Effect of asam kandis *Garcinia cowa* Roxb extract in drinking water on egg quality of Japanese quail *Coturnix coturnix japonica*

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**ARTICLE INFO**

| Keywords | ABSTRACT |
|----------|----------|
| Asam Kandis | Asam kandis (*Garcinia cowa* Roxb) fruit has been reported to contain phytochemicals such as xanthones, hydroxy ctyric acid and flavonoids that have various activities such as antimicrobial and antioxidant. This study was aimed to investigate the effect of asam kandis extract addition in drinking water on the quality of quail eggs. Ninety-nine laying quails of 59 days of age were divided into 3 treatments and 3 replications with 11 laying quails in each replication. The Completely Randomized Design was used and the treatments were: T1= control (drinking water without asam kandis extract), T2= drinking water with asam kandis extract at pH 4, T3= drinking water with asam kandis extract at pH 3. The parameters observed were egg weight, egg shape index, yolk color, yolk percentage, albumen percentage, eggshell percentage, shell thickness, and Haugh unit score. The data obtained were analyzed by Analysis of Variance (ANOVA) and significant differences among treatments means were tested by Duncan’s multiple test. The addition of asam kandis extract did not affect (P>0.05) egg weight, egg shape index, yolk color, yolk percentage, albumen percentage, eggshell percentage, shell thickness, and Haugh unit score. The addition of asam kandis extract in drinking water at pH 3 significantly (P<0.05) increased eggshell thickness compared to that of other treatments. It is concluded that the addition of asam kandis extract in drinking water at pH 3 resulted in the highest eggshell thickness and the addition of asam kandis extract up to pH 4 did not influence the negative impact on egg weight, egg shape index, yolk color, yolk percentage, albumen percentage, eggshell percentage, and Haugh unit score. |
| Eggshell | |
| Haugh Unit | |
| Yolk | |
| Qualis | |

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**Introduction**

Japanese quail (*Coturnix coturnix japonica*) is one of the poultry commodities that has potential as animal protein sources because it has a higher protein content than chicken eggs (Thomas *et al.*, 2016). However, farming of laying quail in the tropics causes heat stress which can reduce egg production and economic losses. Heat stress also affects the synthesis, stability, and enzyme activity (Tamzil *et al.*, 2014) increases respiration rate, decreases feed consumption and egg quality (Barrett *et al.*, 2019).

Measurement of physical egg quality is important for both poultry breeders and consumers. According to Sanbeta *et al.* (2015), egg quality greatly affects consumer acceptance. Bobbo *et al.* (2013), also reported that the decline in the quality of eggs caused 7-8% of the total of eggs that are broken through the transfer from the production to the consumer. Therefore it is necessary to make efforts to overcome the effect of heat stress on quail to maintain egg quality. One of the efforts that can be done is by providing natural compounds as antioxidants and acidifiers through drinking water.

Asam kandis (*Garcinia cowa* Roxb) is a fruit that has been reported to contain phytochemicals such as xanthones, benzophenones, and flavonoids (Hemshkhar *et al.*, 2011) that has various activities such as antimicrobial, antimalarial, antioxidant, anti-inflammatory, and anticancer (Panche *et al.*, 2016). Ethyl acetate fraction in asam kandis has antioxidant activity that was similar to the standard of BHT antioxidant (Fu *et al.*, 2012). Antioxidants are chemical compounds that can be used to protect biological components such as lipids, proteins,
vitamins and DNA from oxidation (Mbah et al., 2019). In addition, asam kandis is able to act as a natural acidifier that can improve performance through decreasing gastrointestinal pH which is suitable to support the digestive enzymes and reduce the pathogenic bacteria in the intestine (Hamid et al., 2018; Kopecký et al., 2012). Hydroxy citric acid is the main organic acid in asam kandis that can cause a decrease in pH value (Onakpoya et al., 2011). Murmu et al. (2016) also reported that extracted asam kandis fruit was able to inhibit gram-positive bacteria, gram-negative bacteria, and fungus. However, limited information related to the effect of asam kandis extract on the quality of quail eggs. Therefore, this study aims to evaluate the effect of asam kandis extract through drinking water on the physical quality of quail eggs.

Materials and Methods

Animal and treatment

Ninety-nine laying quails of 14 weeks of age were offered treatment through drinking water for 6 weeks. A completely randomized design with 3 treatments, 3 replicates and 11 laying quails each replicate was used in this experiment. The laying quails were allocated randomly in each cage. The treatments were T1 = control treatment (without asam kandis extract), T2 = drinking water with asam kandis extract at pH 4, T3 = drinking water with asam kandis extract at pH 3.

