Evaluation of diatomaceous earth on production, anatomical traits and quality of eggs in Japanese quail

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Received: 28 /2/2018
Accepted: 18 /12/2018
Publishing: 31/ 1/2019

Summary

An experiment has been carried out to evaluate a diatomaceous earth on performance and egg traits of Japanese quail. The diatomaceous earth used in the current trial was food grade which produced in Germany and is listed Generally Regarded As Safe. Eighty layer Japanese quail were randomly divided into 2 treatments from 16-20 weeks of age. Each treatment consisted 4 replicates (pens) of 10 birds each. The first treatment (control) contained a standard recommended diet with no added diatomaceous earth. The second treatment was the basal diet of the first treatment plus 1.5% diatomaceous earth in the feed. Feed and water were offered ad libitum from days 1 to 140. Egg production per pen was recorded daily. Egg traits were measured at the end of each week during experimental period. Utilization of diatomaceous earth did not have a pronounced effect on the production parameters and weight of egg, albumen, and shell, but significantly improved yolk size.

Keywords: Diatomaceous earth, Albumen, yolk, Egg shell, quail

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Introduction

Dietary use of various aluminosilicate compounds as natural feed additive has fruitful impacts on health and performance of different poultry species (1). Natural diatomaceous earth (DE) is the remains of microscopic one-celled plants (phytoplankton) called diatoms that lived in the oceans and lakes. The DE consists of 86 to 94% silica, with the remainder containing aluminums, calcium, phosphorus, sodium, potassium, magnesium, iron, sulfur, and other trace elements (2 and 3). The DE with less than 7% composition of crystalline silica is generally recognized as a safe food additive in North America which is called food grade(4).

The use of adsorbent clay supplements in the form of phyllosilicates such as bentonite and kaolinite, has been shown to have some direct benefits in poultry by improving feed efficiency (5). It has also been claimed that feeding DE to laying hens can increase feed efficiency and egg production (6). Other researchers (7) found that feeding DE significantly improved feed conversion ratio in broilers. Therefore, this study aimed to test the claim that feeding DE to laying quails can increase feed efficiency as well as egg quantity and qualit.

Materials and Methods

Eighty day-old Japanese quail (Coturnix coturnix Japonica) were randomly divided into 2 treatment groups. Each treatment consisted of 4 replicates (pens) of 10 birds each. The first treatment (control) contained a standard recommended diet with no added additive. The second treatment contained 1.5% diatomaceous earth (DE). The DE used in the current trial was food grade which produced in Germany. This product was applied due to its approve for use in animal feeds and is listed as Generally Regarded As Safe (GRAS) between 16 and 20 weeks of age, body weight of individual hens and pen feed intake were measured. Body weight was measured hence before the hens were fed. Daily egg production per pen was recorded for ever week. Once every weekend, between 16 and 20 weeks of age, all the eggs laid were collected, weighed, and stored overnight at 4°C. Eggs were broken out onto a level glass surface and the height of the albumen was measured using a standard tripod micrometer. The yolk was weighed and its color was measured with a Roche yolk color fan scale. Shells were washed, dried, and weighed. The albumen mass was then calculated by the difference between shell and yolk weights.

The experimental diet which is shown in (Table, 1) was formulated to meet the nutrient requirements of quail as recommended by (8). Pen dimensions were 40×40 cm, so that each bird had 160 cm2 floor space. The initial house temperature was set at 36°C and was gradually decreased to 22°C until day 35. Average relative humidity was kept at 60% during the experimental period. A lighting schedule of 16:8 h illumination was for the trial period. Mash feed and water were offered ad libitum throughout the trial. The experimental protocol was approved by the Animal Care Committee of Amol University of Special Modern echnologies, Amol, Mazandaran Province, Iran all data were analyzed using the Statistical Analysis System software (9). T-test was used to compare the means. All statements of significance were based on probability of P<0.05.

Table, 1: The composition of experimental diet.

