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Research Article

The Effects of Mannan Oligosaccharide and Chitosan Oligosaccharide on Performance and Blood Parameters of Broilers

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ABSTRACT: The aim of this study was to evaluate the mannan oligosaccharide (MOS) and chitosan oligosaccharide (COS) on growth performance and blood parameters in broilers. A total of one day old 120 male broiler chicks (Ross 308) were utilized in this study. Chickens were fed a period of 42 days with experimental diets. Each dietary treatment was assigned to four replicates of 10 birds. Dietary treatments included a basal diet (control group); the MOS group (basal diet + 100 ppm Mannan oligosaccharide); and the COS group (basal diet+ 100 ppm Chitosan oligosaccharide). Total protein, albumin, total cholesterol, triglyceride, glucose, and plasma Cu and Zn levels were analyzed. At the end of the experiment, mean body weights (BW) were measured 2340.45, 2458.11, and 2325.38 g, respectively. Chicks fed with MOS group had a 5.03% higher BW than the control group. Dietary addition of MOS and COS had no significant effects in body weight gain, feed consumption, feed conversion ratio, carcass yield, and some blood parameters. Serum Cu level was significantly increased by dietary supplementation of MOS and COS compared to the control group. In conclusion, dietary supplementation of MOS and COS led to improved serum Cu level in broiler.

Keywords: Broiler, Prebiotic, Performance, Mannan oligosaccharide, Chitosan oligosaccharide

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Broyler Rasyonlarına Mannan Oligosakkarit ve Kitosan Oligosakkarit İlavesinin Performans ve Bazı Kan Parametreleri Üzerine Etkisi

ÖZ: Bu araştırma, broyler rasyonlarına mannan oligosakkarit (MOS) ve kitosan oligosakkarit (KOS) ilavesinin performans ve bazı kan parametreleri üzerine etkisini değerlendirmek amacıyla yapılmıştır. Denemede toplam 120 adet erkek broyler civciv kullanılmıştır. Her bir denemede, 10 civcivden oluşan 4 tekrarlı grup kullanılmıştır. Deneme 6 hafta sürmüştür. Deneme rasyonları, kontrol grubu (basal rasyon); MOS grubu (basal rasyon + 100 ppm Mannan oligosakkarit) ve KOS grubunu (basal rasyon +100 ppm Kitosan oligosakkarit) içermektedir. Araştırma sonunda, rasyona MOS ve KOS ilavesinin canlı ağırlık, canlı ağırlık artışı, yem tüketimi, yemden yararlanma oranı, karkas randımanı ve bazı kan parametreleri üzerine istatistiksel olarak etkisi gözlenmemiştir. MOS ve KOS ilave edilen grup, kontrol grubu ile karşılaştırıldığında, serum Cu seviyesi önemli bir şekilde artmıştır. Sonuç olarak rasyona MOS ve KOS ilavesi broylerlerde sadece serum Cu düzeyinde gelişmeye sebep olmuştur.

Anahtar Kelimeler: Broyler, Kitosanoligosakkarit, Mannanoligosakkarit, Performans, Prebiyotik

INTRODUCTION

Using antibiotics as growth promoters was forbidden in poultry industry because of potential bacterial resistance and transmission of antibiotics into meat. Therefore, great interest has been recently shown for prebiotics. Most prebiotics are non-digestible carbohydrates that promote colonic colonization of beneficial microorganisms and aid for a healthy growth and maintenance of probiotics (14). Prebiotics like mannan oligosaccharide (MOS) and chitosan oligosaccharide (COS) are used as alternatives to antibiotics.

Mannan oligosaccharide is obtained from yeast cell wall surface and serves as a binding site for bacteria. Pathogens possessing mannose–specific-type 1 fimbria are attached to MOS instead of intestinal epithelial cells, and thus cannot colonize intestinal canal. Hence, MOS provides a means for removal of pathogenic bacteria capable of binding to intestinal lumen. In addition to limiting the colonization of pathogenic bacteria, mannan oligosaccharide also serves as an energy source for *Lactobacillus* and *Bifidobacterium* species (8, 12, 24). Chitin, a substance found on the outer structure of shellfish (e.g. crab, shrimp), is a component of cell walls of insects and fungi (10). Chitosan is a biologically active, non-toxic product derived by the removal of acidyl residue from biopolymerized chitin. The chitosan oligosaccharide (COS) form that is derived from chitosan by chemical and enzymatic hydrolysis is more soluble than the parent compound (17, 21). Multiple studies have shown that COS reduces cholesterol levels and the number of pathogenic bacteria in the intestinal system; favorably affects performance and immune system; and exerts anti-carcinogen, antioxidant, and antidiabetic effects (5, 15, 34).

This study aimed to investigate the effects of MOS (Mannan oligosaccharide, Bio-Mos®, Alltech, Nicholasville, Kentucky) and COS (Chitosan oligosaccharide, GlycoBio, Dalian, China) added to broiler diets on growth performance, carcass yield, and blood parameters.

