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# PRODUCTIVITY, EGG QUALITY, AND EGG COMPOSITION OF QUAIL SUPPLEMENTED WITH CASSAVA LEAF PASTE

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Abstract

Cassava leaf paste contains macro, micro, and bioactive mineral nutrients that improve physiological performance. The study aimed to evaluate the effect of adding cassava leaf paste on the productivity and quality of quail eggs. The parameters measured were performance, egg quality, and quail egg composition. The results showed that the application of cassava leaf paste increased quail body weight gain. The average quail eggshell that received cassava leaf paste was thicker than the control group. The percentage of quail egg whites and egg yolks that received cassava leaf paste treatment was higher than the control. This study concluded that quail treated with cassava leaf paste resulted in higher quail performance such as body weight gain and egg mass. Giving cassava leaf paste causes the quail to be healthier by producing a higher egg composition such as the percentage of egg whites and yolks and thicker eggshells.

## Introduction

Quail has potential as an excellent and affordable source of animal protein, both for carcass and eggs produced (MARARENI and MNISI 2020). The Directorate General of PKH (2019) in 2018–2019 stated that the consumption of quail eggs in Indonesia per capita increased annually, by 7769

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to 9177 quail eggs, with a percentage increase of 0.18%. The consumption of quail eggs is followed by an increase in the quail population in Indonesia. The quail population in Indonesia from 2018 to 2019 was 14 062 000 to 14 107 000, with a percentage increase of 0.32% (DITJEN PKH 2019). Quail also produce eggs with high productivity. Data from the Directorate General of PKH (2019) for 2018–2019 shows that the number of quail egg production in Indonesia increased, from 28 957 000 eggs to 29 090 000 eggs, with a percentage increase of 0.45%. Quail egg production in Indonesia in 2018–2019 increased by 0.46% (RAHMASARI et al. 2022). MONE et al. (2016) stated that the temperature of the rearing environment is a factor that affects quail productivity.

An increase in quail egg production must be followed by an increase in egg quality (KUSUMORINI et al. 2021). Egg quality is an indicator to determine whether an egg is good (VLAICU and PANAITE 2022). Assessment of egg quality is very important to know so that people know the eggs that are consumed, namely eggs that have good quality (SASS et al. 2020). KALVANDI et al. (2022) stated that the factor that affects the quality of quail eggs is the temperature of the rearing environment.

REHMAN et al. (2022) stated that the thickness of the shell and the Haugh Unit are indicators that describe the indicators of egg quality. A good shell thickness indicates that the thicker the shell size will help minimize the inside of the egg that is contaminated with the environment so that the contents of the egg still have good resistance (KALVANDI et al. 2022). Meanwhile, a thin egg shell will cause the eggs to easily crack or break (ZOTTE et al. 2019). KALVANDI et al. (2022) stated that the thickness of quail shells aged 65–121 days reared at 22°C was 0.17 mm, while those reared at 34°C for 8 hours per day were 0.16 mm. Quail aged 42 days given Moringa leaf powder got 0.17 mm of shell thickness compared to those that did not get 0.18 mm of Moringa leaf powder (MINJ et al. 2022).

In addition, egg white quality, especially high egg white, is also an important measure in keeping eggs fresh (KRISNANINGSIH et al. 2022). The egg white height will affect the resulting Haugh Unit (NASRUSHIN et al. 2021). The higher the Haugh Unit value, the better the egg quality (JUMADIN et al. 2022). A Haugh Unit score over 72 is categorized as AA quality eggs, 60–72 as A quality eggs, 31–60 as B quality eggs, and Haugh Unit value less than 31 are categorized as C quality eggs (USDA 2020).

