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Bentonite Addition in Quail Diet (Coturnix-Coturnix Japonica) on Egg Weight, Shell Weight and Shell Thickness

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Abstract

The objective of this study was to see whether addition bentonite to quail rations affected egg weight, shell weight, and shell thickness. For a period of three months, this study was carried out in the cage of Fapet Farm, Faculty of Animal Husbandry, Jambi University. The instruments and materials utilized in this investigation were quails aged 49 days, with up to 180 quails, and 20 units of quail cages measuring 60 x 45 x 45 cm each unit, with 9 quails in each unit. Bentonite, yellow corn, fish meal, bone meal, bran, CaCO3, soy meal, premix, lysine, methionine, and oil had been used as diet components. This study used a group randomized design (GRD) with 5 groups and 4 treatments. The treatments were P0 (0% bentonite), P1 (1% bentonite), P2 (2% bentonite), and P3 (3% bentonite). Feed consumption, drinking water intake, egg weight, shell weight, and thickness are among the variables that had been determined. The data collected was analyzed using ANOVA, and Duncan's Multiple Range Test was employed if the treatment had a statistically significant impact on the measured variables. The study found that utilizing bentonite up to 3% had no influence on feed consumption, water consumption, egg production, or egg weight or thickness. The addition of bentonite to quail diets had no effect on egg weight, shell weight, or shell thickness.

Keywords: *Bentonite, eggs, quail.*

Introduction

Quail (Coturnix coturnix japonica) is a poultry product with developmental potential because it may contribute to the provision of animal protein through both eggs and meat (Vargas-Sánchez, et al. 2019). The nutritional requirements during the production phase must be addressed to produce high-quality eggs (Kowalska, et al. 2021). Another method is to supply extra feed, such as feed additives, so that the digestive tract can absorb nutrients from the diet more effectively (Carmen, et al. 2021).

Bentonite is a mineral that occurs naturally in rock-type montmorillonite. Bentonite has a high absorption capacity due to its layered construction structure with layers that can expand efficiently when activated to release the water trapped in it (Macheca, et al. 2021;Martin, et al. 2019:Rozy, 2008). Because of its layered wake structure, which creates layers that may expand efficiently when activated to release the water contained in them, bentonite has high absorbency, which is one of its benefits (Liu, et al., 2017; Hardyanti, et al., 2017; Rozy, 2008). Several components, including H_2O 7.2%, CaO 0.6%, K_2O 0.4%, Al_2O_3 19.8%, Na_2O 2.2%, Fe_2O_3 3.9%, MgO 1.3%, and SiO_2 61.3-61.4%, are present in bentonite, according to Trishinta (2005) and Berhe, et al., (2023). The capacity of bentonite to absorb water very effectively leads to a slowing of the passage of digesta through the digestive system, giving animals more time to absorb nutrients from the digestive system (Khanedar, et al., 2013: Wawrzyniak, et al., 2017). Darmawan and Ozturk. (2021) argued that, although bentonite does not contain any nutrients, using it in a pelleted ration at a level of 2.5% can help chicks grow and absorb their feed more effectively (Attar et al., 2018: 2019)

Egg quality is greatly influenced by the body's ability to absorb nutrients from the diet; if this ability is high, eggs will be of the highest possible quality (Tugiyanti and Iriyanti, 2012: Réhault-Godbert, et al., 2019). Egg quality is determined and measured by two factors, exterior and internal quality, according to Chukwuka, et al., (2011). The cleanliness of the shell, shell color, thickness, egg weight, and egg index are all indicators of the egg's exterior quality, which is the condition of the egg's exterior. When an egg is broken and cracked, its internal quality, which is determined by the egg's Haugh units, egg white index, yolk index, and yolk color, can be seen (Leke, et al., 2019). The type of bird, the time of year it lays eggs, heredity, the parent's body weight, and the amount of food ingested are only a few variables that affect egg weight (Murtidjo, 1987).

Bentonite has already been evaluated in broilers as a performance and carcass stimulant (Pasha et al., 2008; Damiri et al., 2012; Bouderoua et al., 2016). Although there has been some research on the influence of bentonite clay on meat qualities and antioxidant status in broilers chickens (Safaei et al. 2016) and lambs (Aydin et al. 2020), no research on this topic in quails has been discovered.

It is necessary to determine how the addition of bentonite to quail diets affects the exterior quality of quail eggs, such as egg weight, shell weight, and shell thickness. To date, the effect of bentonite addition on egg quality has not been examined.

Meterials and Methods

The research was carried out on the Animal Husbandry Faculty Farm. The study's materials were 180 growth phase quail aged 6 weeks. Bentonite was supplied from a company in Jambi, Indonesia. Diets made from yellow maize, soybean meal, fish meal, rice bran, bone meal, $CaCO_3$, premix, lysine, methionine, and oil. All diet supplies were bought from a poultry shop in Jambi.

