances bind to proteins and inhibit the protease enzymes activity, forming complexes with proteins so makes the digestibility of protein decrease [17]. Still, in this study, it did not have a negative effect on ration consumption. This is due to the mangosteen meal used first in extracted. Extraction of active substances with ethanol solvents can reduce tannin levels so that it can reduce the bitter taste and smell typical of mangosteen peel. According to [18], the tannin content in the basal ration, which added 1% of mangosteen peel meal or equivalent to 133 ml/kg of ration was 0.36g / kg. If we calculate the tannin content of mangosteen peel in the ration, each treatment turns out to be below tolerance, P1 = 0.24g/kg, P2 = 0.36 g/kg, and P3 = 0.48 g/kg. The threshold for using tannin in rations is 2.6 g/kg [8]. The extraction process of mangosteen peel can reduce tannin levels so that it does not have a negative effect on feed consumption and does not reduce palatability in Sentul chicken. Taste, smell, color, and texture can influence palatability so that it can increase appetite for chicken.

2) *Egg production:* In Table 2, the Sentul chicken egg production (hen-day) ranges from 41.14 - 48.00 %. The results of the analysis variance showed that the addition of MPE in the ration was a significant effect ($P < 0.05$) on egg production (Hen-day). Hen-day production between treatments P0 and P1 did not give a significantly different outcome, but the treatment of P2 and P3 was considerably higher, resulting in egg production compared to P0 and P1. The treatment of P2 and P3 using rations in addition to MPE at the level of 100 ml/kg ration and 133 ml gave a positive response to egg production. This is due to the active substance in the MPE in the form of xanthenes, which will function as antioxidants. These antioxidants can prevent the occurrence of free radicals that can cause a decrease in the immune system. Mangosteen peel contains xanthenes as antioxidants, antiviral, antifungal, and antibacterial agents, which are thought to be able to improve the structures of intestinal villi in the process of absorption of nutrients and can suppress the growth of pathogenic bacteria in the intestine [19]. Mangosteen peel contains alkaloids, saponins, triterpenoids, tannins, phenolics, flavonoids, which are compounds in plants that have antibacterial activity [20]. Saponin is an active substance that can increase membrane permeability so that cell hemolysis occurs, if saponins interact with germ cells, they will break or lysis. The more xanthenes consumed by chickens, the better the nutrients absorbed, so that the production needs will be fulfilled and will affect the production of eggs produced.

3) *Feed conversion:* In Table 2, the average value of feed conversion in the Sentul chicken ranges from 4.08 - 5.40. The results of the statistical analysis showed that the addition of MPE in ration was significantly affected by feed conversion value. The conversion value of treatment rations

P1, P2, P3, and P4 is significantly lower than the control ration (P0). This is because the ration plus MPE can be more efficient in producing egg production so that it can reduce feed conversion value. The content of xanthenes, flavonoids, and saponins in MPE as antioxidants and antibacterial can improve the structures of intestinal villi in the process of absorption of nutrients. It could suppress the growth of pathogenic bacteria in the intestine. The digestive tracts of Sentul chicken can work well and cause the utilization of rations to become more efficient. The effects of plant extracts containing antibacterial compounds can increase the efficiency of the use of rations and help absorb the digestive tract [19].

B. Effect of the Treatment of Egg Quality

1) *Egg Weight*: The results of the observation of the effect of MPE in the ration on the weight of the eggs of Sentul chicken can be seen in Figure 4 and Table 3.

