Original Article

Chaya Leaf Infusion (*Cnidoscolus aconitifolius*) as a Phytogenic for Productivity and Egg Quality of Japanese Quail (*Coturnix coturnix japonica*) of 17-20 Weeks of age

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ABSTRACT

Chaya (*Cnidoscolus aconitifolius*) from family *Euphorbiaceae* is a plant has leaves similar to papaya leaves but with dark green leaf color. This plant contains phytochemical compounds such as alkaloid, flavonoid, triterpenoids, glycoside, and tannin that can function as antibacterial, antioxidant, and anti-inflammatory. Chaya leaf infusion are processed into infusion before given to the quails through drinking water, this method is used to obtain the phytochemical compounds contained in chaya leaves. This study aimed to evaluate chaya leaf infusion (*Cnidoscolus aconitifolius*) as a phytogenic source on the productivity and egg quality of japanese laying quail (*Coturnix coturnix japonica*) aged 17-20 weeks. Chaya leaf infusion is given through drinking water and is expected to increase the productivity and quality of quail egg. The variables observed consisted of productivity (water intake, feed intake, egg weigh, QDP, egg mass, FCR, mortality) and egg quality (yolk, albumen, shell weight and percentage, egg index, yolk index, albumen index, shell thickness, yolk color, and haugh unit). This study was analyzed using the T test with 2 treatments and 4 replications: T0 = drinking water without any additives and T1 = drinking water with a concentration 10% of chaya leaf infusion. The results showed that chaya leaf infusion had a significant effect ($P \leq 0.05$) on quail day production, egg mass, albumen index, and yolk color. Besides that, supplementation chaya leaf infusion significantly reduces ($P<0.05$) feed convertion ratio. So that the use of 10% chaya leaf infusion in drinking water by giving it 2 times a week can increase the productivity and egg quality of laying quail (*Coturnix coturnix japonica*) 17-20 weeks old.

Keywords: Chaya Infusion, Egg Quality, Phytogenic, Production, Quail Egg

1. Introduction

Quail (*Coturnix coturnix japonica*) has the potential to be developed because the demand for quail eggs is quite high, and the price is relatively affordable by the community. The general goal of raising quail is to produce eggs for consumption. Therefore, since a female quail can lay eggs without a male quail, male quails are not needed (1). Fast favorable returns, consumer acceptance, nutritional quality in human food, low investment and labor requirement, and a small area for bird house are among the advantages of quail production (2). Chaya (*Cnidoscolus aconitifolius*) is a group of arborescent shrubs from the *Calyptosolen* section of the genus *Cnidoscolus*, closely related to the more known as genus Manihot. Both belong to the tribe *Manihotae* of the subfamily *Crotonoideae* of *Euphorbiaceae* (3). Chaya is a plant that come from the *Euphorbiaceae family.* This plant has the local Iyana Ipaja in the Yoruba ethnic group living in the state of Lagos and Ibadan in the western part of Nigeria (4). Proximate analysis revealed that chaya leaves contain moisture (5.35%), ash (13.69%), crude protein (18.74%), fat (11.95%), fiber (9.81%), and carbohydrates (40.48%). Mineral analysis shows that the leaves contain sodium (77.32 mg 100 g^{-1}), potassium (58.45 mg 100 g^{-1}), calcium (44.82 mg 100 g^{-1}), magnesium (23.46 mg 100 g^{-1}), zinc (0.02 mg 100 g^{-1}), copper (0.004 mg 100 g^{-1}), iron (0.06 mg 100 g^{-1}), But was not contain lead (5). Therefore, chaya is a nutritious green vegetable that can be used as a medical plant. Commercial cultivation was less explored. So further research was needed that chaya can be widely cultivated and utilized and its use are highly encouraged (6). Chaya leaves contain phytochemical compounds, such as flavonoid (23.72%), alkaloids (17.45%), saponins (12.49%), and tannins (5.72%) which can function as anti-inflammatory, antimicrobial, and antioxidants (7). Phytogenic feed additives has been widely used and is one way to increase poultry productivity due to the ban on using Antibiotic Growth Promoter (AGP) by the government. Herbal species and various plant extracts have been shown to be possible candidates to replace antibiotic growth promoter (AGP) in animal diets (8). In addition, using phytogenic feed additives in poultry is more economical and has no residual effect on humans when properly administered (9). Therefore, the present study aimed to analyze the effect of chaya leaf infusion on the productivity and egg quality of Japanese quail aged 17-20 weeks.

