Effect of Adding Water-Soluble Chitosan on Some Physiological Traits of Quail Males

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Abstract

The study was conducted to determine the effect of adding water-soluble chitosan on some hematological and biochemical traits in the quail during rearing for meat production, twenty-seven male quail at nine weeks of age were randomly assigned to three treatments with three replicates, it was treated with chitosan for 28 days, according to the following concentrations, the first treatment (control treatment), the second and third treatments, water-soluble chitosan was added at a concentration of 0.2 and 0.3 g/L, respectively. The results showed that there were no significant differences among treatments in RBC, PCV, Hb, MCV, MCH, glucose concentration and AST and ALT enzymatic activity, while there were significantly increased WBC in both experiments in addition treatments compared to the control treatment. The adding of the water-soluble chitosan at a concentration of 0.2 and 0.3 g/L resulted in a significant decrease in the concentration of cholesterol and triglycerides, while the adding 0.3 g/L led to a significant increase (P≤ 0.05) in the total protein concentration, albumin and Globulin compared with the control group. We conclude from this research that the adding of water-soluble chitosan at a concentration of 0.3 g/L has the potential to improve productive performance and enhance bird health.

Keywords: Chitosan, Quail, Physiological traits.

1. Introduction

Poultry farmers use antibiotics extensively as food additives in dietand drinking water for poultry to enhance the growth and health of birds and reduce their sensitivity to infectious diseases where they are intensively bred [1,2], and thus increase their production (meat, eggs) and reduce the mortality rate. at the same time, antibiotics were found to have potentially negative effects because of potential bacterial resistance and transmission of antibiotics into meat[3]. Therefore, great interest has been recently shown for prebiotics[4,5].Most prebiotics are non-digestible carbohydrates that promote colonic colonization of beneficial microorganisms and aid for a healthy growth and maintenance of probiotics [6]. Prebiotics like mannann oligosaccharide (MOS) and chitosan oligosaccharide (COS) are used as alternatives to antibiotics[7,5]. Chitosan is the second most abundant polymer in nature [8,9]. It is obtained by removing the acetylcholine (deacetylation) from the ketene found in the exoskeleton of crustaceans and insects [10] or in the outer cell wall of yeast and fungi [11,12]. Chemically, chitosan is synthesized from the bonding of similar units of N-acetyl-D-glucosamine with glycosides bonds of type β- (1 → 4) from which sub-chains of type β- (1 → 4)-2- amino-2-deoxy-D- glucopyranose [13,11]. Since chitosan contains effective functional groups, which are the amine group and the primary and secondary carboxylic groups, it has many biological functions [14] as well as its role in improving the growth and productive performance of animals [15], It reduces cholesterol and low-density lipoproteins (LDL) in the plasma and decreases the formation of triglycerides in the liver [16,17], it an antioxidant [18] and a free radical scavenger [19]. So, this research aims to know the effect of adding water-soluble chitosan on some physiological traits of quail males.

2. Materials and Methods

The study was conducted in the animal production farm of the Animal Production Department / College of Agriculture / University of Tikrit, the twenty-seven male quail birds, nine weeks old, were used and that was prepared from the Agricultural Research Department, Abu Ghaiba, and randomly distributed to three groups, each treatment three replicates (9 males / treatment). They were reared in cages with three floors (one cage size 40 x 40 x 40 cm) placed in each cage three male quails, the experiment lasted 28 days, during which the birds were given chito-oligosaccharide in water according to the following concentration: the first treatment birds (control treatment) plain Water Free of dissolved chitosan, the second treatment birds were given water to which water-soluble chitosan was added at a concentration of 0.2 g / L, while the third treatment birds were given water to which chitosan was dissolved in water at a concentration of 0.3 g / L, water was supplied ad libitum throughout the experiment. The birds were fed a productive diet containing metabolic energy of 2832.73 kcal/kg feed and...
crude protein, at 20.50%. The water-soluble chitosan used in the experiment has a 95% purity, supplied by (Xi’an China) Xi’an Lyphar Biotech Co., Ltd Tanyan road China.

