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Effect of Prebiotics Supplementation on Growth Performance and Blood Biochemical Parameters in Commercial Broiler

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ABSTRACT

The present study was undertaken to evaluate the effect of supplementing different levels of prebiotic *i.e.* mannan oligosaccharide (MOS) on growth performance and blood biochemical parameters on commercial broiler chickens. One hundred and sixty day-old broiler chicks (Cobb 400) were randomly assigned to four dietary treatments (control (T_1), 0.1%, 0.25% and 0.5% supplementation of MOS in groups T_2, T_3 and T_4, respectively). Each treatment was replicated four times with 10 birds/replicate. Growth performance e.g., feed intake, body weight gain, feed conversion ratio were observed. Blood biochemical parameters were observed by sacrificing four birds per group at the end of the trial. Weekly body weight gain was found to increase significantly ($P<0.01$) in all supplemented groups on 6th week. Overall body weight gain was found higher in T_4 group than other groups. FCR was found linearly higher in finisher phase in comparison to the starter phase which means feed efficiency decreased with increasing time period. All the blood biochemical parameters were found to be in normal range. It was concluded that supplementation of prebiotic (MOS) at 2.5g/kg (0.25%) of feed improved growth performance without affecting blood biochemical parameters in commercial broiler.

Key words: Broiler performance, Blood biochemical parameters, Feed consumption, Prebiotic

INTRODUCTION

Poultry serves as one of the means of satisfying the increased demand for animal protein. Presently, chicken meat is on demand as a cheap source of protein with low cholesterol value. Antibiotics have long been used as growth promoters. To promote growth, protect well-being and maximize the genetic prospective of modern broiler (Dhama *et al*, 2011) and layer hybrids (Youssef *et al*, 2013) growth promoter feed additives have been included in poultry diets. There are different types of growth promoters which are used in the broiler industry like antibiotics, probiotics (bio growth promoters), prebiotics, exogenous enzymes, antioxidants, coccidiostats *etc.* (Allen, 1999; Walker and Duffy, 1998; Dhama *et al*, 2007, 2011; Angelakis *et al*, 2013). The use of prebiotics is a promising approach for enhancing the role of endogenous beneficial microbiota in the gut. In India the use of growth promoters have been accepted in the broiler industry and they are usually included in the feed in very small quantities. One of the most promising prebiotic is mannan-oligosaccharides (MOS). The benefits of MOS are based on specific properties, including modification of the intestinal micro-flora, reduction in turnover rate of the intestinal mucosa, and modulation of the immune system in the intestinal lumen. These properties have the potential to enhance growth rate, feed efficiency, and livability in poultry species (Parks *et al.,* 2001). Iji *et al.* (2001) examined the effects of MOS (0, 1, 3 and 5 g MOS/kg diet) on the intestinal structure and function of birds during a 21-day feeding period. Improvements in the intestinal structure and function were noticed in birds supplemented with medium or high level of MOS but the effects of MOS on the growth performance were minimal. In considering the possibility of total antibiotic restrictions in the future and potential benefits of MOS in poultry feeding, the effects of MOS on the growth performance of birds need to be

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explored.

MATERIALS AND METHODS

This experiment was conducted at Poultry Research and Training Center, Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut-250110 (U.P.). Feed consumption, growth performance were weekly measured and blood biochemical parameters were analysed at the end of 6 week of age. One hundred and sixty day-old broiler chicks (Cobb 400 strain) were procured and were randomly distributed into 4 treatments with 4 replications. Each replicate contained 10 chicks. The chicks were kept on deep litter system. Fresh and clean water was provided *ad libitum* every day to the chicks in each treatment group throughout the period of the study (42 days). Standard broiler feeds for the starter (0-3 weeks) and finisher (4-6 weeks) periods as per BIS specifications (1992) were procured from local market (Godrej Pvt. Ltd, India). In treatment group, the measured amount of mannan oligosaccharide (MOS) was supplemented at different levels in the basal diets (T_1) at the rate of 1.0 g/kg, 2.5 g/kg, and 5 g/kg in the ration of birds of groups T_2, T_3 and T_4, respectively. Samples of starter and finisher feeds were analyzed for nutrient composition *viz.* dry matter (DM), crude protein (CP), ether extract (EE), total ash, crude fibre (CF) as per AOAC (2005). The broilers were weighed individually at weekly interval till the end of experiment. Daily record of feed given to different groups was recorded. Left over feed was weighed weekly. The feed intake in different groups was calculated by subtracting the weight of left over feed from the weight of total feed offered within that period of time. On the last week of the feeding trial, blood samples were collected randomly from one bird from each replicate. Blood samples were collected in gel and clot activator vials and were centrifuged at 3000 rpm for 10 min for plasma separation. Separated plasma samples were stored in the freezer and were used for serum biochemical analysis (cholesterol, total protein, uric acid, alkaline phosphatase (ALP), aspartate transaminase (AST) and alanine transaminase (ALT) after 2 days. The data obtained was subjected to analysis of variance following procedures for completely randomized design (Snedecor and Cochran, 1994) using Statistical Package for the Social Sciences (SPSS, 2011).Differences among treatments were considered to be significant when $P \leq 0.05$.