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MATERIALS AND METHODS

Experimental Design and Diet

In this study, a total of one day old 120 male broiler chicks (Ross 308) were utilized in experiment with a period of 42-day. Chicks were divided into 3 groups consisting of four replicates with 10 chicks in each. Chicks each replicate group were placed in stainless steel cages 40 × 65 × 98 cm, 10 chicks per m^2. Plastic holed flooring was used as bedding. The composition of the basal diet is given on Table 1 and formulated to starter (0 to 21 d) and grower periods (22 to 42 d). Dietary treatments included a basal diet (control group); the MOS group (basal diet + 100 ppm Mannan oligosaccharide); and the COS group (basal diet + 100 ppm Chitosan oligosaccharide). Chemical analyses of the experimental diets were determined by AOAC (write the year). Fresh water and treatment diets were available *ad libitum* throughout the study. Room temperature was initially set at 33°C and gradually reduced by 3°C per week to 24°C at third week, and was kept controlled thereafter. The metabolizable energy value of the rations was calculated according to TSE (33).

Table 1. Composition of the basal diets

Ingredients (%)	Starter diet (0-21 d)	Finisher diet (22-42 d)
Corn	40.10	42.30
Wheat	9.30	10.20
Soy bean meal	25.10	23.00
Full-fat soybean	15.00	15.00
Fish meal	3.40	1.20
Vegetable oil	3.80	5.00
Lime stone	0.90	0.90
DCP	1.50	1.50
Salt	0.25	0.25
Vitamin+Mineral premix*	0.20	0.20
DL-Methionine	0.20	0.20
L-Lysine	0.15	0.15
L-Treonin	0.10	0.10
Chemical composition (Analyzed)		
HP	23.25	21.10
ME (kcal/kg)	3.112	3.228
Cu mg/kg, (as feed, analyzed)	9.10	8.25
Zn mg/kg, (as feed, analyzed)	23.75	29.00

*Vitamin-Mineral premix (IU or mg/kg diet): 12000 IU vitamin A; 1500 IU vitamin D3; 30 mg vitamin E; 5 mg vitamin K3; 3 mg vitamin B1; 6 mg vitamin B2; 5 mg vitamin B6; 0.03 mg vitamin B12; 40 mg nicotinic acid amine; 10 mg D-Ca-pantothenate; 0.075 mg folic acid; 375 mg choline; 80 mg manganese; 80 mg iron; 8 mg copper; 0.5 mg iodine; 0.2 mg cobalt; 0.15 mg selenium.

Performance and Carcass Yield

The experiment was lasted 42 days. Chickens were individually weighed on a weekly basis (Wk 1 to 6) to determine mean body weight (BW) and body weight gain (BWG). The feed consumption (FC) and feed conversion ratio (FCR) were measured weekly (FC/BWG). At the end of study, a total of 12 chicks (3 chicks per replicate) from each group were randomly selected and slaughtered, mechanically defeathered, processed (separation of head and feet), and eviscerated (separation of digestive system). Hot carcass yield was calculated by dividing final body weight.

Analysis of Blood Parameters

Blood samples taken into serum test tubes were centrifuged at 1600 × g and 4°C for 10 minutes, and stored at – 20°C. Blood parameters were analyzed spectrophotometrically (Shimadzu UV, 1700, Japan) using diagnostic kits. Serum values of Cu and Zn were analyzed with the atomic absorption spectrophotometer, Perkin Elmer, Aanalyst 400, USA (Tiftik, 1996). Kırıkkale University Ethics Committee approved the study protocol (Protocol Number: 2012/20).

Statistical Analysis

All data were subjected with SPSS 16.0 for Windows. One-way analysis of variance (ANOVA) was applied to determine significant differences between groups. Differences between means were detected using the Duncan's multiple range test.

RESULTS AND DISCUSSION

The effect of supplementation MOS (Mannan oligosaccharide) and COS (Chitosan oligosaccharide) on growth performance of broilers are given in Table 2. MOS addition had no statistically effect on BW, but tended to be numerically higher 5.03% compared to control group. During the experiment BWG, FC, FCR were not influenced significantly by supplementations of MOS and COS (P>0.05). Yalcinkaya et al. (38) reported that the addition of 0.05%, 0.10%, and 0.15% MOS to the broiler diet did not influence the performance. Eseceli et al. (11) also found that the addition of MOS (starter 0.15%, grower 0.1%, finisher 0.05%) in broiler diets had no effect on BW. Similar results were also reported by some other researchers (9, 23, 35). Keser et al. (19) observed no effect on the performance (BW, BWG, FC, FCR) by administering 0.025% COS to broilers at all measurement periods. Similarly, Huang et al. (16) showed no differences between the groups fed basal, 50, and 150 ppm COS diets with respect to BWG. These results were consistent with ours. In addition, some other studies reported positive effects of MOS (1, 4, 6, 20) and COS (22, 26) supplementation into broiler diets. These differences may be due to the level of dietary supplementation.