Ingredients	Percentage
Corn	57.10
Soybean meal	34.02
Vegetable oil	0.51
Limestone	5.40
Dicalcium phosphate	0.45
Common salt	0.32
DL-Methionine	0.10
Vitamin premix[1]	0.25
Trace mineral premix[2]	0.25
Choline chloride	0.10
Diatomaccous earth(DE)[3]	1.50
Calculated contents (%)	
ME(Keal/Kg)	2900.00
Crude protein	20.00
Calcium	2.50
Available phosphorus	0.35
Sodium	0.15
Lysine	1.12
Methionine+Cystine	0.78

Results and Discussion

The effects of DE on egg production and its characteristics are shown in (Tables, 2-5). The application of DE did not have a pronounced effect on the daily egg production as well as weight of egg, albumen, and shell, but significantly improved yolk length (P = 0.049) and yolk diameter (P = 0.010). Moreover, yolk weight was improved by the DE although it was not statistically significant (P=0.079). These results are somehow in consistent with the findings of (10) which reported hens fed diet containing 2% DE were significantly heavier, laid more eggs, and consumed more feed than hens fed the control diet, but feed efficiency did not differ between the two dietary treatments. Additionally, Bovan Brown hens consuming the DE diet laid larger eggs containing more albumen and yolk than hens consuming the control diet .

Nevertheless, (11) indicated that egg production in organic hens fed DE was higher than control treatment and that effect was consistent throughout the study; however, no positive effects were found with regard to egg shell quality (weight, density, egg specific gravity) or broken egg percentage.

They also mentioned that, beside DE, the Red Lake Earth supplement contains 35% montmorillonite. Chemically, montmorillonite is hydrated sodium calcium aluminum magnesium silicate. For internal use, montmorillonite is effective in the treatment of irritable bowel syndrome (12) and for the prevention of aflatoxicosis (13 and 14) indicated that feeding laying hens with 7.5% defatted diatom microalgae biomass in the corn-soybean meal diet for 8 weeks had no adverse effect on their health, egg production, or egg quality, but 15% inclusion reduced feed intake, egg production, and efficiency of feed utilization. Researchers (10) Concluded that it would also be worthwhile to separate the effects of DE and montmorillonite in the diet,while (15) reported that hens increased their feed intake in response to increasing amount of sand in their diet. This compensation allowed them to maintain their egg production and egg weight but BW gain was still compromised. It is not clear how DE could help hens to maintain their BW and better egg production. Hens fed the DE - supplemented diet consumed more and the increased feed intake could be a significant factor. It may be possible that DE offers essential trace elements or may improve absorption of nutrients. It has been suggested that these compounds increase the absorption of nutrients by slowing gastric passing (5 and 16). Therefore, perhaps DE also slows gastric passing and may increase absorption of nutrients that may prevent weight loss in hens

during high egg production. In conclusion, the DE in the current trial was somehow effective on yolk size, but not any other egg.

Table, 2: Evaluation of diatomaceous earth on egg production and its characteristics in quail

Treatments	Egg percentage	Egg weight(g)	Egg length(mm)	Egg width(mm)
Control	59.90	1 1.49	33.46	25.95
Diatomaceous earth	62.09	11.90	33.45	26.26
SE	1.262	0.152	0.165	0.116
P-Value	0.260	0.103	0.99	0.11

Table, 3: Evaluation of diatomaceous earth on egg characteristics in quail

Treatments	Albumen height(mm)	Albumen length(mm)	Albumen width(mm)	Albumen weight(g)
Control	4.12	32.89	24.77	6.01
Diatomaceous earth	4.20	32.94	24.67	6.10
SE	0.140	0.284	0.276	0.148
P-Value	0.70	0.90	0.79	0.707

Table, 4: Evaluation of diatomaceous earth on egg yolk characteristics in quail

Treatments	Yolk height(mm)	Yolk diameter(mm)	Yolk weight(g)
Control	10.45 [b]	25.92 [b]	3.87
Diatomaceous earth	11.27 [a]	26.32 [a]	4.16
SE	0.235	0.078	0.097
P-Value	0.049	0.010	0.079

[a,, b] **Means within each column with no common superscript are significantly different (P <0.05).**

Table, 5: Evaluation of diatomaceous earth on egg shell characteristics in quail

Treatments	shell weight (g)	Shell thickness (mm)
Control	0.544	0.851
Diatomaceous earth	0.533	0.842
SE	0.009	0.016
P-Value	0.471	0.525

Acknowledgement

The authors wish to thank Houshmad Parvaran Honami and Mamatir Daneh Caspian Feed Mill for their contributions to do this experiment.

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