RESULTS AND DISCUSSION

The analyzed nutrient content of experimental diet (Table 1) was almost similar in terms of its protein and other proximate parameters. From 2nd to 6th week, it was observed that the increase in body weight was proportional to the level of supplementation (Table 2). Body weight gain was also improved with supplementation (Table 3). The use of MOS in broiler

Table 1. Analyzed nutrient content of experimental diet (g/kg as DM)

Attributes	Experimental basal diet	
	Starter	Finisher
Dry matter	888.5	862.5
Ash	149.8	150.6
Crude protein	230.6	197.8
Ether extract	41.2	58.2
Crude fibre	39.9	44.0
Nitrogen-free extract	535.3	550.3
Neutral detergent fibre	305.0	357.3
Acid detergent fibre	113.7	123.2
Calcium	14.0	10.6
Phosphorus	9.8	9.3

Table 2. Effect of supplementing different levels of mannan oligosaccharide (MOS) on weekly body weight (g) of broiler chickens

Treatments	Age (weeks)						
	Initial	1	2	3	4	5	6
T_1	39.20	165.65[a]	369.13[a]	740.70[a]	993.10[a]	1377.08[a]	1780.68[a]
T_2	39.68	163.80[a]	442.40[b]	845.55[b]	1097.03[b]	1467.13[b]	1927.68[b]
T_3	40.05	174.05[b]	423.95[c]	857.25[c]	1122.48[c]	1572.28[c]	2047.53[c]
T_4	39.30	176.68[c]	450.80[d]	879.33[d]	1158.55[d]	1731.40[d]	2191.48[d]
SEM	0.26	0.57	0.45	0.59	1.97	4.01	3.54
P value	0.09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Means bearing different superscript in a column differ significantly (P<0.05)

diets had shown to positively impacts on performance criteria (Rosen, 2007; Fritts and Waldroup, 2003). Pelicano *et al.* (2004) reported better weight gain (P<0.05) when the diet of broiler chickens was supplemented with phosphorylated mannan oligo-saccharide (MOS) compared to diets without MOS. Mohamed *et al.* (2008) observed that addition of MOS slightly improved (P>0.05) body weight gain during the finishing (29 to 42 days of age) and the overall experimental period (1 to 42 days of age) by about 2% compared to the control diet. Sohail *et al.* (2012) demonstrated that adding MOS to broiler chicks diet gave higher (P<0.05) body weight gain compared with the control group under heat stress. Murshed *et al.* (2015) found that addition of MOS at 0.75 g/kg in starter diet and 0.6 g/kg in the finisher diet caused improvements in body gain of broiler chickens.

Data pertaining to weekly feed consumption of experimental birds is presented in Table 4. Feed consumption was higher in the birds of group T_4 fed basal diet supplemented with MOS at 0.5% of the ration. Rosen (2007), after evaluating several papers found out that MOS depressed feed intake by 0.46%. However, no such depression due to feeding of MOS was noted in this experiment. In fact DMI increased in groups fed 0.25% and 0.5% supplemental MOS. Similarly, Konca *et al.* (2009) found that supplementation of mannan oligosaccharide at 1 mg/ kg increased feed intake in turkey during 10 to 20 weeks of age. However, Sohail *et al.* (2012) demonstrated that adding MOS to broiler chicks diet resulted in higher feed intake as compared to control group under heat stress. FCR was found to differ (P<0.05) significantly between the treatment groups. FCR was higher in finisher phase in comparison to the starter phase which means feed efficiency decreased with increasing age. Overall FCR

Table 3. Effect of supplementing different levels of Mannan oligosaccharide (MOS) on weekly body weight gain (g) of broiler chickens

Treatments	Age (weeks)					
	1	2	3	4	5	6
T_1	126.30[a]	203.18[a]	368.05[a]	252.40[a]	383.98[a]	403.60[a]
T_2	124.08[a]	278.60[b]	403.15[b]	251.48[a]	370.10[a]	460.55[b]
T_3	134.00[b]	249.90[c]	433.30[c]	265.23[b]	449.80[b]	475.25[b]
T_4	137.38[c]	274.13[d]	428.53[c]	284.30[c]	567.98[c]	460.08[b]
SEM	0.64	0.68	1.96	3.15	5.04	4.91
P value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Means bearing different superscript in a column differ significantly (P<0.05)

