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RESEARCH ARTICLE

Effects of Methionine Supplementation on Growth, Productivity, and Health Parameters in Japanese Quails (*Coturnix coturnix japonica*)

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ABSTRACT

Methionine Amino acid that has a crucial role in synthesis of proteins, methylation and antioxidant protection of poultry. Japanese quails (*Coturnix coturnix Japonica*) due to their high productivity and economic status need optimum nutritional management to boost their performance. The present research is aimed at determining the impacts of different amounts of dietary methionine supplementation on egg production, growth performance, physiological parameters of health, and immune responses in Japanese quails. Two hundred and forty days-old quail chicks were assigned randomly and fed using four dietary treatments, namely, control (basic diet), and basic diets to which the control diet had been added 0.1, 0.2, and 0.3 percent methionine diet after six weeks. The parameters that were evaluated were body weight gain, feed intake, and feed conversion ratio (FCR), egg production characteristics, serum biochemical indices, and hematological indices, and antioxidant enzyme activities. Findings show that there was significant effect of methionine supplementation on body weight, FCR, egg production and percentages of hatching. Also, methionine increased serum proteins, decreased oxidative stress, and facilitated immune response. The best outcomes were attained with supplementation at 0.2%. These results indicate that moderate diets, which enrich methionine, positively improve the health and overall performance of Japanese quails.

1. Introduction

Japanese quail (*Coturnix coturnix japonica*) is a high-prolific poultry species and is extensively utilized in meat and egg production because of its short generation interval, potential egg-laying ability and effective use of feed [1]. In order to attain maximum productivity, nutritional methodology has to be formulated that responds to the metabolic demands of this bird, in terms of intake of amino acids [2].

Methionine is one of the most important amino acids that are crucial in poultry nutrition. Methionine is a sulphur (sulfur)-containing amino acid in attachment to the protein synthesis, transsulfuration, methylation and immune control [3]. It is also an intermediate precursor to other sulfur containing amino acids such as cysteine and taurine as well as to glutathione, the most important antioxidant molecule. Methionine deficiency may cause development retardation, depress reproductive performance, undermine immune performance and result in oxidative stress [4].

Methionine supplementation in the diet of poultry birds has escalated in the recent years especially because of the affordability of the synthetic form of DL-methionine and its

favourable impact on the performance variables [5]. Nonetheless, broilers and layers have received a lot of research attention whereas; the importance of methionine impregnation has received less research interest among the Japanese quails [6]. Furthermore, the optimum and dose and relationship of the occurrence of performance and health parameters are still a matter of discussion.

The objective of the study is to determine the impacts of dietary methionine supplementation on growth, productive performance and health related traits in Japanese quails. Body weight gain, egg production, feed efficiency, hematological indices as well as oxidative stress measurements were carried out. Results of this research are likely to tool towards the improved knowledge of amino acids nutrition in quail production systems and supply some practical suggestions regarding feed formulation.

2. Materials and Methods

2.1. Animal Husbandry and Experimental Design

The purchase of 240 one-day old Japanese quail chicks was done at random and assigned to 4 dietary treatment group each containing 3 replicates of 20 birds each. The following were the treatments: A1 (Control): Nonprovision of extra methionine in the diet; B 2: Basal diet + 0.100 % DL-methionine; C3: Basal diet + 0.2 % DL-methionine; D4: Basal diet with 0.3 percent DL-methionine. Birds were kept in an enclosed environment and ambient temperatures were kept at 32 Cº to 35 Cº in the initial week dropping to 24 Cº by fourth week. Feed was given ad libitum and water. The experimental time extend was 6 weeks.

S.No	Ingredient	Quantity (g/kg)
1	Maize	500
2	Soybean meal (45% CP)	300
3	Wheat bran	80
4	Fish meal	50
5	Limestone	20
6	Dicalcium phosphate	15
7	Vitamin-mineral premix	10
8	Salt	3
9	DL-Methionine	As per treatment

2.2. Diet Composition

The basal diet was designed as per the NRC (1994) guidelines of the Japanese quails which had maize, soybean meal, vitamins and minerals. DL-methionine provided at more than 99 purities was procured commercially and homogenously added to feed as per the treatment levels.

2.3. Parameters of Growth Performance

The gains of body weight a week, the intake of feed and feed conversion ratio (FCR) were noted. Death was recorded every day.

