Effect of betaine supplementation on the growth pattern of quails reared in a tropical environment

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Abstract. Betaine plays a vital role in forming amino acids to compose proteins, converted into structural tissue in poultry. This study aimed to predict the growth pattern of quails fed diet supplemented with betaine using a logistic regression model. In total, 84 10-day-old quails were divided into two treatments (T0: control, T1: betaine supplementation 0.12%). The diets were given in 2 phases (starter: 22% crude protein; layer: 20% crude protein), where weekly bodyweight data was recorded in each phase. The t-test was conducted to see the effect between treatments, while logistic regression was used to predict the pattern of bodyweight growth. The result showed no effect of betaine in bodyweight parameters (p>0.05) between T0 and T1 both for the starter and layer phases which might be associated with the nutrient sufficiency in the diet, particularly dietary protein. The logistic model's bodyweight prediction has high accuracy with the fitness value for T0=99% and T1=98%. It can be concluded that betaine supplementation in high nutritional diets could not modify the growth pattern of quails.

1. Introduction
Betaine plays an essential role in minimizing the negative impact of tropical environmental stressors. Dehydration in poultry due to tropical stressors causes unstable cell structure [1]. Betaine serves as an organic osmolyte that stabilizes intestinal cells’ structure and function so that they can run optimally [1–3]. In another process, betaine provided a methyl group in the transmethylation cycle [2–4]. The transmethylation cycle produces amino acids, namely methionine, glycine, and cysteine, which act as precursors of protein synthesis [2,3].

Protein is the primary structure-forming animal tissue, including poultry [5–7]. An adequate protein diet is possible to optimize poultry growth. Bodyweight gain response is one of the parameters to determine the effect of protein adequacy diet in poultry [8]. Park and Kim [9] stated that giving betaines increased duck body weight at 42 days. Al-Sagan et al. [10] explained that 0.10% betaine supplementation increased broilers' body weight and feed intake.

The growth pattern was visualized as a predictable sigmoid curve with a nonlinear logistic regression model [11,12]. Parameters from logistic regression are used to evaluate poultry growth performance based on the suitability value between actual body weight gain and predictions data [13,14]. The application of logistic regression assessed the pattern of body weight growth effectively [15] and has never been applied to predict quail growth patterns given 0.12% betaine supplementation in a tropical
environment. This study aimed to predict the growth pattern of quails fed diet supplemented with betaine using a logistic regression model.

2. Materials and methods

2.1. Experimental design
This study used 84 10-days old quail (Coturnix coturnix japonica) obtained from the same local breeding farm. Quail were distributed into two treatment groups with seven replications. The research design used was a one-factor completely randomized design. Since the beginning of quail rearing, the treatment was given T1 = basal diet (control) and T2 = 0.12% betaine supplementation. Betaine was supplemented to the diet using the expense method [14]. The diets given consisted of 2 periods: starter (weeks 3–6) and layer diets (weeks 7–9). Adaptation of the diet for two days was carried out on a transition period with a ratio of 50%:50%. The nutrient composition of the basal diet (Table 1) was based on the nutrient adequacy of the NRC [16].

| Nutrients             | Starter Diet | Layer Diet |
|-----------------------|--------------|------------|
| Metabolizable energy (kcal/kg) | 2800         | 2800       |
| Crude protein (%)     | 22.01        | 20.00      |
| Crude fat (%)         | 2.96         | 4.55       |
| Crude fiber (%)       | 5.81         | 4.48       |
| Calcium (%)           | 1.04         | 3.35       |
| Phosphor (%)          | 0.41         | 0.46       |
| Methionine (%)        | 0.42         | 0.41       |

2.2. Research parameter and data analysis
Quail body weight data were obtained weekly from 3–9 weeks of age. The weighing was done individually using a digital scale with a capacity of 600×0.01 g. The body weight parameter was divided into two observation periods: starter (weeks 3–5) and layer (weeks 6–9). A T-test was conducted to determine the effect between the treatments. Performance confirmation was carried out using logistic regression to assess the level of conformity between the actual and predicted data. Data analysis was carried out using R software according to the R Core Team [17].

3. Results and discussion

3.1. Growth response
The effect of betaine supplementation on quail’s weekly quail body weight can be seen in Table 2. The non-significant effect of 0.12% betaine supplementation was shown in quail body weight at the starter period (P>0.05). The layer period indicated a similar result, where the significant difference was not seen in the weekly body weight parameters for T1 and T2 treatments (P>0.05).

Park and Kim [9] stated that the availability of protein in the diet is a factor that determines poultry bodyweight response. Based on NRC [16], protein requirement for quail in the starter and layer periods has been fulfilled from the experimental diets. The diet protein level given may have reached the maximum absorption limit in quail. Betaine supplementation did not increase body weight because the diet contained adequate protein content and caused nutrient inefficiency in poultry [18]. Based on references, it can be concluded that the provision of betaine in a high nutritional diet did not affect the body weight of the quail during starter and layer periods.
Table 2. Effect betaine on quail growth responses

| Age       | T1         | T2         | P-value |
|-----------|------------|------------|---------|
| Starter period |           |            |         |
| Week 3    | 53.76±7.65 | 55.78±7.21 | 0.22    |
| Week 4    | 74.89±10.34| 76.75±9.90 | 0.40    |
| Week 5    | 98.77±9.25 | 96.77±12.03| 0.39    |
| Layer period |           |            |         |
| Week 6    | 115.08±11.08| 111.45±13.33| 0.18    |
| Week 7    | 129.31±9.15 | 126.23±12.31 | 0.18    |
| Week 8    | 141.05±12.53| 138.78±13.89| 0.43    |
| Week 9    | 150.44±11.81| 148.75±14.54| 0.56    |

Note: T1=control; T2=0.12% betaine supplementation

3.2. Effect of betaine on the quail growth pattern

The weekly body weight gain curve of quails in treatment T1 and T2 is relatively parallel (Figure 1). The body weight gain curve increase indicates that quail's weight gain has not yet reached the growth peak. Kaplan and Gürçan [15] stated that the quail growth curve would be sigmoid in shape with the growth peak starting to slope. The logistic regression parameters compared the actual and predicted growth data accuracy with T1=99% and T2=98%. The accuracy value in this study is classified as high because it has approached 100% [19]. Based on the existing references, it can be concluded that the actual data on the growth of quail body weight has been able to represent the actual data with a high point of conformity.

![Figure 1. Quail growth pattern. (a) actual growth, (b) logistic regression model](image)
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