2. Materials and Methods

2.1. Experiment Design

Quail maintenance was carried out at the Field Laboratory C, Faculty of Animal Science. Analysis of egg quality was performed at the Poultry Nutrition Laboratory, Department of Nutrition and Feed Technology, Faculty of Animal Science, IPB University, Indonesia. Quails used in this study were laying Japanese quails 17 weeks of age with average initial body weight of 184.76 ± 10.23 g. There were 80 birds used in this study which were divided into two treatments with four replications. They were allocated randomly in cage with a size 0.5 x 0.6 x 0.3 m containing 10 birds each. Commercial feed, namely SP22 from PT Sinta Feedmill, was used. The birds were given free access to drinking water and feed during the experimment. Quail maintenance was carried out starting from 17 weeks old, which lasted for 4 weeks. The quail had previously undergone feed adaptation for two weeks. Maintenance includes providing feed and drinking water, cleaning feed and drinking water area then cleaning the cage, drinking water place, and cleaning the cage. Feeding and drinking water were provided ad libitum. Chaya infusion was made every week and given two times a week. Egg collection and Eggs were collected and weighed, as well as a recording of data, were carried out every day. The egg quality test was carried out every two weeks with three egg samples for each replication selected by simple random sampling method. The variable measures are productivity (water intake (ml/bird/day), feed intake (g/bird/day), egg weight (g), Quail Day Production (QDP) (%), egg mass, Feed Convertion Ratio (FCR), mortality, and egg quality (yolk, albumen, shell weight and percentage, egg index, yolk index, albumen index, shell thickness, yolk color, and Haugh unit).

2.2. Chaya Leaf Infusion

Chaya leaves are given in the form of an infusion which is added to drinking water of the quail. The infusion method is an extract method using a solvent in the form of water. This method is suitable for extracting active substances from the leaves. In accordance with research conducted by Widjaya, Retnani, and Hermana (10). The leaves used for making infusions are leaves with more than five shoots. This leaf was chosen because it has a larger size than young leaves. The leaves are washed and drained; then, mixed with water and mashed using a blender. The ratio of chaya leaves to water is 1:2. The solution is then heated in a saucepan over low heat at 90°-98°C for 15 min. This time is calculated when the temperature in the solution reaches 90°C. Pure infusion (100%) is diluted to 10% according the treatment.

2.3. Statistical Analyses

Data were analyzed by t-test (11) using SPSS (version 26). The present study used two treatments consisting of T0 = just drinking water (control) and T1 = drinking water with chaya leaf infusion concentration of 10%.

3. Results

3.1. Phytochemical on Leaf Infusion

The results of screening phytochemical were showed in Table 1. It showed that chaya leaf infusion contained alkaloids, flavonoids, triterpenoids, glycosides, and tannin, while phenol hydroquinone, sterols, and saponins were absent.

3.2. Production of Laying Quail 17-20 Weeks Aged

Supplementation chaya leaf infusion as phytogenic for production performance of laying quail 17-20 weeks aged, are presented in Table 2. Although supplementation chaya leaf infusion had a significant effect on Quail Day Production, egg mass, and FCR ($P \leq 0.05$), it had no significant effect on water intake, feed intake, egg weight, and mortality ($P \geq 0.05$).

3.3. Egg quality of Laying Quail 17-20 Weeks Aged

The egg quail quality with chaya leaf infusion is shown in Table 3. Based on the results of the analysis, although the administration of chaya leaf infusion had a significant effect on albumen index and egg yolk color ($P \leq 0.05$), it had no significant effect on albumen weight, yolk weight, eggshell weight, yolk proportion, albumen proportion, eggshell proportion, egg index, yolk index, eggshell thickness, and Haugh unit (HU; $P \geq 0.05$).

Table 1. Phytochemicals Screening of Chaya Leave Infusion

Phytochemicals	Result [a]
Alkaloids	+
Flavonoids	+
Phenol hydroquinone	-
Steroids	-
Triterpenoids	+
Glycosides	+
Tannins	+
Saponins	-

Results of laboratory analysis of the Center for Spices and Medicinal Plants (2023)

Table 2. Production performance of laying quail (17-20 week)

Variables	Treatments	
	Control	10%
Water intake (ml/bird/day)	59.67±7.17	59.03±7.35
Feed intake (g/bird/day)	26.32±0.05	26.05±0.41
Egg weight (g/egg)	10.76±0.42	11.30±0.32
QDP (%)	68.78±10.57a	87.37±3.30b
Egg mass (g/bird/day)	7.43±1.35a	9.88±0.59b
FCR	3.60±0.64a	2.65±0.20b
Mortality (%)	5%	5%

Different letters on the same row indicates statistical difference ($P \leq 0.05$) among treatments.