The dried asam kandis fruit peel used as the source of organic acids. Then, 40 grams of dried asam kandis fruit peel was added into 1 liter of boiling water and stored for 12 hours to be asam kandis solution. The solution containing the peels and some particles was filtered to have a clear extract. Then asam kandis extract was added to drinking water until pH 3 and 4 were reached. The drinking water was tested for pH using a digital pH meter. The treatments through drinking water were provided ad libitum two days a week (Sunday and Monday for 24 hours).

The ingredients of the commercial diet used were corn, rice bran, corn gluten meal, pollard, meat meal, bone meal, soybean meal, natrium chloride, oil, calcium phosphate, calcium carbon, amino acids, antioxidants, and trace minerals. The diet and drinking water were provided ad libitum. The nutrient content of the commercial diet was shown in Table 1.

Variables and sampling

The parameters observed were egg weight (g/egg), egg shape index, yolk color, yolk weight percentage, eggshell weight percentage, albumen weight percentage, eggshell thickness (mm), and haugh unit. Egg weight was recorded daily. At the end of the 4th, 5th, and 6th weeks, three eggs from each replicate were collected to determine the average egg quality. An electronic digital balance (AND HL-100) was used to measure egg weight, yolk weight, eggshell weight, and albumen weight. The yolk color was measured using the Roche color fan (DSM) with the scale of 1 to 14.

Table 1. Nutrient content of the commercial diet (as fed).  
| Nutrient content* | %  |
|-------------------|----|
| Ash               | 14.27 |
| Dry matter        | 91.12 |
| Crude Protein     | 20.17 |
| Crude Fiber       | 2.24  |
| Crude Fat         | 5.54  |
| Calcium           | 3.50  |
| Available Phosphorus | 0.65 |

* Analyzed at Research Center for Bioresources and Biotechnology, IPB University

The egg index was calculated by dividing egg width by egg length and was expressed by percentage. Percentage of yolk weight, eggshell weight, and albumen weight were calculated by dividing each variable weight by egg weight and multiplied by 100. The average of eggshell thickness was calculated by measuring three locations of eggshell including air cell, equator and sharp end using a digital micrometer (Mitutoyo). Albumen and yolk were separated and weighed using a digital balance. Then, albumen thickness was measured by a digital micrometer (Mitutoyo). Egg weight and albumen thickness were used to calculate the Haugh unit value by using the formula (Haugh, 1937).

Haugh Unit = 100 log (H - 1.7 W0.37 + 7.57)

H = Albumen thickness (mm); W = Egg weight (g)

Statistical analysis

The data were subjected to analysis of variance (ANOVA), and followed by a Duncan’s multiple range test to determine the significant difference among mean values using SPSS vr.21.0 for window.

Results

The ANOVA test showed that the addition of asam kandis extract did not affect (P>0.05) egg weight, egg shape index, yolk color, yolk percentage, albumen percentage, eggshell percentage, and Haugh unit score. However, the addition of asam kandis extract in drinking water at pH 3 gave a significant
effect on the egg shell thickness (P<0.05), where the highest egg shell thickness was found at T3 (drinking water with asam kandis extract at pH 3), this value was significantly different with other treatments. The results revealed that addition of asam kandis extract in drinking water up to pH 4 did not give a negative impact on quail egg qualities.

Table 2. The effect of asam kandis extract on the physical quality of quail egg

| Parameters                  | Treatments          | T1       | T2       | T3       |
|-----------------------------|---------------------|----------|----------|----------|
| Egg weight (g/egg)          | T1                  | 10.07±0.11 | 10.47±0.3 | 10.5±0.27 |
| Egg shape index (%)         | T2                  | 77.12±1.22 | 77.21±1.02 | 78.14±1.02 |
| Yolk color                  | T3                  | 3.89±0.12  | 3.89±0.13 | 3.89±0.11  |
| Yolk weight (%)             | T1                  | 36.52±1.08 | 36.44±1.64 | 35.93±0.82 |
| Albumen weight (%)          | T2                  | 53.27±1.07 | 53.57±1.63 | 53.95±0.9  |
| Eggshell weight (%)         | T3                  | 10.22±0.01 | 9.99±0.19  | 10.13±0.17 |
| Eggshell thickness (mm)*    | T1                  | 0.22±0.02  | 0.21±0.02 | 0.32±0.09  |
| Haugh unit                  | T2                  | 93.67±0.14 | 94.66±1.01 | 95.21±0.53 |
|                            | T3                  | 94.66±1.01 | 95.21±0.53 |           |

T1= control (drinking water without asam kandis extract), T2= drinking water with asam kandis extract at pH 4, T3= drinking water with asam kandis extract at pH 3. *Significant at p<0.05.