At the end of the experiment, carcass yield of broilers were not affected by the supplementation of MOS and COS, as shown in Table 2. Similarly, some researchers (7, 37) have reported that no significant improvement observed in carcass yield of broilers. Whereas Tufan and Aslan (31) did not detect any significant effect of the addition of COS in broiler diets with respect to carcass weight and yield, some studies reported favorable effects on carcass yield have been observed order like as (3, 11).

Blood parameters are shown in Table 3. In the present study, the addition of MOS and COS to basal diet had no significant differences in serum total cholesterol, triglyceride, glucose, total protein, and albumin levels (P>0.05). Stanley et al. (27) showed that adding MOS to broiler diets led to no significant differences in serum total protein, glucose, and total cholesterol levels. Li et al. (22) reported that serum triglyceride and total cholesterol levels were not altered by the addition of 0.05% MOS. The absence of any significant change in serum triglyceride level in our study was consistent with previous reports that the addition of MOS (29, 38, 39). However, Kannan et al. (2005) reported lower triglyceride level in chickens fed with diets containing MOS compared with the controls.

Table 2. The effects of dietary MOS and COS supplementation on performance of broiler

Performance Parameters	Period (d)	Control	MOS	COS	P
BW	42	2340.45±23.77	2458.11±40.93	2325.38±92.34	NS
	1-21	1120.85±19.13	1110.25±26.55	1135.00±26.49	NS
FC (g/bird)	21-42	2836.35±42.45	2862.03±29.65	2803.25±45.76	NS
	1-42	3957.20±37.62	3972.28±65.96	3938.25±55.65	NS
BWG (g/bird)	1-21	762.95±10.97	822.88±19.60	789.30±22.25	NS
	21-42	1538.53±19.17	1633.23±11.81	1561.71±64.43	NS
	1-42	2300.83±10.11	2415.71±39.73	2284.85±76.22	NS
FCR	1-21	1.47±0.022	1.35±0.050	1.44±0.041	NS
	21-42	1.84±0.038	1.75±0.012	1.80±0.037	NS
	1-42	1.72±0.020	1.65±0.023	1.72±0.038	NS
Carcass yield, %		73.36±0.47	74.97±0.73	74.71±0.71	NS

NS: not significant, MOS, Mannan oligosaccharide; COS, Chitosan oligosaccharide; BW, body weight; FC, feed consumption; BWG, Body weight gain; FCR, feed consumption ratio.

Table 3. The effects of dietary MOS and COS supplementation on some blood parameters in broiler

Blood Parameters	Control	MOS	COS	P
Total Protein, g/dl	2.06±15.48	2.22±9.35	2.01±9.97	NS
Albumin, g/dl	1.94±0.08	1.94±0.07	1.86±0.08	NS
Total cholesterol, mg/dl	4.29±0.13	4.39±0.12	4.18±0.14	NS
Triglyceride, mg/dl	20.37±1.60	24.21±2.45	22.09±2.50	NS
Glucose, mg/dl	266.78±7.07	274.17±11.78	274.16±11.77	NS
Copper (ppm)	0.48^{b}±0.01	0.77^{a}±0.01	0.87^{a}±0.03	0.000***
Zinc (ppm)	4.28±0.13	4.25±0.15	4.41±0.12	NS

$^{a, b}$: Means within a row that have different superscripts are significantly different**;** NS: not significant, ***P<0.001

Tufan et al. (32) did not observe any significant difference in serum total protein, albumin, glucose and total cholesterol concentrations after the supplementation of quail diets with 150 ppm COS. Similar to our results, several studies reported that the addition of COS to broiler diets had no effect on serum albumin and total protein concentrations (3, 19, 40). On the other hand, Li et al. (22) showed that the adding COS to broiler diets significantly increased total protein, total cholesterol, and triglyceride levels.

In this study, serum Cu level was significantly higher in MOS and COS supplemented groups compared to the control group (P<0.001). Sohail et al. (28) showed that serum mineral concentrations (Cu, Zn) increased in the MOS supplemented group. Yalçınkaya et al. (38) reported that the addition of prebiotics favorably affected mineral absorption while the addition of MOS increased plasma Cu level. Another study reported that the supplementation of MOS to diets did not affect plasma Cu, Zn, and Mn levels (13). Moreover, COS did not influence plasma Zn level but increased Cu level when added to the diets, supporting the hypothesis that prebiotics favorably affect mineral absorption. Prebiotics may enhance mineral absorption in caecum since undigestible carbohydrates facilitate water transfer into the large bowel, thereby raising fluid volume in which minerals can dissolve. This also increases the absorption of ionized minerals by reducing cecal pH and fermentation (25).

CONCLUSION

Prebiotics are already widely used as supplements to poultry feed and are becoming increasingly popular in many countries worldwide. In this study, no significant favorable effect could be demonstrated on the performance and some biochemical parameters when MOS and COS were added to broiler diets at a level of 100 ppm. However, serum Cu level increased by the addition of prebiotics. Whereas some studies have shown favorable effects on these parameters, some others have not reproduced same results. Such differences among studies may have occurred due to chemical structure and level of a prebiotic, diet composition, poultry housing conditions, and various environmental factors. More research is needed to determine effective prebiotic levels for poultry feeding.

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