2.4. Production Parameters of Reproduction and eggs

Beginning with week 5, the egg-laying performance was measured. The parameters were, age of first egg, the percentage of hen-day egg production, the weight of eggs, the mass of eggs, the shell thickness and hatchability.

2.5. Biochemical and Hematological study

Blood samples of five birds per replicate, chosen at random, were taken at the final part of the trial. Red cell related indices were packed cell volume (PCV), hemoglobin (Hb), red blood cell (RBC), and white blood cell (WBC). Serum was prepared and tested according to the total protein, albumin, globulin, glucose, cholesterol levels.

2.6. Immune and Antioxidant Parameters

The liver was homogenized in order to determine antioxidant enzyme activities: superoxide dismutase (SOD), catalase (CAT), and malondialdehyde (MDA) as mark of lipid peroxidation. The ELISA kits were used to determine the levels of serum immunoglobulin G (IgG).

2.7. Statistical Analysis

The SPSS (Version 25) was used to analyze data based on the one-way ANOVA and the comparison of means was performed with the help of Tukey test. The study response was to establish significance at $p < 0.05$.

3. Results

3.1. Growth Performance

The supplementation with methionine influenced the gain in body weight and FCR on a significant level ($p < 0.05$) (Table 2). The best final body weight was found in birds fed on C3 (0.2% methionine) and better than in D4 and B2. The performance of the control group in growing was the poorest. The FCR was low in C3 and this shows increase in feed efficiency.

3.2. Reproductive characteristics and Egg production

Birds in C3 also produced the earliest first placement egg (36.8 0.5 days) and had the greatest production on the basis of hen days (86.5 1.7 %) ((Table 3). Egg weight and shell thickness was also significantly greater in C3 as compared to control. There was an increase in the hatchability in C3 and D4 but no much difference in fertility among the groups.

3.3. Hematological Indices

In methionine supplemented groups, there were significant increases in PCV, Hb and white blood cells counts. C3 birds possessed the greatest concentration of Hb (14.5 0.4 g/dL), as well as PCV (41.2 0.12 %) (Figure 1).

3.4. Serum Biochemical Pro Files

Total serum protein, albumin and globulin concentrations were enhanced with the administration of methionine, particularly in C3 (Figure 2). The level of cholesterol and UA were lower in B2-D4 than in control.

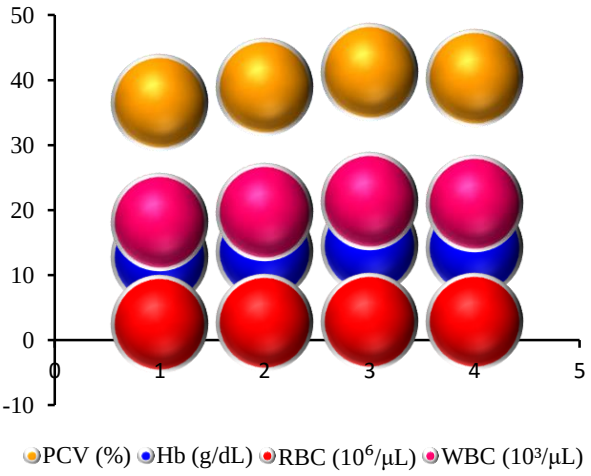
Table 2. Growth Performance of Japanese Quails at 6 Weeks

Parameter	A1 (Control)	B2 (0.1%)	C3 (0.2%)	D4 (0.3%)	SEM	*p*-value
Final Body Weight (g)	158.4	165.2	175.2	172.3	2.1	<0.05
Feed Intake (g/bird)	520.1	525.3	528.8	527.1	1.8	ns
FCR	3.28	3.12	3.01	3.05	0.05	<0.05

Table 3. Egg Production and Reproductive Traits

Parameter	A1 (Control)	B2 (0.1%)	C3 (0.2%)	D4 (0.3%)	SEM
Age at First Egg (days)	38.1	37.2	36.8	37.0	0.5
Egg Production (%)	74.3	80.4	86.5	84.2	1.7
Egg Weight (g)	10.2	10.9	11.5	11.3	0.3
Hatchability (%)	65.5	70.2	76.8	75.4	1.6

Figure 1. Hematological Parameters



3.5. Antioxidant Status

The activities of SOD and CAT enzymes were much higher with supplemented birds. MDA was the lowest in C3, meaning that less damage due to oxidation was present. The findings indicate that methionine increases antioxidant defense processes (Figure 3).