Discussion

The addition of asam kandis extract in drinking water at pH 4 (T3) produced the highest eggshell thickness (0.32 mm) compared to the result of T1 (0.22 mm) and T2 (0.21 mm). This result was in line with founded of Fouad et al. (2016) that diets containing lactic acid and butyric acid significantly increased eggshell thickness. Ratriyanto et al. (2020) also reported that the addition of ascorbic acid in tropical environments in the diet significantly increased quail eggshell thickness.

The increase of eggshell thickness in the present study may be the consequence of the improvement of mineral absorption especially calcium mineral. According to Adil et al. (2010), organic acids are able to increase the digestibility of calcium, phosphorus, magnesium, zinc, and proteins. The availability of calcium is the main factor that determines the eggshell quality because calcium mineral is the major component of the eggshell (Arpašová et al., 2010; Shwetha et al., 2018). Asam kandis contains hydroxy citric acid (Onakpoya et al., 2011) that might be able to enhance calcium absorption and decrease calcium excretion by acid-base balance mechanism in the gastrointestinal tract. According to Shwetha et al. (2018), the poultry will increase the rate of breathing under high-temperature ambient that makes the reducing CO2 and increases blood pH to be alkaline, then this condition will reduce the availability of calcium for the eggshell. Another study reported that citric acid was able to decrease the phytic acid capacity in binding certain minerals thus it increased the availability of phosphorous and calcium minerals (Vargas-Rodriguez et al., 2015). In addition, the presence of flavonoids may able to against pathogenic bacteria that can injure the intestinal villi, thus a decrease in pathogenic bacteria may increase intestinal villi density and nutrient absorption (Srividya et al., 2010) such as minerals absorption.

This showed that the addition of asam kandis extract at pH 3 and pH 4 in drinking water resulted in the same egg weight, egg shape index, yolk color, yolk percentage, albumen percentage, eggshell percentage, and Haugh unit score compared to the control treatment. The present result was similar to its reported by Attia et al. (2013) that the suplementations of 6 % organic acids on quail diet did not significantly affect quail egg weight and yolk weight percentage. The absence of effects asam kandis extract on egg weight could be because of similar crude protein and metabolizable energy contents in diets.

According to Godbert et al. (2019), protein, energy consumption, and linoleic acid are the most factors that influence egg weight. The egg shape index resulted in this study was 77.12% to 78.14%, which was according to Alasahan and Copur (2016), the egg shape index value of 74% to 78% resulted in the greatest hatchability of fertile eggs, and hatchability rate. Yolk color, albumen percentage, eggshell percentage, and Haugh unit value were not affected by treatments and it was in agreement to the findings by Rahman et al. (2008), Yusuf et al. (2015), Alrahawi (2019), and Youssef et al. (2013) respectively. Yolk color and albumen weight percentage were not affected by treatments because the yolk color and albumen weight may be more affected by carotenoid content in the diet (Bovšková et al., 2014) and protein consumption especially methionine (Fouda et al., 2016; Ratriyanto et al., 2019).

In addition, according to Viana et al. (2017), the level of protein in the diet is important for the formation of the yolk and especially of the albumen. The haugh unit in the present study ranged from 93.67% to 95.51% and it was greater than reported by Yilmaz et al. (2011) and Attia et al. (2013) which were 87.41% and 91.21 % respectively. A high score of the haugh unit indicates fresh egg with thick albumen (Lee et al., 2016; Duman et al., 2016), and the storage time can affect the quality of eggs, one of
which decreases the Haugh unit score (de Menezes et al., 2012).

Conclusions

The conclusion was the addition of asam kandis extract through drinking water at pH 3 produced the highest eggshell thickness. The addition of asam kandis extract in drinking water up to pH 4 did not influence the negative impact on quail egg qualities did not on egg weight, egg shape index, yolk color, yolk percentage, albumen percentage, eggshell percentage, and Haugh unit score.

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