Egg production parameters of quails receiving dietary betaine supplementation with different floor space in a tropical environment

F T Anggraini¹, S A Pamungkas¹, D A Putra¹, G M Rantau², A Masykur², S Prastowo¹,², N Widyas¹ and A Ratriyanto¹,²*

¹Department of Animal Science, Faculty of Agriculture, Universitas Sebelas Maret, Jl. Ir. Sutami 36A Surakarta 57126, Indonesia
²Master Program of Animal Science, Faculty of Agriculture, Universitas Sebelas Maret, Jl. Ir. Sutami 36A Surakarta 57126, Indonesia

Corresponding author: ratriyanto@staff.uns.ac.id

Abstract. This study investigated the effect of dietary betaine supplementation and floor space on quail egg production parameters. With six replicates, four hundred fifty-six quails (21-day-old) were randomly assigned to a 2×2 factorial arrangement. The first factor was floor space of 225 cm² (F1) and 164 cm² (F2) by allocating 16 and 22 birds per cage (size: 3600 cm²). The second factor was dietary betaine supplementation at 0% (CON) and 0.15% (BET). Egg production was collected in 2 periods (2×28 days) starting from 43 days old. The age of the first production, 10%, 50%, and peak production, was also recorded. There is an interaction between dietary betaine supplementation and floor space on the age of productive parameters, where quails receiving betaine supplementation reached faster 50% production and peak production (p<0.05). Furthermore, the F1 group had a higher average egg production than F2 (p<0.05). BET group had a higher average egg production than CON (p<0.05). Thus, floor space 225 cm² can be applied in the tropics provided the quails received dietary betaine supplementation.

1. Introduction

Japanese quail begins to lay eggs at the age of 42 days, and in one year, they can produce 250–300 eggs with an average weight of 10 grams/egg [1]. Peak production in laying quail occurs at the age of 3–5 months or about 12–20 weeks in one population with an average egg production of 78–85% [2]. Production performance in quail can be optimized by providing the required ventilation and temperature by adjusting the floor space of the cage.

If the floor space of the cage is too narrow, it will result in a linear decrease in diet consumption, and stress will occur, which results in decreased egg production and egg weight of quail [3–5]. One of the consequences of narrow the floor space is that it will cause heat stress due to the accumulation of body heat [6]. This condition will disrupt the electrolyte balance and osmotic pressure in the body's cells and cause insufficient metabolic energy to support optimal production and decrease performance [7,8].

One of the efforts that can be done to reduce stress due to improper floor space of the cage is by modifying the diet given through betaine supplementation in the diet. Betaine is a potential osmolyte [9] that is good for use in the poultry diet because it has an osmotic function for epithelial cells and microflora of the digestive tract, increasing nutrient digestibility [10]. As reported by Ratriyanto et al.
The presence of betaine in the diet increased the digestibility of dry matter, crude protein, crude fat, crude fiber, and crude ash in quail. In addition, it can increase the egg production of quail by up to 9%. Thus, this study investigated the effect of dietary betaine supplementation and floor space on quail egg production parameters.

2. Materials and methods

2.1. Experimental design and diets

This study used 456 Japanese quails 21 days old distributed into a 2×2 factorial arrangement with six replicates. The first factor was the floor space consisting of 225 cm$^2$ (F1) and 164 cm$^2$ (F2) per bird by allocating 16 and 22 birds per cage (cage size is 3,600 cm$^2$). The second factor was betaine supplementation at 0% (CON) as a basal diet and 0.15% (BET). The nutrient content of the basal diet was presented in Table 1.

Table 1. Nutrient contents of basal diet

| Nutrient                          | Content |
|-----------------------------------|---------|
| Metabolizable energy (kcal/kg)    | 2,799   |
| Crude protein (%)                 | 20.01   |
| Calcium (%)                       | 3.21    |
| Available phosphorus (%)          | 0.40    |
| Lysine (%)                        | 1.19    |
| Methionine (%)                    | 0.45    |

Commercial grower diets were given to quails from 21–33 days old, then a mixture of grower diets and basal diets with a 50:50 ratio was given to quails 34–35 days old. The basal diet was given in full after 35 days old. The diets were given twice a day in the morning and evening, and water was provided ad libitum.