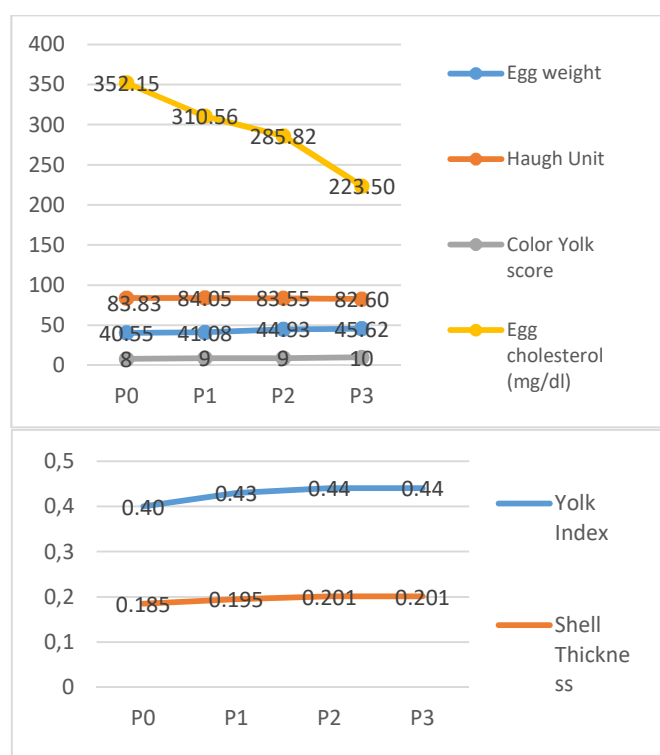


Fig. 4 Average on the Effect of the Treatment of Egg Quality

Figure 4 and Table III above shows that the average weight of eggs ranges from 40.55 – 45.62 gram. The results of the statistical analysis showed that the addition of MPE in ration had a significant effect on egg weight. The addition of MPE from 100 ml/kg ration (P2) to 133 ml/kg ration (P3) significantly increased egg weight compared to control treatment (P0).

This means that the addition of MPE until 133 ml/kg ration gave a positive response to egg weight. This is because of the active substance in MPE, which is in the form of *Xanthone* function as an antioxidant, antiviral, antifungal, and antibacterial. Function as antibacterial agents that can suppress the growth of pathogenic bacteria in the intestine, and are able to improve the structure of intestinal villi in the process of absorption of nutrient substances [19]. The existence of xanthenes makes the condition of the

digestive tract good, and the process of absorption of nutrients in food, especially protein and fat, which is the most important food factor that affects the weight of the egg becomes more optimal. This is supported by [21] that egg weight is influenced by protein, fat, and essential amino acids contained in the ration. The presence of antioxidants contained in the MPE can capture free radicals in the body so that the presence of antioxidants can suppress the emergence of free radicals. This is supported by [22] that antioxidants have an important role to play in preventing damage caused by free radicals. Increased free radicals cause the body's defense ability to decrease, which can lead to stress in livestock, which results in a decrease in egg production, especially the weight of eggs.

TABLE III
EFFECT OF MANGOSTEEN PEEL EXTRACT (MPE) ON EGG QUALITY

Variable	P0	P1	P2	P3
Egg weight (g)	40.55 ^a	41.08 ^a	44.93 ^b	45.62 ^b
Yolk Index	0.40 ^a	0.43 ^a	0.44 ^a	0.44 ^a
Haugh Unit	83.83 ^a	84.05 ^a	83.55 ^a	82.60 ^a
Shell Thickness (mg)	0.185 ^a	0.195 ^a	0.201 ^a	0.201 ^a
Color Yolk score	8 ^a	9 ^b	10 ^c	10 ^c
Egg yolk cholesterol (mg/dl)	352.15 ^a	310.56 ^b	285.82 ^b	223.50 ^c

Description: The same letter in the direction of the rows shows no significant difference ($P > 0.05$)

Notes :

- P0 = 0 ml MPE/kg feed
- P1 = 67 ml MPE/kg feed
- P2 = 100 ml MPE/kg feed
- P3 = 133 ml MPE/kg feed

2) *Shell Thickness*: Based on the analysis of variance that the addition of PME in the ration had no significant effect ($P > 0.05$) in increasing the eggshell thickness of the Sentul chicken. These results illustrate that the shell thickness of each treatment is in the same range, even though there is an increase in shell thickness but non significantly different. This can be caused by the low mineral content contained in the mangosteen peel, namely calcium as much as 11 mg, and phosphorus as much as 17 mg. At the same time, the thickness of the shell is much influenced by minerals, especially calcium and phosphorus. In line with the opinion of [23] that, shells are prepared by 1.6% water, 95.1% minerals, and 3.3% protein. The main nutrients affecting eggshell thickness are calcium, phosphorus, and vitamin D3 [24]. Another factor that affects eggshell thickness is feed consumption, where about 35-75% of calcium for eggshell formation comes from feed consumed [25]. The more rations consumed to cause the increased availability of calcium salts in the blood for eggshell formation [26]. The average feed consumption obtained during the study was, P0 of 79.74 grams/day/bird, P1 of 77.30 grams/day/bird, P2 of 77.81 grams/day/bird, and P3 of 76.10 grams/day/bird. These results illustrate that the feed consumption of each treatment is in the same range, causing calcium consumption in each treatment to be

relatively the same, which results in the thickness of the eggshell in the same range.

