



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

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ABSTRACT

Asam kandis (*Garcinia cowa* Roxb) fruit has been reported to contain phytochemicals such as xanthone, hydroxy citric 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, and Haugh unit score. The addition of asam kandis extract in drinking water at pH 3 significantly ($P<0.05$) increased eggshell thickness compare 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.

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,

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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).

$$\text{Haugh Unit} = 100 \log (H - 1.7 W^{0.37} + 7.57)$$

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)	10.07±0.11	10.47±0.3	10.5±0.27
Egg shape index (%)	77.12±1.22	77.21±1.02	78.14±1.02
Yolk color	3.89±0.12	3.89±0.13	3.89±0.11
Yolk weight (%)	36.52±1.08	36.44±1.64	35.93±0.82
Albumen weight (%)	53.27±1.07	53.57±1.63	53.95±0.9
Eggshell weight (%)	10.22±0.01	9.99±0.19	10.13±0.17
Eggshell thickness (mm)*	0.22±0.02 ^b	0.21±0.02 ^b	0.32±0.09 ^a
Haugh unit	93.67±0.14	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 (Arpášová *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-Rodríguez *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 supplementations 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 (Fouad *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.

References

- Adil, S., T. Banday, G.A. Bhat, M.S. Mir, M. Rehman. 2010. Effect of dietary supplementation of organic acids on performance, intestinal histomorphology, and serum biochemistry of broiler chicken. *Veterinary Medicine International*, 2010: 479-485.
- Alasahan, S.I., A.G. Copur. 2016. Hatching characteristics and growth performance of eggs with different egg shapes. *Brazilian Journal Poultry Science*, 18: 001-008.
- Alarahawi, G.A.M. 2019. Effect of adding organic acid to diet in some egg quality and intestinal environment for quail. *Mesopotamia Journal of Agriculture*, 47:1-13.
- Arpášová, H., M. Halaj, P. Halaj. 2010. Eggshell quality and calcium utilization in feed of hens in repeated laying cycles. *Czech Journal of Animal Science*, 55: 66-74.
- Attia, Y.A., A.E. Abd El-Hamid, H.F. Ellakany, F. Bovera, M.A. Al-Harhi, S.A. Ghazaly. 2013. Growing and laying performance of Japanese quail fed diet supplemented with different concentrations of acetic acid. *Italian Journal of Animal Science*, 12: 222-230.
- Barrett, N.W., K. Rowland, C.J. Schmidt, S.J. Lamont, M.F. Rothschild, C.M. Ashwell, M.E. Persia. 2019. Effects of acute and chronic heat stress on the performance, egg quality, body temperature, and blood gas parameters of laying hens. *Poultry Science*, 98: 6684-6692.
- Bobbo, A.G., S.S. Baba, M.S. Yahay. 2013. Egg quality characteristics of three phenotypes of local chickens in Adamawa State. *Journal of Agriculture and Veterinary Science*, 4:13-21.
- Bovšková, H., K. Míková, Z. Panovská. 2014. Evaluation of egg yolk colour. *Czech Journal of Food Sciences*, 32: 213-217.
- Duman, M., A. Şekeroğlu, A. Yıldırım, H. Eleroğlu, Camcı. 2016. Relation between egg shape index and egg quality characteristics. *European Poultry Science*. DOI: 10.1399/eps.2016.117
- de Menezes, P.C., E.R. de Lima, J.P. de Medeiros, W.N.K. de Oliveira, J. Evêncio-Neto. 2012. Egg quality of laying hens in different conditions of storage, ages and housing densities. *Revista Brasileira de Zootecnia*, 41:2064-2069.
- Fouad, A.M., D. Ruan, Y.C. Lin, C.T. Zheng, H.X. Zhang, W. Chen, S. Wang, W.G. Xia, Y. Li. 2016. Effects of dietary methionine on performance, egg quality and glutathione redox system in egg-laying ducks. *British Poultry Science*, 57: 818-823.
- Fu, M., H.J. Feng, Y. Chen, D.B. Wang, G.Z. Yang. 2012. Antioxidant activity of *Garcinia xanthochymus* leaf, root and fruit extracts in vitro. *Chinese Journal of Natural Medicines*, 10: 129-134.
- Godbert, R.S., N. Guyot, Y. Nys. 2019. The golden egg: Nutritional value, bioactivities, and emerging benefits for human health. *Nutrients*, 11:1-26.
- Hamid, H., H.Q. Shi, G.Y. Ma, Y. Fan, W.X. Li, L.H. Zhao, J.Y. Zhang, C. Ji, Q.G. Ma. 2018. Influence of acidified drinking water on growth performance and gastrointestinal function of broilers. *Poultry Science*, 97: 3601-3609.
- Haugh, R.R. 1937. A New method for determining the quality of an egg. *US Poultry Magazine*, 39: 27-49.
- Hemshekhkar, M., K. Sunitha, M.S. Santhosh, S. Devaraja, K. Kemparaju, B.S. Vishwanath, S.R. Niranjana, K.S. Girish. 2011. An overview on genus *Garcinia*: Phytochemical and therapeutic aspects. *Phytochemistry Reviews*, 10: 325-351.