Table 3. Egg quality of laying quail (17-20 week)

Variables	Treatments	
	Control	10%
Albumen (g)	5.94±0.30	6.33±0.18
Yolk (g)	3.97±0.44	3.79±0.17
Eggshell (g)	1.34±0.10	1.35±0.10
Albumen (%)	54.06±1.53	55.24±0.70
Yolk (%)	36.05±4.26	33.02±1.25
Eggshell (%)	12.19±0.94	11.75±0.68
Egg index	78.39±1.98	78.55±0.59
Yolk index	47.07±1.12	48.68±1.20
Albumen index	11.16±0.57a	12.17±0.52b
Shell thickness (mm)	0.18±0.00	0.19±0.01
Yolk color score	4.17±0.14a	4.46±0.16b
Haugh unit (HU)	90.09±1.13	91.91±1.42

Different letters on the same row indicates statistical difference ($P<0.05$) among treatments.

4. Discussion

The results of screening phytochemicals are presented in Table 1. It showed that chaya leaf infusion contained alkaloids, flavonoids, triterpenoids, glycosides, and tannin, while phenol hydroquinone, sterols, and saponins were absent. Another study showed that water and alcohol extracts of chaya leaf contain phenolic compounds consisting of coumarins, flavonoids, phenols, tannins, and anthraquinones (12). Phytogenic additive in water or feed, including alternatives used as a substitute for AGP. Phytogenic can positively affect the health and productivity of poultry (13). Phytogenic can be herbs, whole plants, its parts, extracted, or essential oils from plants (14). Supplementation of essential oils from oregano, savory, and rosemary in diets can reduce ileal *Lactobacillus* spp., serum cholesterol concentration and increase meat oxidation stability (15). Essential oils containing phenolic compounds prevent oxidation by deactivating fat-free radicals and proxy radicals and increasing the reductive power. Polyphenols, having antioxidant properties, increase the shelf life of meat (16). The results of this study, supplementation chaya leaf infusion as phytogenic for laying quails of 17-20 weeks old production, are presented in Table 2. Quail Day Production, egg mass, and FCR were affected by supplementation chaya leaf infusion ($P \leq 0.05$). Water intake, feed intake, egg weight, and mortality had not significant in every group Dosoky (17) reported that dietary herbal additive significantly affected body weight, laying rate, egg weight, egg number, egg mass, and FCR. Supplementation phytogenic increases the growth performance, nutrient digestibility, and gut health in poultry. Phytogenic substances improve animal performance and health through the following effects: improvement of digestibility, antimicrobial activities, anti-inflammatory and antioxidant effect, stabilization of intestinal microbiota, improvement of animal traits, and reduction in environmental emissions (18). Herbal medicines can be used as beneficial additives in poultry nutrition to improve growth performance, reduce the *Salmonella* population in the gastrointestinal tract, and cholesterol, triglycerides, and meat oxidation (19). The average water intake of quail aged 17-20 weeks in control and quails that given 10% chaya leaf infusion were 59.67 and 59.03 ml/bird/day. Chaya leaf infusion had no significant effect on drinking water consumption ($P \geq 0.05$; Table 2). The absence of this influence can be seen from the amount of drinking water consumed by quails every day the absence of this influence can be seen in the amount of drinking water consumed quails every day was the same. It showed that the astringent taste contained in chaya leaf infusion can still be tolerated by quails of 17-20 weeks of age. The average quail feed intake ranged from 26.05-26.32 g/bird/day. Administration of chaya leaf infusion through drinking water had no significant effect on feed consumption ($P \geq 0.05$). According to Valentim (2), natural additive, or known as phytogenic, have antioxidant or nutraceutical activities that can affect physiological metabolism and productivity. Based on the results of this analysis, the quail fed by chaya leaf infusion had a Higher Quail Day Production (QDP) with higher egg weight. The FCR is affected by feed intake and egg mass production. Although Higher egg mass results in lower FCR value, egg mass is influenced by egg weight and QDP. This showed that the content of phytochemical compounds in chaya leaf infusion can increase egg production. According to Liu (20), flavonoid compound in the leaves can increase egg production. The average quail egg mass ranged from 7.43-9.88 g/bird/day (Table 2). These results are not much different from the findings by Zeweil (8), with a quail egg mass of around 8.28 g/bird/day. Statistical analysis showed that chaya leaf infusion significantly affected egg mass ($P \leq 0.05$). Quail with chaya leaf infusion produced a higher egg mass. The average FCR ranges from 2.65-3.60 (Table 2). The FCR value is lower than the research conducted by Zeweil (8), with a FCR value of around 3.65. Based on the results of the analysis, it showed that administration of chaya leaf infusion as a phytogenic had a significant effect on FCR. Phytogenic supplementation from plant can improve performance and stimulate egg production through increased digestion and assimilation of nutrients (21). The egg quail quality with chaya leaf infusion is shown in Table 3. Based on the results of this analysis, although the administration of chaya leaf infusion had a significant effect on albumen index and egg yolk color ($P \leq 0.05$), it had no significant effect on albumen weight, yolk weight, eggshell weight, yolk proportion, albumen proportion, eggshell proportion, egg index, yolk index, eggshell thickness, and HU ($P \geq 0.05$). Karakçi (22) reported aromatic plant extract mixture as phytogenic to quail diet increased in terms of albumen index, egg yolk color, eggshell thickness, and HU. Egg index, yolk index, and albumen index ranged from 78.39-78.55, 47.07-48.68, and 11.16-12.17. Based on the results of the analysis, chaya leaf infusion had no significant effect on the egg index and yolk index ($P \geq 0.05$). However, it had a significant effect on albumen index ($P \leq 0.05$). Albumen contains ovomucin, which plays a role in binding water to form albumen gel; therefore, albumen can be thick. The albumen will become thicker if there is large amount of ovomucin and strong so that the albumen viscosity becomes high. High albumen viscosity can cause a higher