3) *Egg Yolk Color*: Effect of Treatment on Egg Yolk Color The results of the observation of the effect of treatment on the color of Sentul chicken egg yolks can be seen in Table 3. Based on the Kruskal-Wallis test, the results show that the addition of MPE in the ration was significantly different ($P < 0.05$) in increasing the color egg yolk. These results illustrate that the color of the yolk for each treatment increased. Several factors can cause this to show that the addition of mangosteen peel extract in the ration can increase the yolk color. This is caused by xanthenes contained in mangosteen peel, and xanthophyll contained in the ration. Xanthenes function as an antibacterial that can suppress the growth of pathogenic bacteria in the intestine, and can improve the structure of intestinal villi in the process of absorption of nutrient substances [19], the existence of xanthenes will make the digestive tract conditions good and the process of absorption of nutrients from ration especially xanthophyll, which gives color to the yolk, becomes more optimal. Color pigments will be absorbed by the digestive organs of the small intestine and transported in the blood circulation then circulated to the target who needs it [27].

4) *Haugh Unit*: The value of the Haugh Unit (HU) is a reflection of the quality of eggs, which shows the dilution of egg white and can determine the level of quality of eggs [28]. The average value of HU is between 82.60 - 84.05. The results of the analysis of variance, the effect of the treatment of the addition of MPE in the ration did not significantly affect the value of HU. This is because the consumption of protein for each treatment is the same, so that the need for amino acids for egg production has been fulfilled, which causes the amino acid content in the egg white to be the same, which in turn produces egg whites with the same freshness. This same level of freshness will produce HU values that are not significantly different. Haugh unit values are influenced by genetics, chicken age, season, storage conditions, and ration [29].

5) *Yolk Index*: The results of the variance analysis show that the effect of MPE additions in the ration does not significantly influence the value of the Yolk Index. That is, the addition of MPE in the ration gives the same result as the value of the Yolk Index from the control treatment. Table 3. and Illustration 2. The average value of the Yolk Index given by mangosteen peel extract is higher than the control (P0), although the Yolk Index value is not significantly different. This means the quality of the yolk is good. This is consistent with the opinion of [30] that the Yolk Index is the quality index of egg yolk measured by the height and diameter of egg yolk. [31] states that the value of the Yolk Index is used to determine the freshness of eggs. The yolk index identifies a decrease in vitellin membrane function in eggs, the smaller the yolk index, the lower the egg quality.

6) *Egg yolk Cholesterol*: The average results show that egg yolk cholesterol level treatments are in the normal range, 223.50 - 352.15 mg/dl . The normal total egg yolk cholesterol level in native chickens ranges 1881.30 mg/100g [32]. Statistical analysis showed that the results were

significantly different ($P < 0.05$) to decrease egg yolk cholesterol levels. The addition of MPE in the ration gave a positive response to the average egg yolk cholesterol level. Overall, the average of each treatment given tended to decrease the egg yolk cholesterol level. MPE contains xanthone compounds as antioxidants. Xanthenes are a natural chemical substance that is closely related to flavonoids. Flavonoid is one of the phytochemical groups that have the same structure. For instance, polyphenols have the mechanism to reduce cholesterol levels due to HMG-CoA (Hydroxy Methyl Glutatyil-CoA) reductase activity, reduce the activity of the enzyme acyl-CoA cholesterol acyltransferase (ACAT), and reduce cholesterol absorption in the digestive tract [33].

IV. CONCLUSION

It can be concluded that the addition of MPE 133 ml/kg ration had a significant effect on egg production, egg weight, feed conversion, the thickness of eggshell, the color of egg yolk, and egg cholesterol. However, it is insignificant to feed consumption, yolk index score and Haugh unit. The MPE can be used as a feed additive until 133 ml/kg ration to give the best on production and egg quality of Sentul chicken.

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