One of the factors that affect the productivity and quality of quail eggs is the temperature of the rearing environment (MONE et al. 2016). WASTI et al. (2020) stated that the thermoneutral zone of poultry, including quail, is 18–21°C. High environmental temperatures that exceed the range of the quail comfort zone have an impact on decreasing the productivity and quality of quail eggs (MEHAISEN et al. 2019). Quail experiencing heat stress will reduce heat production by limiting feed intake, resulting in a reduced availability of nutrients needed by quail (KALVANDI et al. 2019). Quail will also release its heat by panting when the ambient temperature is above the comfort zone (WASTI et al. 2020). Quails at the critical time, there is a decrease in the availability of carbon dioxide ($CO_2$) in the quail's blood. The reduction of $CO_2$ causes a decrease in bicarbonate concentration. Meanwhile, bicarbonate is a material needed in the formation of egg shells (EL-TARABANY 2016).

The provision of cassava leaf paste is expected to increase the productivity and quality of eggs in quail. Cassava leaf paste contains high protein and low crude fiber (JUMADIN et al. 2022a). Therefore, this study was conducted to evaluate the effect of adding cassava leaf paste on productivity, egg quality, and egg composition of quail reared under natural conditions in the tropics, such as in Indonesia.

## Material and Method

### Place and animal ethics

This research was carried out in several places, namely in the Jaja Quail Animal Cage, Pilot Plant Seafast Center Laboratory of LPPM IPB, Physiology Laboratory, SKHB, and IPB. The procedures used in this study were by the rules of the Animal Ethics Commission of the School of Veterinary Medicine and Biomedical IPB (No. 007/KEH/SKE/V/2021).

### Preparation of cassava leaf paste (*Manihot esculenta* Crantz)

Fresh cassava leaves were obtained in Rancabungur Village, Ranca Bungur District, Bogor Regency. The cassava leaves used are whole and undamaged leaves. The leaf part is the sixth leaf from the shoot. The leaves were first washed with clean water, then dried at room temperature. Then cut into small pieces to facilitate the process of crushing with a blender, then extracted. A total of ±50 grams of cassava leaf pieces are crushed in a blender using 125 mL of 70% ethanol for 3 minutes, intermittently every 1 minute. The solution of cassava leaves in ethanol is then filtered by a fine cloth, then the filtrate obtained is filtered again with a Buchner funnel using filter paper. The residue is washed with 75 mL 70% ethanol, then filtered again with a Buechner funnel. The filtrate is taken as a cassava leaf extract. Furthermore, the extract of the cassava leaves is evaporated for one hour at a temperature of 70°C, resulting in cassava leaf paste. The calculation of the dose of cassava leaf paste in this study was a dose conversion of quail with a body weight of 168 g given 5.29 mg/head/day (JUMADIN et al. 2017). Doses 2 and 3 are multiples of dose 1.

### Preparation and maintenance of experimental animals

Experimental animals used were female quail of layer period (aged 42 days) as many as 160 tails. The cage used was a 4-storey colony cage with 16 plots, measuring 100 cm long x 30 cm wide x 20 cm high. Each plot was filled with 10 birds and their placement was done randomly. Each plot is equipped with excreta storage, lighting, feed and drinking containers. All cage plots were placed in open cages. Open cage equipped with thermostat digital.

### Experimental design

The study used a completely randomized design. The treatment was giving cassava leaf paste to quail, consisting of 4 levels/dose of cassava leaf paste, namely P0 (0 mg/g), $P_1$ (5.29 mg/g), P2 (10.58 mg/g), and P3 (15.87 mg/g). The experiment was repeated 4 times. Each replication consisted of 10 tails. Giving cassava leaf paste to quail is given through drinking water. Give it in the morning. At 6 o'clock all quail were fed, for 1 hour. At the time of feeding, all drinking water is taken, so the quail are thirsty. After that, drinking water mixed with cassava leaf paste was given at each dose of 5.29 mg/g; 10.58 mg/g; and 15.87 mg/g. After the drinking water that has been mixed with cassava leaf paste is used up, then proceed with ordinary drinking water.

