

Effects of Mineral and Vitamin Supplements on Highly Productive Meat Quail Breeds

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Abstract: A total of two hundreds and fourty of 11-day-old quails was allotted into treatments in order to evaluate the effect of vitamin and mineral addition from various preparations on bodyweight gain, feed consumption to 39 days of age. Each experimental unit consists of 12 quails which were arranged in four treatmets and four replicates. After 42 days of age, an examination of 240 quails were conduted in order to test the criteria of live weight, slaughter weight and carcass characteristics. Quails were fed with mixed feed which were supplemented with mineral and vitamin ingredients from the respective preparations of 0.33% (premix 1), 0.5% (premix 2), 4% (PS), 4% (Calli). The findings showed that the supplemental diet of 0.5% Premix2 helped quails' bodyweight gain (157.7 g), a daily bodyweight gain (4.30 g / d) and feed conversion ratio (3.68 g feed / g gain), which was better than those of the remaining treatments

I. INTRODUCTION

Japanese quail (*Coturnix coturnix japonica*) is a small bird species but has high value in economic term as it provides meat and eggs as well as animal protein sources for humans [1]. Unlike other poultry species, in Japan, female quails have a larger body size than male quails [2]. Research by [3][4] also showed that female quails have a larger body mass and carcass than male quails. In addition, gender that influences on quail productivity has also been reported in many studies; however, studies on the effect of nutrition on growth and quality of meat of this bird at both sex are still limited. The optimization of animal productivity depends on the quality and quantity of their diets [5], in which nutrition is an essential element since it plays important role to the body, especially to growth [1]. Minerals are inorganic ingredients in poultry feed, accounting for a very small proportion in diet, but being important for poultry. In a study on Japanese quail in the period of 1-16 days of age, the quails need plentiful polyminerals including calcium, chlorine, magnesium, Nonphytate Phosphorus, Potassium, Sodium with the corresponding portion of 0.8%, 0.14%, 300 mg, 0.3 %, 0.4%, 0.15%, and essential trace minerals such as Copper (5%), iodine (0.3%), iron (120 mg), manganese (60%), selenium (0.2%), zinc (25%) (NRC 1994).

For providing sufficient minerals and vitamins for quails, the Premix mineral preparations were adequate to meet the vitamin and mineral nutritional needs of Japanese quails. Besides the addition of minerals and vitamins from the Premix compositions, some researches have considered additional applications of mineral and vitamin into the diets of poultry from natural origin. According to research by [6], *Calliandra calothyrsus* dry leaves contain 22% crude protein, 30-70% fiber, fat 2-3%, 4-5% ash and no toxic substances. A study on laying hens showed the effectiveness of the addition of 5%, 7.5% and 10% *Calliandra calothyrsus* leaf meal in increasing live weight [7]. Furthermore, there are potential applications in animal husbandry considering the nutrient content present in *Psophocarpus scandens*, which contains nutritional components such as lipids (2.22%), crude protein (30.8%), iron (375 ppm) and manganese (126 ppm) [8]. However, there is still a lack of additional studies on the mineral composition and vitamins of *Psophocarpus scandens* and *Calliandra calothyrsus*.

II. Materials and Methods

2.1 Experimental birds

The quail-raising space is divided into cages with the size of 0.15m x 0.14m x 0.1m per each, in which each cage has 1 animal. There are five floors designed according to the ladder model, and is of 0.4 m to the ground. The door is made of zinc, covered with a net. The trough is made of 40-meter-long plastic tube, cut in half vertically, each of which is divided into each cell to be fed separately. There are 5 ranges of drinking troughs according to automatic drinking system.

2.2 Design

240 quails at 11 days old were allotted into the treatments to 39 days of age. The experiment was designed in a completely randomized block with five treatments and four replications. Each experimental unit consists of 48 quails arranged with the same proportion of sex. The quails were fed with the same mixed feed which, however, differed in the amount of PS, Calli, Premix1 and Premix2 added to the diet

The treatments in the experiment consist of Control: mixed feed; *Psophocarpus scandens* (PS): mixed feed + 4% PS; *Calliandra* (Calli): mixed food + 4% Calli; Premix1: mixed feed + 0.33% Premix1; Premix2: mixed feed + 0.5% Premix2.

2.3 Chemical analysis of the leaf meal

PS leaf powder and Calli leaf powder are produced in the animal feed laboratories, Animal Husbandry Department, Faculty of Agriculture & Applied Biology, Can Tho University. The powder of these two leaves is added to the quail diet (Table 1).

