Methionine supplementation to quails diet improves egg weight consistency

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Abstract. Methionine is an essential amino acid which plays important roles in metabolism. Methionine sufficiency is expressed in the animals’ performance. This research aimed to study the effect of methionine supplementation on the consistency of quail’ egg weight. There were three treatments groups with five replicates of 15 birds each as follows: D0 (control), D1 (control + 0.06% methionine) and D2 (control + 0.12% methionine). The egg weight data were collected for two periods of 28 days (2 × 28 days) started from when the egg productions reached 50% (63 days of age). The D1 and D2 yielded heavier egg than D0 (P<0.01). The data were split and averaged into eight weeks and were divided into two subsets: the consistency of the first period (1st–4th week) and second period (5th–8th week). Intraclass correlation was used as the measure of egg weight consistency. Result showed that intraclass correlation of D0, D1 and D2 in the first period were 0.29, 0.79 and 0.63 respectively; whereas in the second period were -0.11, 0.54 and 0.08 respectively. Intraclass correlation of D1 and D2 were higher than D0. Finally, methionine supplementation in the quail’ diet consistently increases egg weight.

1. Introduction
Indonesia as a tropical country has a relatively high environmental temperature. This condition will restrict the ability of the poultry to absorb nutrients in the diets; and one of them proteins. Protein is the determining factor in the preparation of diet to optimize the birds’ performance [1].

The Japanese quail (Coturnix coturnix japonica) is a type of potential poultry in Indonesia as an egg producer. In a year, quail can produce an average of 200-300 eggs. Therefore, necessary diet modification for tropical areas with optimal nutrient content accompanied by supplementation of amino acids methionine which plays a role in protein metabolism [2,3].

Methionine supplementation has been shown to increase the weight of yolk and albumen [4] chickens’ egg weight [5] and the quail’ egg weight [6]. However, these studies focus solely on the performance, while the consistency of the improvement has not been explored. Thus, the study aims to explore the consistency of the quail’s egg weight under the influence of methionine supplementation using the intraclass correlation approach [7].
2. Materials and methods

2.1. The diet experiments
In total 250 individual quails were used in this study. They were randomized into 3 different treatments: D0 (Control), D1 (Control + 0.06% methionine) and D2 (Control + 0.12% methionine) according to Table 1.

Table 1. Nutrient content of the control diet

| Nutrient                      | Content |
|-------------------------------|---------|
| Metabolizable energy (Kcal/kg)| 2,800.10|
| Crude protein (%)             | 19.51   |
| Calcium (%)                   | 3.40    |
| Lysine (%)                    | 1.14    |
| Phosphorus (%)                | 0.62    |
| Methionine (%)                | 0.41    |

Each treatment consisted of five replicates with 15 quails per replicates. The egg weight data were collected for two periods of 28 days (2 × 28 days or eight weeks) started from when the egg productions reached 50% (63 days of age).

2.2. Data analysis
The weekly egg weight data obtained from the average egg weight in each replicate. The data is analyzed to compare the treatment and calculate consistency. All Analysis used a custom script in the R programming language [8].

2.2.1. Compare treatments
A comparison of treatments was done with ANOVA to know the effect of treatment on the quail’ egg weights. If significant differences were observed (P<0.05), we proceed with the Duncan Multiple Range Test (DMRT).

2.2.2. Intraclass correlation
The data were split and averaged into eight consecutive weeks and were divided into two subsets: the consistency of the first period (1st–4th week) and the second period (5th–8th week). Intraclass correlation is used to determine the variance between replicates (σ²w) and within replicates (σ²e). Furthermore, the consistency is defined as the intraclass correlation coefficient (r) of egg weights was be formulated as:

\[ r = \frac{\sigma^2_w}{\sigma^2_w + \sigma^2_e} \]

3. Results and discussion

3.1. Compare treatments
The Egg weight of three treatments with different methionine supplementation is compared. The comparison results can be seen in Table 2.

Results showed increased egg weight as supplementation levels increased. This finding suggests that methionine supplementation affects the quail’ egg weight (P<0.05). The presence of methionine supplementation may increase quails’ feed consumption that will lead to increased intake of protein and other nutrients [9,10]. The excess nutrient such as protein and fat can be allocated to increase the egg weight [11]. This is because methionine is the first limiting amino acid [12] which donates its methyl (CH₃) in a transmethylation process that can increase protein synthesis [2,3]. The results are supported by preceding research Ratriyanto et al. (2017) where methionine supplementation of up to 0.12% may increase egg production, egg weight and quail’ egg mass.
The study was aimed at observing the consistency of quail’s egg weights in the levels of different methionine supplementation. Consistency is interpreted by measuring the correlation of egg weight among weeks of data collection as presented in Table 3.

Table 2. Mean of the egg weight (gram) in the eight weeks of observation

| Week | D0 Mean ± sd$^1$ | D1 Mean ± sd$^1$ | D2 Mean ± sd$^1$ |
|------|------------------|------------------|------------------|
| 1    | 8.45 ± 0.30      | 8.75 ± 0.30      | 8.74 ± 0.44      |
| 2    | 8.43 ± 0.32      | 8.78 ± 0.28      | 8.76 ± 0.43      |
| 3    | 8.39 ± 0.33      | 8.77 ± 0.28      | 8.81 ± 0.43      |
| 4    | 8.38 ± 0.33      | 8.80 ± 0.27      | 8.90 ± 0.44      |
| 5    | 8.63 ± 0.26      | 9.49 ± 0.27      | 9.56 ± 0.25      |
| 6    | 8.62 ± 0.27      | 9.53 ± 0.26      | 9.63 ± 0.24      |
| 7    | 8.63 ± 0.26      | 9.54 ± 0.26      | 9.66 ± 0.26      |
| 8    | 8.63 ± 0.26      | 9.54 ± 0.26      | 9.70 ± 0.30      |
| Averages | 8.52 ± 0.12$^c$ | 9.15 ± 0.40$^b$ | 9.22 ± 0.45$^a$ |

$^1$standard deviation

$^{a,b,c}$ Different superscripts on the same row indicate a noticeable difference (P<0.05)

3.2. Intraclass correlation

Although methionine supplementation increased the egg weight, the consistency has not been explored. As explained above, the calculation of consistency was divided into two subsets; the consistency of the first period (1st–4th week) and the second period (5th–8th week). The consistency influenced by genetic, permanent environment and temporary environmental influence [13]. Supplementation of methionine levels of 0.06% or 0.12% both 1st period and 2nd period indicate a higher consistency value compared to control. In this case, methionine supplementation can optimize the genetic potential for optimal productivity. Finally, our findings confirmed that supplementation in the quails diet increases egg weight and its consistency.

Table 3. Parameter of intraclass correlation

| Treatments | Parameter | 1st period | 2nd period |
|------------|-----------|------------|------------|
|            | $\sigma^2_{\omega}$ | $\sigma^2_e$ | r | $\sigma^2_{\omega}$ | $\sigma^2_e$ | r |
| D0         | 0.03      | 0.08       | 0.29       | -0.01       | 0.07       | -0.12 |
| D1         | 0.09      | 0.02       | 0.79       | 0.05        | 0.04       | 0.54  |
| D2         | 0.17      | 0.10       | 0.63       | 0.01        | 0.10       | 0.08  |

$\sigma^2_{\omega}$ variance between repeat

$\sigma^2_e$ variance between observations within repeat

r consistency

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