albumen index then albumen index is one of the indicator egg quality. Phytogenic causes the water content in the albumen to be low enough to extend the shelf life of the egg powder in a humid environment (9). The average eggshell thickness ranged from 0.18-0.19 mm. Based on the analysis, supplementation chaya leaf infusion as phytogenic had no significant effect on eggshell thickness ($P \geq 0.05$). The thickness of the egg shells produced in this study was higher than the research conducted by Karakçi (22), the eggshell thickness in quail without any provision was 0.15 mm. Quail egg yolk color scores ranged from 4.17-4.46. These results are almost the same as a study conducted by Siahaan (23); the color of quail egg yolk was around 4.16. Based on the results of an analysis, supplementation of chaya leaf infusion has significant effecton increasing the color of quail egg yolk ($P \leq 0.05$). The yolk color score indicates color level in the range 1 (pale yellow) to 15 (dark orange). The HU of quail egg ranged from 90.09-91.91. Based on the results of the analysis, supplementation of chaya leaf infusion had no significant effect on quail HU with chaya leaf infusion ($P \geq 0.05$). The HU indicates egg quality based on albumen height and correlates albumen height with egg weight. The higher HU value, the better egg quality (24). The HU in this study was included in grade AA. Egg values according to HU was divided into AA: (100-72), A: (71-60), B(59-30), dan C: (<29) (25). The HU is known as an indicator egg freshness and is associated with shelf life. Phytogenic is able to improve the egg quality (22). In conclusion, supplementation of 10% chaya leaf infusion in drinking water by giving it two times a week led to enhance productivity (increase QDP, egg mass, decrease FCR) and eggs quality (increase albumen index and yolk color) of laying quail 17-20 weeks old.

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Authors' Contribution
Study concept and design: R. N. N; W. H; and Y. R.
Acquisition of data: R. N. N.
Analysis and interpretation of data: R. N. N; W. H; and Y. R.
Drafting of the manuscript: R. N. N.
Critical revision on the manuscript for important intellectual content: W. H; and Y. R.
Statistical analysis: R. N. N.
Administrative, technical, and material support: R. N. N; W. H; and Y. R.

Ethics
All animal procedures were approved by the Animal Ethics Committee IPB University, Bogor, Indonesia.

Conflict of Interest
The authors declare that they have no conflict of interest.

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