Table 1. Chemical composition of experimental diets

Parameters	Concentrate	PS leaf powder	Calli leaf powder
Dry matter (%)	87.0	20.8	29.4
Crude protein (%)	24.0	23.7	22.7
Crude fiber (%)	5.0	-	-
NDF (%)	-	41.4	23.4
ADF (%)	-	40.1	23.1
Ca (%)	0.8-1.0	-	-
P (%)	0.6-1.5	-	-
Lysine (%)	1.2	-	-



Methionine + Cystine	0.75	-	-
Metabolizable Energy (Kcal/kg)	2950	-	-

Note: PS: *Psophocarpus scandens*; Calli: *Calliandra*

Premix1 and Premix2 added to the quails' diet contain many nutrients, vitamins and minerals. The composition of Premix1 in 1 kg was Iron (25.5g), Manganese (24.5g), Magnesium (12.6g), Zn (7.3g), Cu (2.1g), Met (2g), Cobalt (1.26g), Lys (1g), Iod (400mg), Selenium (60mg), Calcium carbonate and Calcium diphosphate (40%) and excipient to 1 kg. Premix2 composed of Vitamins A, D3, E, Biotin and ZnSO₄ with standard quality in 1 kg as follows: humidity (max) 12%; Vitamin A (min) 2.000.000 UI; Vitamin D3 (min) 300.000 UI; Vitamin E (min) 8.000 UI; Biotin (min) 30 mg; Zn2+ (min-max) 10.900-13.320 mg; grain of sand (max) 0.5% and excipient to 1 kg.

2.3 Data collection

2.3.1 Body weight

Body weight is identified by quails' initial weigh at the start of the experiment, which is monitored in each experimental plot. The quails after 7 days will be weighed once in the morning until the end of the experiment. Quails' weight gain is calculated according to the formula:

Quails' weight gain after 7 days = quail weight after 7 days - the initial quail weight.

$$\text{Daily weight gain (g/d)} = \frac{\text{Weight gain after 7 days}}{7}$$

2.3.2 Feed Conversion Ratio (FCR)

The amount of quails' feed after being weighed in the morning will be put into the trough and the food leftover after 7 days will be weighed for each experimental plot. Weighing feed is coupled with weighing quails. Feed consumption in each experimental unit was the difference in feed intake and the amount of leftovers after 7 days.

$$\text{FCR (g feed/g gain)} = \frac{\text{Food intake}}{\text{Food leftover}}$$

2.3.3 Feed intake

$$\text{Feed intake (g/d)} = \frac{\text{Weekly food consumption (g)}}{7}$$

2.3.4 Statistical analysis

All data collected on feed conversion ratio, feed intake, body weight, daily weight gain, live weight, slaughter weight and carcass characteristics were statistically analyzed using the GLM procedure of Statistical Analysis System (SAS 2014). Values were considered significant at ($P \leq 0.05$).

III. Results and discussion

3.1 Effect of treatments on body weight, daily weight gain, feed intake and feed conversion ratio of quails

In the present study, the differences in body weight, daily weight gain, feed intake and FCR over the weeks of development were shown in Table 2. The indicators for the development of 11-to-39-day-old quails in the treatments shows statistically significant difference. The results in Table 2 show that body weight and feed intake are not affected by different mineral and vitamin diets at the beginning of the experiment. However, the two periods of 25-39 weeks of age (body weight) and 11-39 weeks (feed intake) show statistically significant impact of other mineral and vitamin diets on these two parameters. In particular, diets with 0.5% Premix2 helped more gain weight as compared with other treatments. Specifically, in the last stage, 39-day-old quails had weight of 157.7 g with Premix2 treatment, which was higher than the weight of quails having Premix1, PS, Calli, Ctrl with 153.0 g, 148.9 g, 146.2 g, 139.2 g, respectively. However, with feed intake, the treatment of Calli supplementation was shown to be higher than other diets and has a statistically significant difference from treatment Ctrl.



Table 2. Body weight, daily weight gain, feed intake and feed conversion ratio of quails subjected to different diets

Parameters	Age (d)	Treatments					SE mean	P
		Ctrl	Premix1	Premix2	PS	Calli		
Body weight (g)	11	37.4	37.2	37.5	38.2	38.6	0.769	0.648
	18	63.6	74.1	75.8	71.6	68.8	2.942	0.072
	25	90.0^b	102.5^{ab}	106.3^a	99.3^{ab}	96.4^{ab}	3.453	0.043
	32	113.6^b	126.9^{ab}	131.3^a	121.8^{ab}	119.1^{ab}	3.704	0.035
	39	139.2^b	153.0^a	157.7^a	148.9^{ab}	146.2^{ab}	3.017	0.007
Daily weight gain (g/d)	11-18	3.74^b	5.28^a	5.48^a	4.76^{ab}	4.32^{ab}	0.339	0.015
	18-25	3.77^b	4.06^{ab}	4.35^a	3.96^{ab}	3.95^{ab}	0.116	0.038
	25-32	3.34	3.48	3.57	3.20	3.24	0.161	0.471
	32-39	3.66	3.73	3.78	3.88	3.88	0.168	0.857
	11-39	3.64^c	4.14^{ab}	4.30^a	3.95^{abc}	3.85^{bc}	0.085	0.001
Feed intake (g/d)	11-18	9.10	9.53	9.66	9.65	9.92	0.325	0.520
	18-25	14.95	16.28	16.03	16.19	16.09	0.428	0.222
	25-32	15.72	16.12	15.74	16.42	16.50	0.214	0.054
	32-39	18.54	18.51	18.27	18.77	18.96	0.464	0.858
	11-39	14.58^b	15.10^{ab}	14.92^{ab}	15.26^{ab}	15.37^a	0.180	0.050
FCR (g feed/g gain)	11-18	2.52^a	1.80^b	1.77^b	2.05^{ab}	2.36^{ab}	0.156	0.013
	18-25	3.97	4.01	3.69	4.09	4.09	0.096	0.055
	25-32	4.70	4.64	4.42	5.21	5.11	0.227	0.122
	32-39	5.09	4.97	4.84	4.92	4.89	0.196	0.921
	11-39	4.07^a	3.86^{ab}	3.68^b	4.07^a	4.11^a	0.078	0.005