A total of 180 quails were randomly assigned to one of four treatments and five replications using a randomized block design (RBD). 100% basal ration without bentonite (P0), 100% basal ration + 1% bentonite flour (P1), 100% basal ration + 2% bentonite flour (P2), and 100% basal ration + 3% bentonite flour (P3) were the treatments employed. Table 1 shows The feed composition of basal diet and Table 2 shows Nutrients content of basal rations.

Table 1. The feed composition of basal diet (%)

Material	Amount (%
Yellow Corn	48.50
Fish flour	11.00
Bran	13.00
Soybean Meal	17.00
Bone Meal	5.00
CaCO3	1.00
Lysine	0.25
Methionine	0.25
Premix	1.00
Oil	3.00
Amount	100

Table 2. The nutritional content of basal rations (%)

Food Substances	P0	P1	P2	P3
Dry matter	86.73	85.87	85.03	84.20
Crude protein	21.53	21.31	21.11	20.90
Crude Fat	7.27	7,20	7.13	7.06
Crude Fiber	3.97	3.93	3.89	3.85
Calcium	2.58	2.55	2.53	2.50
Phosphorus	1.35	1.34	1.33	1.31
Lysine	0.66	0.66	0.65	0.64
Methionine	0.69	0.68	0.67	0.67
EM (kcal/kg)	2643.49	2617.31	2591.65	2566.49

180 quail were placed in colony battery cages for the feeding treatment period. a colony cage measuring 60x45x45 cm and consisting of 20 units; each unit or cage houses 9 quail. For an 8-week feeding study period, the treatment rations and drinking water were administered ad libitum. The variables evaluated in this study were feed intake, water intake, egg weight, shell weight, and shell thickness.

The acquired data were analyzed using analysis of variance (ANOVA) with the experimental design (randomized block design) adjusted. If any significant differences remained, they were examined again using Duncan's Multiple Range Test (Bewick et al., 2004).

Results and Discussion

The averages of ration consumption, drinking water consumption, egg weight, shell weight and shell thickness during the study are presented in Table 3.

Table 3. Mean feed consumption, drinking water intake, egg weight, shell weight and shell thickness of quail eggs aged 49 to 106 days.

Parameters	Treatments			
	P0	P1	P2	P3
Feed consumption (g/quail/day)	24,07±1,54	22,41±1,04	22,63±1,11	23,62±1,99
Drinking water intake (ml/quail/day)	44,64±2,81	40,10±4,88	41,59±5,66	42,44±4,50

Egg weight (g)	10,46±0,53	10,57±0,34	10,58±0,49	10,93±0,65
Egg Shell weight (g)	0,95±0,06	1,00±0,09	1,04±0,12	1,02±0,09
Shell tickness (mm)	0,15±0,01	0,16±0,01	0,15±0,01	0,16±0,01

Description: P0 (Ration containing 0% bentonite), P1 (Ration containing 1% bentonite), P2 (Ration containing 2% bentonite), P3 (Ration containing 3% bentonite).

Feed Consumption

The findings of the analysis of variance revealed that the up to 3% bentonite addition to the ration had no apparent effect on feed consumption (P > 0.05). Similarly, Attar et al. (2019) found no differences in feed consumption among broilers fed processed sodium butyrate and also to finding of Demirel, et al. (2011) who found no differences in rat. Other investigates, on the other hand, have discovered beneficial advantages for bentonite on poultry growth performance (Pasha et al., 2008; El-Abd, 2014; Bouderoua et al., 2016; Prasai et al., 2017). There may not be much of a difference in the amount of diet consumed by each treatment due to the possibility that the bentonite addition to the quail diet does not significantly alter the nutrients contained in the diet or effects their palatability. The average daily intake range in this study was 22.41 to 24.07 grams per head per day. Albuquerque, et al.'s (2003) argumented that energy and protein content are strongly related to feed consumption predicts that if these components are present in all diets, feed consumption will be roughly the same. The palatability can affect feed consumption, suggested Nuraini et al. (2012).

The results of this study were relatively the same as Triyanto's study (2007), which found that consumption of quail the diet aged 6 to 13 weeks ranged from 20.96 to 23.82 grams per quail per day, but lower than that of Santos et al. (2011), who found that feed consumption for sexually mature quails was 25.09 to 29.61 grams per quail per day, but higher than the results of Achmanu et al. (2011), who found that consumption of quail the diet was 21.05 grams per quail per day.

Drinking Water Consumption

Drinking water consumption is calculated by subtracting the amount of drinking water given from the leftover drinking water. An analysis of variance demonstrated that adding up to 3% bentonite to the ration had no significant effect (P > 0.05) on drinking water consumption. The ability of bentonite to absorb water does not result in a slowed flow rate or a decrease in water content in digestion, nor does it result in a change in water intake. Water consumption, which ranged from 40.10 to 44.64 ml/quail/day had no significant different; Bentonite is a clay with strong colloidal qualities; when it comes into contact with water, it absorbs fast and expands its volume by swelling, giving rise to a thixotropic product such as jelly. It turns out that this trait has little effect on quail's water requirements. According to Church and Pond (1988), poultry drinking water consumption is 1.6-2.0 times the amount of feed consumption, but when stressed, it can reach 3-4 times the feed consumption. In this study, the rate of drinking water intake was lower than that of Djulardi et al. (2006). According to Djulardi et al. (2006), the demand for drinking water in quail older than 8 weeks ranged from 56-60 ml/quail/day. The findings of this study are consistent with Taryati's (2010) research, which discovered that drinking water intake in quail ranged from 202.85 ml/week to 327.14 ml/week, or equivalently, 28.98 ml/day to 46 ml/week.