- Karadas, F., E. Grammenidis, P.F. Surai, T. Acamovic, N.H.C. Sparks. 2006. Effects of carotenoids from lucerne, marigold and tomato on egg yolk pigmentation and carotenoid composition. *British Poultry Science*, 47: 561-566.
- Kopecký, J., C. Hrn, J. Weis. 2012. Effect of organic acids supplement on performance of broiler chickens. *Journal of Animal Science and Biotechnology*, 45: 51-54.
- Lee, M.H., E.J. Cho, E.S. Choi, S.H. Sohn. 2016. The Effect of storage period and temperature on egg quality in commercial eggs. *Korean Journal of Poultry Science*, 43: 31-38.
- Mbah, C.J., I.H. Orabueze, N. Okorie. 2019. Antioxidants properties of natural and synthetic chemical compounds: therapeutic effects on biological system. *Acta Scientific Pharmaceutical Sciences*, 3: 28-42.
- Murmu, P., S. Kumar, J. Patra, N. Singh, S. Rath. 2016. Ethnobotanical, nutritional, phytochemical and antimicrobial studies of *Garcinia xanthochymus* fruit extracts. *British Biotechnology Journal*, 13: 1-11.
- Onakpoya, I., S.K. Hung, R. Perry, B. Wider, E. Ernst. 2011. The use of *Garcinia* extract (hydroxycitric acid) as a weight loss supplement: A systematic review and meta-analysis of randomised clinical trials. *Journal of Obesity*. doi:10.1155/2011/509038
- Panche, A.N., A.D. Diwan, S.R. Chandra. 2016. Flavonoids: An overview. *Journal of Nutrition Science*, 5:1-15.
- Rahman, M.S., M. Howlader, M. Mahiuddin, M.M. Rahman. 2008. Effect of supplementation of organic acids on laying performance, body fatness and egg quality of hens. *Bangladesh Journal of Animal Science*, 37:74-81.
- Ratriyanto, A., S. Nurcahyo, S. Prastowo, N. Widya. 2019. Validating Egg component proportions in quail receiving methionine supplementation. Paper presented at the The 1st Animal Science and Food Technology Conference (AnSTC), 6-8 August 2019, Purwokerto, Indonesia, available at: <https://iopscience.iop.org/article/10.1088/1755-1315/372/1/012015/meta> (accessed 20 February 2021).
- Ratriyanto, A., F. Firmanda, H. Purwanti, M. Murjoko. 2020. Nutrient digestibility, performance, and egg quality traits of quails raised in different stocking densities and ascorbic acid supplementation in a hot, tropical environment. *Turkish Journal of Veterinary and Animal Sciences*, 44: 350-357.
- Senbeta, E.K., N.A. Zeleke, Y.G. Molla. 2015. Attitudes and Perceptions of Consumers to Chicken Egg Attributes in Eastern Ethiopia. *Journal of Animal Production Advance*, 5:705.
- Shwetha, S.M. Dhananjaya, S.K. Ananda. 2018. Comparative study on calcium content in egg shells of different birds. *International Journal of Zoology Studies*, 3: 31-33.
- Soltan, M.A. 2008. Effect of dietary organic acid supplementation on egg production, egg quality and some blood serum parameters in laying hens. *International Journal of Poultry Science*, 7: 613-621.
- Srividya, A.R., S.P. Dhanabal, V.K. Misra, G. Suja. 2010. Antioxidant and antimicrobial activity of *Alpinia officinarum*. *Indian Journal of Pharmaceutical Science*, 72:145-8.
- Tamzil, M.H., R.R. Noor, P.S. Hardjosworo, W. Manulu, C. Sumantri. 2014. Hematological response of chickens with heat shock protein 70 genotypes to acute heat stress. *International Journal of Poultry Science*, 13: 14-20.
- Thomas, K., P. Jagatheesan, T. Reetha, D. Rajendran. 2016. Nutrient composition of Japanese quail eggs. *International Journal of Science, Environment*, 5: 1293-1295.
- Vargas-Rodríguez, L.M., J.G. Herrera, J.E. Morales, J.L. Arcos-García, R. Lopez-Pozos, G. Ruelas. 2015. Effects of the addition of citric acid, phytase and calcium to diets of laying hens on productive performance, digestibility and mineral excretion during the first stage of production. *International Journal of Poultry Science*, 14: 222-228.
- Viana, E.F., J.H. Stringhini, F.B. de Carvalho, P.D.M. Viana, M.A. da Costa. 2017. Effects of crude protein levels on egg quality traits of brown layers raised in two production systems. *Revista Brasileira de Zootecnia*, 46: 847-855.
- Yilmaz, A., C. Tepeli, T. Çağlayan. 2011. External and internal egg quality characteristics in Japanese quails of different plumage color lines. *Journal of Food, Agriculture and Environment*, 9: 375-379.
- Youssef, A.W., H.M.A. Hassan, H.M. Ali, M. A. Mohamed. 2013. Effect of supplementation of probiotics, prebiotics and organic acid on layer performance and egg quality. *Asian Journal of Poultry Science*, 7:65-74.
- Yusuf, M.S., M.M.A. Mahmoud, H.M. Samy, M.T. Ibrahim. 2015. Effect of lactose, yeast and organic acids mixture supplementation on laying performance of Japanese quails (*Coturnix coturnix japonica*). *Global Animal Science Journal*, 2: 123-138.