Note: PS: *Psophocarpus scandens*; Calli: *Calliandra*

Diets have the effect on two parameters of average daily weight gain and FCR at the beginning and end of the experiment. The experimental results on average daily weight gain at 0.5% Premix2 had more significant effects than compared with Premix1, PS, Calli and Ctrl when added to the diet at 11-25 and 11-39 days of age. In particular, Premix2 resulted in the highest weight gain (4.30 g/ d), followed by Premix1 (4.14 g/ d), PS (3.95 g/ d), Calli (3.85 g/d), and Ctrl (3.64 g/d). With FCR, with 0.5% Premix2 helped reduce feed consumption to 3.68 g feed/g gain, which was lower than that in Premix1, PS, Calli and Ctrl treatment with 4.07 g feed/g gain.

In general, the results in Table 2 show that, in all the average survey parameters of the completely experimental period, there was a significant impact between different diets. In particular, the quails supplemented with Premix2 diet showed body weight (157.7 g), daily weight gain (4.30 g / d) and feed intake



(14.92 g / d), which were higher and differed significantly compared to treatment Control and lower than FCR (3.68 g feed / g gain)

3.2 Body weight, daily weight gain, feed intake and feed conversion ratio

Current research results show that mineral and vitamin supplementation has significantly improved body weight, daily weight gain, feed intake and feed conversion ratio. In which, two supplemental treatments of premix1 and premix2 showed a high improvement and statistically significant difference compared to treatment Control ($P < 0.05$). The effect of minerals and vitamins in diet on production capacity has also been demonstrated in chickens [9]. The writers also show that Chromium and Vitamin C supplementation on broiler helped increase body weight gain ($P < 0.01$), the amount of food consumption ($P < 0.01$), and feed efficiency ($P < 0.05$). These supplements also helped increase meat weight and yield ($P < 0.05$) [9]. Minerals are essential for animal health, survival and production due to their involvement in physiological, structural, catalytic and regulatory functions of animal bodies [10]. Mineral supplementation in diet ensures mineral needs to support metabolic activity in tissues [11]. According to [12] minerals are closely associated with animal growth because of its important role in protein and energy metabolism; animals lacking in minerals can reduce food consumption and and efficient use. Therefore, the addition of minerals (premix1) to diet has significantly improved body weight (153.0g), daily weight gain (4.14 g / d) and feed conversion ratio (3.86 g feed / g gain) compared to PS, Calli and especially Control; however, the effect was lower than the treatment supplemented with vitamin (premix2) (157.7 g, 4.30 g / d and 3.68 g feed / g gain respectively).

In addition to mineral, vitamins (A, C and E) play important role in the immune function and growth of poultry, in which vitamin C plays important role in corticosterone biosynthesis-an energy-boosting hormone during stress. Heat stress at different levels severely affects egg laying, egg size, eggshell durability and body weight gain [13][14][15][16]. In addition, the role of vitamin E in growth stimulation has also been indicated by [17]. Regarding the role of vitamins, [18] showed that the supply of a vitamin complex (B-Complex, A, D and E) to drinking water of broiler chickens has reduced stress, improved weight gain and feed conversion ratio. According to [17], vitamin E, which acts as an antioxidant breaking down the biological chain, is included in poultry feed to improve productivity. Current research results show that the addition of premix2 containing vitamins A, D3 and E significantly improves body weight (157.7 g) and the daily weight gain (4.30 g / d) and FCR (3.68 g feed / g gain) which was lower than the remaining treatments and showed a statistically significant difference compared to Control treatment (139.2g, 3.64 g/d and 4.07 g feed /g gain respectively). However, Shah et al (2016) reported that, vitamin E supplementation on quail diets showed that FI, FCR, WG, and BW were not different ($P > 0.05$), yet FI and WG in experiments with supplementary 150 mg vitamin E/ kg of feed were higher than the control group. This result shows that supplemental premix2 treatment with 3 vitamins A, D3 and E has an effective effect on body weight indicator, daily weight gain, feed intake and feed conversion ratio of the experiment.

IV. Conclusions

In conclusion, vitamins and mineral composition of Premix2 help to reduce feed consumption, to have better weight gain and to increase economic efficiency compared with other treatments.

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