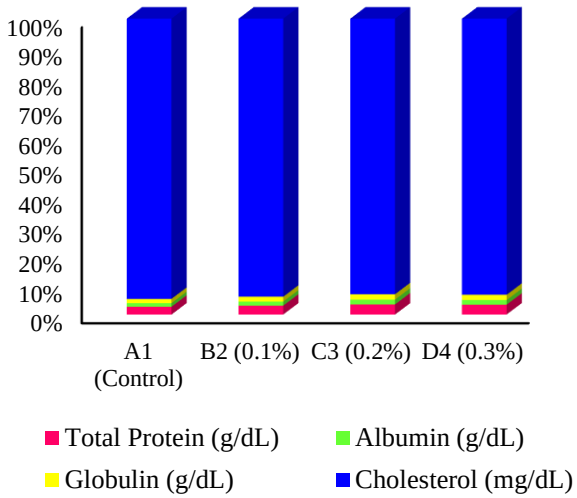
3.6. Immune Response

There were significant differences in serum IgG levels with in-creased level in methionine supplemented groups and the largest being in C3 and D4 pro-viding an indication of better humoral immunity (Figure 3).

4. Discussion

The findings of the present paper confirm the fact that methionine supplementation can markedly improve growth, productivity and health into the Japanese quails. The improvement in bodyweight and FCR is similar to the observation in previous studies involving both broilers and

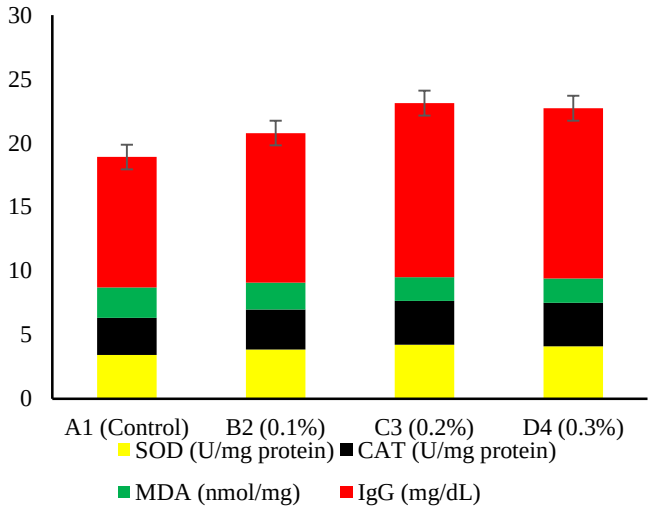
Figure 2. Serum Biochemical Parameters



layers in which the supplementation with methionine resulted in enhanced nitrogen retention and protein synthesis [7,8]. Methionine concentration of 0.2 percent enhanced egg production characteristics signifying that 0.2 percent could be optimal level which would support maximum performance during laying in quails. The enhanced presence of the Methionine in the methyl group transfer as well as fatty acids metabolism might be attributed to the superior yolk and shell attributes [9].

The enhanced hematological findings in birds fed with methionine comprise improved oxygen-carrying ability and immune competence. This agrees with the findings that indicated methionine stimulates the erythropoiesis and the growth of immune cells [10].

Figure 3. Antioxidant and Immune Response Markers



The alleviation of the antioxidant status through enhancing the SOD and CAT activity, as well as a decreasing MDA levels signifies methionine to decrease oxidative stress. Methionine being the antecedent of glutathione enhances scavenging of free radicals and preservation of cellular integrity [11,12].

Biochemical parameters in serum were also confirmed to clinically confirm health-promoting effects of methionine; increased liver functions and decreased metabolic waste. A rise in the levels of serum proteins and immunoglobulins also indicates the good absorption of nutrients and immunomodulations [12]. Notably, there were no side effects in the highest supplementation group (0.3%) and thus performance improvement was exemplified by a good margin of safety since it could not be enhanced further than 0.2%. Thus, more than expected is not seeming to have extra benefits and appears to be not cost dependable.

5. Conclusion

The supplementation of Methionine in the diets of Japanese quail remarkably enhances the growth performance, monodiosurin output, and the antioxidant capacities, as well as the immunity of the quails. The best results were noted at a supplementation level of 0.2%, which is the reason why this value can be accepted as a suitable inclusion level. Such studies prove the importance of including methionine in commercial quail diets as a measure of improving productivity and health, especially in intensive rearing condition.

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