### Research procedure

A total of 160 quails from the age of 42 days were fed commercial feed (which contains 2900 kcal/kg metabolizable energy, 22% protein, 7% fat, 7% crude fiber, 14% ash, 2.5–3.5% calcium, 0.6–1.0% phosphorus, 0.9% lysine, 0.4% methionine) (JUMADIN et al. 2022a). Feed and drinking water were provided ad libitum. Temperatures was recorded every morning, afternoon, evening and night at 06.00 WIB, 12.00 WIB, 18.00 WIB and 24.00 WIB. The provision of cassava leaf paste was carried out through drinking water in 100 mL at each treatment level.

The study was conducted by rearing quail for 30 days. Observation of egg production performance was carried out from the first day to the end of the study. Analysis of egg quality and egg composition was carried out at the end of the study.

## Research variables

The variables observed in this study included performance, egg quality, and egg composition in quail. Observation of quail performance was detected by calculating body weight gain, egg mass, mortality, and morbidity. Performances such as egg mass are counted daily. Other performances, such as body weight gain, were weighed when the quails were 42 and 72 days old and mortality was calculated at the end of the study. Morbidity was observed every day.

Observation of quail performance during the production period was carried out on quail aged 42–72 days. Body weight gain was obtained based on the difference between final body weight (72 days old) and initial body weight (42 days old). Egg mass was obtained based on the total egg weight during the study. Mortality was obtained by dividing the number of quails that died divided by the number of quails kept multiplied by 100%. Morbidity was calculated by dividing the number of sick quail by the number of quail population during the study multiplied by 100% (MOLINA-LO´PEZ et al. 2017).

Observations on the quality of quail eggs included counting the thickness of the shell, the height of the egg white, and the height of the yolk. Egg quality analysis was carried out at the end of treatment (72 days old). Observation of the quality of quail eggs in the production period was carried out on quail aged 42–72 days. The number of shell thickness was obtained from the average results of measurements of the pointed, middle, and blunt part of the eggshell using a digital caliper. Analysis of egg white height and yolk height was measured using a digital caliper.

Observation of egg composition was detected by calculating the percentage of egg shell, percentage of egg white, and percentage of egg yolk. Analysis of egg composition was carried out at the end of treatment (72 days old). Percentage of shells was obtained based on the ratio of shell weight to egg weight multiplied by 100%. Egg white percentage was calculated by dividing the egg white weight by the egg weight multiplied by 100%. Yolk percentage was obtained based on the ratio of yolk weight to egg weight multiplied by 100% (ŞENGUL and ÇALISLAR 2020).

## Data analysis

This study was designed using a completely randomized design, with the treatment of giving cassava leaf paste to quail in the production period consisting of 4 levels/dose, namely P0 (0 mg), P1 (5.29 mg), P2 (10.58 mg), and P2 (10.58 mg). P3 (15.87 mg). The study was repeated 4 times. Each treatment, each replication consisted of 10 quails.

Data on quail productivity, egg quality, and egg composition were analyzed for variance using a mathematical model as follows:

$$Yij = \mu + Pi + \varepsilon ij,$$

where:
Yij – the observation value of the *i* cassava leaf paste and the *j* replication
μ – general mean
Pi – the effect of the *i* cassava leaf paste application
εij – treatment error of the *i* cassava leaf paste treatment and the *j* replication.

If real results are obtained, it is continued with Duncan's test (Matjik and Sumertajaya 2013).

## Results and Discussion

### Quail performance

Observations of quail performance in this study included body weight gain, egg mass, mortality, and morbidity. The results of these observations are presented in Table 1.