2.1. Collecting blood samples and serum tests

Blood samples were collected from birds at the end of the experiment period, where two types of tubes were used, the first being a test tube container on EDTA to measured RBC, PCV, Hb, MCV, MCH and WBC according to the method indicated by [20]. The second is anticoagulant-free test tubes for the purpose of obtaining serum for biochemical blood tests that included measuring the concentration of glucose, cholesterol, triglycerides, total protein, albumin and the effectiveness of AST and ALT enzyme serum using kits manufactured by The French company Biolabo Reagents. The concentration of Globulin was calculated according [21].

| Primary feeding materials          | Percentage(%) |
|-----------------------------------|---------------|
| yellow corn                       | 53.10         |
| Soybean meal (48% raw protein)    | 33.10         |
| Vegetable oil (sunflower)         | 4.00          |
| Premix                             | 2.50          |
| Limestone                          | 7.00          |
| Salt                               | 0.30          |
| Total                              | 100           |

Calculated chemical composition *

| Metabolenergy kcal/kg             | 2832.73       |
| Crude protein(%)                 | 20.50         |
| Crude fiber(%)                   | 3.62          |
| Calcium(%)                        | 2.89          |
| Available phosphorus(%)          | 0.40          |
| Lysine(%)                         | 1.12          |
| Methionine(%)                     | 0.47          |
| Methionine + cystine(%)           | 0.80          |

* The chemical composition was calculated according to the NRC [22]. *(Premix) contain 40% crude protein, 2150 kcal / kg, 5% crude fat, 3.85% lysine, 3.70% methionine, 4% methionine+cysteine, 6.5% calcium, 4% phosphorus available.

2.2. Statistical analysis

The Completely Randomized Design (C.R.D) was used and the data analyzed using the SAS [23]. The averages of each trait were compared using the Duncan’s Multiple Ranges Test [24] at (P ≤ 0.05) to determine the significance of the differences among the averages.

3. Results

The results in Table (2) show that there was no significant effect of the addition of water-soluble chitosan in RBC, PCV, Hb, MCV, and MCH, as no significant differences appeared among treatments. WBC increased significantly (P≤ 0.05) in T2 and T3 treatments compared to control treatment.

| Treatment Treats | T1          | T2          | T3          |
|------------------|-------------|-------------|-------------|
| RBC (10^6/mm³)   | 3.81±0.07   | 3.91±0.06   | 3.86±0.10   |
| PCV%             | 39.00±1.00  | 40.00±1.15  | 42.00±1.52  |
| Hb (g/100m)      | 13.00±0.57  | 13.33±0.88  | 14.00±0.57  |
| MCV(µ³)          | 100.88±7.21 | 102.08±1.50 | 108±3.71    |
| MCH(Pg)          | 32.67±0.23  | 34.03±2.05  | 36.25±1.69  |
| WBC(10³/mm³)     | 25.08±0.91b | 29.04±1.18a | 29.70±1.13a |

*a,b. in same row refers to significantly different at level (P<0.05).
T1: control treatment. T2: added water-soluble chitosan at a concentration 0.2 g/L. T3: added water-soluble chitosan at a concentration 0.3 g/L

Table (3) shows the effect of adding water-soluble chitosan on some biochemical parameters in quail males, where a significant decrease in the concentration of cholesterol and triglycerides in the serum of treatments T2 and T3 compared with the control treatment. No significant difference was observed in the concentration of glucose, while a significant increase (P ≤ 0.05) was observed in the concentration of total protein and Globulin in T3 compared to the control treatment and had no significance differences compared with T2, whereas, the albumin concentration increased significantly (P ≤ 0.05) in T3 compared with control treatment and T2. The addition of chitosan of 0.2 and 0.3 g/L did not influence on the ALT and AST enzyme activity, as no significant differences emerged between trial and control treatments.