2.2. Data collection and analysis

The age of first egg-laying, 10%, 50%, and peak production was recorded during the treatment diets. In addition, egg production data was collected for two periods (2×28 days) starting at 43 days. Egg production data were analyzed using Analysis of Variance and Duncan's Multiple Range Test if significant (P<0.05). Furthermore, the age parameter was analyzed using the Kruskal-Wallis test. All data analysis uses the custom script in R programming language.

3. Results and discussion

The mean and standard deviation of the quail production parameters with different floor spaces and betaine supplementation are presented in Table 2. The first egg-laying age was reached when the quail was 41.17–42.33 days old. In addition, the age of production 10% was achieved when the quail was 43.17–44.83 days old. The age of 50% egg production and peak production showed differences (P<0.05), where the floor space and betaine supplementation were able to accelerate the age of 50% production, while the betaine supplemented quail reached peak production faster than the control (P<0.05).

The age of 10%, 50%, and peak production in this study were faster than the study reported by Ratriyanto [13], namely 47.40, 56.20, and 86 days old, respectively. Accordingly, the peak production in this study was also faster than that reported by Narinc $et al.$ [1] and Kaye $et al.$ [14] i.e., 15 weeks and 12 weeks. The difference in the results of these several studies can be caused by variations in quail from each study [13]. In addition, the presence of betaine supplementation with different floor spaces can improve the nutritional status of livestock without supplying nutrients directly but by optimizing the use of nutrients in feed through specific physiological functions.
There was no interaction between floor space and betaine supplementation on average production and peak production (P>0.05). The floor space of the F1 resulted in more average production and peak production than the floor space of the F2 (P<0.05). Ratriyanto and Prastowo [5] reported that the more tightly the floor space is applied, the lower the peak production. In addition, betaine supplementation increased the average production by 9% (P<0.05). Betaine, as a compatible osmolyte, can stabilize the intestinal cell structure and optimize the process of digestion and absorption of nutrients [5,15,16]. It was reported that betaine increases nutrient digestibility in laying hens [15,17] and in quail [11]. Beneficial effects of betaine supplementation on egg performance and quality in quail have been observed [5,11].

4. Conclusion

Based on the results of our study confirmed that the floor space and betaine supplementation in quail diets could affect production parameters. Thus, floor space 225 cm² can be applied in the tropics provided the quails received dietary betaine supplementation.

5. References

[1] Narine D, Karaman E, Aksoy T and Firat M Z 2013 Poult Sci. 92 1676–82
[2] Wuryadi S 2011 Buku pintar beternak dan bisnis puyuh (Jakarta: Agromedia Pustaka)
[3] Fadilah R 2005 Panduan mengelola peternakan ayam broiler komersial (Jakarta: Agromedia Pustaka)
[4] Rodenburg T, Bracke M and Berk J 2005 Word's Poult Sci J. 61 633–46
[5] Ratriyanto A and Prastowo S 2019 J Therm Bio. 83 80–6
[6] Adebiyi O and Adu O 2011 Agric Biol J North Am. 2 1160–5
[7] Morris J R, Petrov D A, Lee A M and Wu C T E 2004 Genetics. 167 1739–47
[8] Hantoro A, Rahardjo D and Sudirman UJ 2012 Indones J Appl Sci. 2 3–6
[9] Harms R H and Russell G B 2002 Poult Sci. 81 99–101
[10] Ratriyanto A, Mosenthin R, Bauer E and Eklund M 2009 Asian-Australasian J Anim Sci. 22 1461–76
[11] Ratriyanto A, Indreswari R and Nuhriawangsa AMP 2017 Rev Bras Cienc Avic. 19 445–54
[12] R Core Team 2019 R: A Language and Environment for Statistical Computing (Vienna, Austria: R Core Team)
R Core Team)

[13] Ratriyanto A 2018 *Caraka Tani J. Sustain. Agric.* **33** 1–7
[14] Kaye J, Luka S J, Akpa G N and Adeyinka I A 2017 *Int J Innov Res Adv Stud.* **4** 93–7
[15] Attia YA, Abd El-Hamid E A El, Ahmed A A, Marfat A B, Mohammed A A-H and Osman K 2016 *Springerplus* **5** 1–12
[16] Eklund M, Bauer E, Wamatu J and Mosenthin R 2005 *Nutr Res Rev.* **18** 31–48
[17] Ezzat W, Shoeib M S, Mousa S M M, Bealish A M A and Ibrahiem Z A 2011 *Egypt Poult Sci.* **31** 521–37