Egg Weight

The analysis of variance revealed that adding up to 3% bentonite to the ration had no significant effect ($P > 0.05$) on egg weight. This is consistent with feed consumption, which in this study was relatively the same across treatments, resulting in nutrients entering and being absorbed into the quail's body being relatively the same, causing the egg weight to be relatively the same and having reached the optimal egg weight. This could be attributed to a lack of improvement in digestion retention time in the lumen, which does not change much for better nutrient utilization. Similarly to the Choi (2018) study, which found that adding 0.5% bentonite to the diet had no effect on egg quality, bentonite can assist chickens absorb calcium rather than albumen and egg yolk. In contrast, Lim et al. (2017) discovered that supplementing laying hens with a silicate-based complex mineral at doses ranging from 0.2% to 0.8% increased eggshell thickness.

In this study, egg weights ranged from 10.46 to 10.93 gram. The maximum egg weight was found in the P3 treatment, which included 3% bentonite, at 10.93 gram. The study's findings remain within the range provided by Yuwanta (2010), which claims that the weight of quail eggs ranges between 8 and 10 gram. According to Pangestuti (2009), the average weight of quail eggs ranged from 10 to 15 gram. The findings of this study are consistent with the findings of Kurtini (2006), who discovered that adding zeolite to the feed of laying hens at a level of 4.5% made no difference in egg weight.

Egg Shell Weight

The analysis of variance revealed that adding bentonite to the ratios up to 3% had no significant effect ($P > 0.05$) on egg shell weight. This suggests that the addition of bentonite to the quail feed had no effect on egg shell weight. This is assumed to be due to the fact that the rations used in each treatment had about the same Ca and P levels. This is consistent with Saki, et al.,(2019) belief that the calcium content influences egg shell quality. The quality of the egg shell will be good if the ration contains enough Ca, P, and vitamin D. Araujo, et al., (2011) then claimed that shell production requires the addition of Ca ions and carbonate ions to produce $CaCO_3$ from egg shells. According to Ketta and Tumova (2016), the quality of egg shells is determined by the age of the quail; the feed given and consumed in the study were essentially the same, therefore the average shell weight of quail eggs was not significantly different.

The egg shell weight range in this study was 0.95-1.04 gram. The maximum egg shell weight was attained in the P2 treatment, at 1.04 gram. This study's average shell weight of eggs was higher than Yuwanta's (2010) research, which discovered that the shell weight of quail eggs is approximately 0.56-0.9 gram. According to Santos, et al., (2015), the weight of the egg shell is greatly determined by feed consumption, egg weight, and quail age.

The Thickness of The Egg Shell

The analysis of variance revealed that adding up to 3% bentonite to the diet had no significant effect ($P > 0.05$) on the thickness of the egg shell. This suggests that adding bentonite to the quail diet did not increase the thickness of the egg shell. This is because quails consume similar feed, particularly minerals like Ca and P. According to Suprijatna et al. (2008), the calcium (Ca) concentration of the diet influences quail eggs.

Egg shell thickness is inversely proportional to environmental temperature; high temperatures impact egg white quality and reduce egg shell strength and thickness (Achmanu et al., 2011). According to Nys, et al., (2004), the thickness of the egg shell is the outermost and toughest component of the egg. This shell is primarily made up of calcium carbonate ($CaCO_3$). As the primary source of calcium (Ca), calcium carbonate plays a vital role. The egg shell contains 98.2% calcium, 0.9% magnesium, and 0.9% phosphorus (phosphoric acid) (Sedigh-Shams, et al.,2023).

In this investigation, the shell thickness ranged from 0.15-0.16 mm. The thickness of this shell is still fairly good, according to the research of Song, et al., (2000), with a thickness range of 0.13 to 0.21 mm. Furthermore, Amo, et al. (2013) discovered that quail eggs have a shell thickness ranging from 0.12 to 0.14 mm. Erisir, et al. (2015), on the other hand, discovered that the average thickness of quail egg shells ranged between 0.17 and 0.30. Ergun and Yamak (2017) discovered that it was greater than previous findings, specifically that the average quail egg shell thickness ranged between 0.28 and 0.29 mm.

Conclusion

The addition of bentonite to quail diets had no effect on egg weight, shell weight, or shell thickness.

Conflict of Interest

We certify that we have no financial, personal, or other links with other people or organizations that are linked to the information mentioned in the text.

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