Table 1
Performance on quail given cassava leaf paste for 30 days

| Variable | P0 | P1 | P2 | P3 |
|---|---|---|---|---|
| PBB [g/head/month] | 6.5 ±0.49$^{b}$ | 7.6 ±3.49$^{b}$ | 13.43 ±3.95$^{a}$ | 14.30 ±5.15$^{a}$ |
| Egg mass [kg] | 2.92 ±0.26 | 2.93 ±0.36 | 3.21 ±0.17 | 3.03 ±0.31 |
| Mortality [%] | 0 | 0 | 0 | 0 |
| Morbidity [%] | 0 | 0 | 0 | 0 |

Numbers accompanied by different letters in the same row indicate significantly different ($p < 0.05$); P0 – cassava leaf paste 0 mg/g; P1 – cassava leaf paste 5.29 mg/g; P2 – cassava leaf paste 10.58 mg/g; P3 – cassava leaf paste 15.87 mg/g; PBB – weight gain

Different levels of cassava leaf paste in this study resulted in significant differences in body weight gain (PBB) of quail. The results showed that there was an increase in body weight (PBB) of quail with increasing doses of cassava leaf paste. This is because the quail is still in the early stages of production. Mone et al. (2016) stated that quail energy needs at the beginning of production are not only used to produce eggs but also for quail growth, especially the increase in their reproductive organs.

The quail egg mass showed no significant difference at various levels of cassava leaf paste administration. The value of egg mass that received cassava leaf paste was higher than the control. Ashour et al. (2020) stated that the nutritional content and mineral elements are factors that support the mass of quail eggs. Another factor that influenced the difference in the mass of quail eggs in this study was egg production and egg weight between treatments. NEMATI et al. (2021) stated that quail egg mass was influenced by egg production and quail egg weight.

Quail treated with cassava leaf paste produced the same mortality and morbidity rates as the control treatment. These results illustrate that the increase in the level of cassava leaf paste in this treatment was able to maintain quail in a healthy condition with a mortality rate of 0%.

## Egg quality

Observation of the quality of quail eggs in this study was carried out by measuring the thickness of the shell, the height of the egg white, and the height of the yolk. The results of these observations are presented in Table 2.

Table 2

Quality of quail eggs given cassava leaf paste for 30 days

| Variable | P0 | P1 | P2 | P3 |
|---|---|---|---|---|
| Shell thickness [mm] | 0.15 ±0.05$^{b}$ | 0.20 ±0.00$^{a}$ | 0.20 ±0.00$^{a}$ | 0.20 ±0.00$^{a}$ |
| Egg white height [mm] | 4.50 ±0.94 | 4.63 ±0.42 | 5.03 ±0.35 | 4.40 ±0.57 |
| Yolk height [mm] | 11.82 ±0.81 | 11.70 ±0.71 | 12.35 ±0.25 | 11.57 ±0.51 |

Numbers accompanied by different letters in the same row indicate significantly different ($p < 0.05$); P0 – cassava leaf paste 0 mg/g; P1 – cassava leaf paste 5.29 mg/g; P2 – cassava leaf paste 10.58 mg/g; P3 – cassava leaf paste 15.87 mg/g

Statistically, the average shell of quail eggs that received cassava leaf paste was thicker than the group of quail eggs that did not get cassava leaf paste. JUMADIN et al. (2022) stated that flavonoids were able to reduce oxidative stress so that the deposition of calcium as the main element in the formation of egg shells from the small intestine into the egg cell was more efficient. The advantage of producing a thick egg shell is that it is not easy to crack or break. Thus, the chance of exposure to microbes is smaller (WIDYANTARA et al. 2017).

Quail that received cassava leaf paste produced higher egg white values than those in the control treatment, except for P3. JUMADIN et al. (2022a) stated that nutritional content is a factor that supports egg quality, including high egg white. Another factor that affects egg white height is the length of egg storage. FITRA et al. (2020) stated that egg white height was influenced by the length of egg storage. The eggs produced in this study were immediately observed. Egg white height will decrease due to storage for too long because it affects the function of ovomucin and egg white viscosity which is characterized by high egg white thickness. The high number of egg whites in P3 did not increase, due to the high fiber in cassava leaf paste resulting in low feed consumption. Cassava leaf paste contains 1.87% crude fiber (JUMADIN et al. 2022a)

The high number of egg yolks in this study was not statistically significantly different. Treatment P2 obtained the highest egg yolk height value with a value of 12.35 mm. The high number of egg yolks was due to differences in nutrient content between treatments. JUMADIN et al. (2022a) stated that nutritional content is a factor that supports egg quality, including high egg yolk. Another factor that affects egg yolk height is the length of egg storage. FITRA et al. (2020) stated that the yolk index including egg yolk height was influenced by the length of egg storage. In this study, the eggs produced were immediately observed.