Table 3. Effect of adding water-soluble chitosan on some biochemical parameters (Means ± Standard error) for the serum of quail males.

| Treatment Traits          | T1                                | T2                                | T3                                |
|---------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Total cholesterol (mg/dl) | 128.24±1.555 a*                   | 104.30±0.768 b                   | 98.90±0.822 c                     |
| Triglyceride (mg/dl)      | 96.29±0.806 a                      | 91.61±1.020 b                     | 75.32±0.809 c                     |
| Glucose (mg/dl)           | 194.00±1.517                       | 191.55±0.879                      | 192.40±0.816                      |
| Total Protein (g/dl)      | 3.20±0.123 ab                      | 3.44±0.074 ab                     | 3.69±0.071 a                      |
| Albumin (g/dl)            | 1.35±0.020 b                       | 1.36±0.018 b                      | 1.48±0.019 a                      |
| globulin (g/dl)           | 1.85±0.106 b                       | 2.08±0.081 ab                     | 2.21±0.059 a                      |
| AST(IU/L)                 | 33.75±1.376                        | 34.25±1.030                       | 32.75±1.030                       |
| ALT(IU/L)                 | 52.00±0.707                        | 50.75±0.853                       | 51.50±0.645                       |

*a,b,c.* in same row refers to significantly different at level (P ≤ 0.05).

T1: control treatment. T2: added water-soluble chitosan at a concentration 0.2 g/L. T3: added water-soluble chitosan at a concentration 0.3 g/L

4. Discussion

The results showed that the addition of water-soluble chitosan did not affect RBC, PCV, HB, MCV, and MCH while increasing the WBC and this result was consistent with [25,16]. PCV and HB are RBC-dependent blood characteristics if healthy birds are stable [20]. The reason for the increase WBC may be due to the role of chitosan in enhancing bird immunity by increasing the weight of the main immune organs [26,27], and increasing the concentration of immunoglobulins (IgG, IgA and IgM) in serum [28,29]. Activating lymphocytes and improving Macrophage function by stimulating them to release Cytokines [26]. Chitosan is one of the compounds that specifically bind to a receptor protein on the surface of macrophage or lymphocytes to stimulate the immune reaction in cooperation with cytokines [16]. From the results in Table (3), the study recorded that the adding of chitosan to the water resulted in a decrease in the total cholesterol and triglyceride concentration in the male blood serum. This result is consistent with [18,30]. The results may be due to the biological role of chitosan in reducing intestinal fat absorption, through its breakdown into polysaccharides causing an increase in intestinal viscosity and a reduction in the absorption of fats and cholesterol [17], which leads to lower cholesterol and increased synthesis of bile acids in the liver [31]. The mechanism of chitosan action on cholesterol metabolism by inhibiting the formation of micelle during digestion of lipid in the tract forming ionic bond with the bile salts and acids [32] necessary for emulsification of dietary fats and activation of the pancreatic lipase activity [30], which limits the absorption of fats. The synthesis of triglycerides in the liver increased the fecal lipid excretion [33]. The serum total protein concentration usually reflects protein metabolism, [34,35], and the immune status in vivo [36]. The high concentration of total protein, albumin, and globulin in the blood serum of quail males when adding dissolved chitosan with water at a concentration of 0.3 g / L, indicates an improvement in productive performance by increasing body protein anabolism, as well as enhancing immune response, this is consistent with [34]. Where albumin is an indicator of production and Globulin is an indicator of immunity, as it includes antibodies in the serum [37]. [14,29,38] have previously reported the possibility of using chitosan as an immuno-stimulant due to its anti-inflammatory properties and its antimicrobial activity. It stimulates cellular and Humoralimmun response [27]. As well as its role in activation Macrophages, stimulation of body resistance and protect against pathogenic infections [39] (Rhodae et al. 2006). The adding of water-soluble chitosan did not significantly affect the effectiveness of AST and ALT enzymes in bird blood serum and may return to the role of chitosan in maintaining bird stability and functions Physiological and this result agrees with [16,40].
Conclusions

We concluded from this study that the positive effect of the addition of water-dissolving chitosan is due to its ability to improve the productive performance of birds and enhancing the health and immunity of birds, as well as its ability to reduce the level of cholesterol and triglycerides and thus, improving the quality of meat.

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