## Egg composition

Observations of egg composition in this study included calculating the percentage of egg shells, the percentage of egg whites, and the percentage of egg yolks. The results of these observations are presented in Table 3.

Table 3

Composition of quail eggs given cassava leaf paste for 30 days

| Variable | P0 | P1 | P2 | P3 |
|---|---|---|---|---|
| Egg shell [%] | 11.91 ±0.91 | 12.23 ±1.74 | 10.95 ±0.75 | 11.64 ±1.19 |
| Egg whites [%] | 54.43 ±5.60 | 61.24 ±13.20 | 61.59 ±4.76 | 65.07 ±12.75 |
| Egg yolk [%] | 36.30 ±3.03 | 36.92 ±2.28 | 38.39 ±4.38 | 36.74 ±1.31 |

Numbers accompanied by different letters in the same row indicate significantly different ($p < 0.05$); P0 – cassava leaf paste 0 mg/g; P1 – cassava leaf paste 5.29 mg/g; P2 – cassava leaf paste 10.58 mg/g; P3 – cassava leaf paste 15.87 mg/g

The results of the analysis of various eggshell percentages showed that there was no effect on various levels of cassava leaf paste administration. Treatment P1 obtained the highest percentage of eggshell with a percentage value of 12.23% of eggshell. This is due to differences in nutrient content and mineral elements between treatments. ABOU-ELKHAIR et al. (2020) stated that the nutritional content and mineral elements are factors that support the percentage value of quail egg shells. Another factor that affects the percentage of eggshells is differences in flavonoids in cassava leaf paste. ABDEL-WARETH and LOHAKARE (2021) and CUI et al. (2020) stated that the increase in egg weight including egg shells was due to the presence of flavonoids which can increase the storage of glucose, phosphorus, calcium, zinc, and iron into egg cells.

The percentage of quail egg whites receiving cassava leaf paste was higher than the control treatment. The cause of the high percentage of egg whites is due to differences in nutritional content, mineral elements, and flavonoids in cassava leaf paste. ABDEL-WARETH and LOHAKARE (2021) and CUI et al. (2020) stated that the increase in egg weight including egg white was due to the presence of flavonoids which can increase the storage of glucose, protein, phosphorus, calcium, zinc, and iron into the oocyte. Cassava leaf paste contains high crude protein and low crude fiber.

The different levels of cassava leaf paste in this study also did not have a significant effect on the percentage value of egg yolks. The percentage of quail egg yolks receiving cassava leaf paste was higher than the control treatment. The high percentage value of egg yolks is due to differences in the nutritional content, mineral elements, and flavonoids in cassava leaf paste. Flavonoids can reduce oxidative stress so that the deposition of glucose, triglycerides, cholesterol, phosphorus, calcium, zinc, and iron into egg cells is more efficient (VAN DE WIER et al. 2017, CUI et al. 2020, ABDEL-WARETH and LOHAKARE 2021).

## Conclusion

Quail with cassava leaf paste treatment resulted in quail performance such as body weight gain, and higher egg mass than without cassava leaf paste treatment. Giving cassava leaf paste can cause quail to be healthier. The quails that were given a dose of cassava leaf paste of 5.29 mg/g (P1), 10.58 mg/g (P2), and 15.87 mg/g (P3) produced thicker egg shells than the group of quail eggs treated with cassava leaf paste didn't get the cassava leaf paste. Quail with cassava leaf paste treatment resulted in higher egg compositions such as egg white and yolk percentage than without cassava leaf paste treatment.

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