Table 4. Effect of supplementing different levels of Mannan Oligosaccharide (MOS) on weekly feed consumption (g) of broiler chickens

Treatment	Age (weeks)					
	1	2	3	4	5	6
T_1	211.23^{ab}	353.93^{a}	531.28^{a}	670.43^{a}	885.33^{a}	906.43^{a}
T_2	208.60^{a}	387.70^{b}	557.38^{b}	632.60^{b}	697.73^{b}	907.80^{a}
T_3	212.03^{ab}	375.48^{c}	577.78^{c}	614.85^{c}	740.35^{c}	945.48^{b}
T_4	213.60^{b}	442.25^{d}	664.15^{d}	751.75^{d}	921.95^{d}	1078.00^{c}
SEM	1.03	1.13	2.78	0.78	1.27	1.30
P value	0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Means bearing different superscript in a column differ significantly (P<0.05)

for all the treatment groups was found to be significantly different from each other (Tables 5 and 6). The feed conversion efficiency of broiler chickens (Table 7) of all the four groups was calculated on weekly intervals and the results are presented as FCE, which with MOS at 0.25% of the diet (Tables 6). However, Pelicano *et al.* (2004) reported that there was no influence of MOS on feed intake of broilers at the different rearing phases. On the contrary, Brummer *et al.* (2010) observed numerical, but not significant

Table 5. Effect of supplementing different levels of Mannan Oligosaccharide (MOS) on weekly feed conversion ratio (FCR) of broiler chickens

Treatment	Age (weeks)					
	1	2	3	4	5	6
T_1	1.67^{a}	1.74^{a}	1.44^{a}	2.66^{a}	2.32^{a}	2.26^{a}
T_2	1.68^{b}	1.39^{b}	1.38^{b}	2.51^{b}	1.89^{b}	1.97^{b}
T_3	1.58^{c}	1.50^{c}	1.33^{c}	2.34^{c}	1.65^{c}	2.00^{b}
T_4	1.56^{d}	1.61^{d}	1.55^{d}	2.66^{a}	1.64^{c}	2.35^{a}
SEM	0.001	0.001	0.002	0.027	0.023	0.026
P value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Means bearing different superscript in a column differ significantly (P<0.05)

was found to decrease from 1st week to 6th week in all the treatment groups. Starter, finisher and total FCR was lower in group T_3 fed basal diets supplemented influence of MOS on FCR. Mohamed *et al.* (2008) found that feed conversion ratio of broiler chickens at 14 and 28 days were significantly improved by the

Table 6. Effect of supplementing different levels of Mannan Oligosaccharide (MOS) on feed conversion ratio (FCR) of broiler chickens during different periods of growth

Treatment	FCR (Starter)	FCR (Finisher)	FCR (Total)
T_1	1.86^{a}	2.28^{a}	2.05^{a}
T_2	1.69^{b}	1.93^{b}	1.80^{b}
T_3	1.65^{c}	1.82^{c}	1.72^{c}
T_4	1.84^{a}	1.95^{b}	1.89^{d}
SEM	0.005	0.012	0.004
P value	<0.01	<0.01	<0.01

Means bearing different superscript in a column differ significantly (P<0.05)

Table 7. Effect of supplementing different levels of Mannan Oligosaccharide (MOS) on feed conversion efficiency (FCE) of broiler chickens during different periods of growth

Treatment	Age (weeks)					
	1	2	3	4	5	6
T_1	0.60[a]	0.57[a]	0.70[a]	0.38[a]	0.43[a]	0.44[ab]
T_2	0.60[b]	0.72[b]	0.72[b]	0.40[b]	0.53[b]	0.41[a]
T_3	0.63[c]	0.67[c]	0.75[c]	0.43[c]	0.61[c]	0.50[b]
T_4	0.64[d]	0.62[d]	0.65[d]	0.38[a]	0.61[c]	0.43[a]
SEM	0.001	0.001	0.001	0.005	0.006	0.017
P value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Means bearing different superscript in a column differ significantly (P<0.05)

addition of MOS. Midilli *et al.* (2008) demonstrated that feed conversion ratio improved (P<0.05) significantly in the diets supplemented with MOS compared to the un-supplemented control.

Data pertaining different levels of mannan oligosaccharide on some blood biochemical parameters *viz.* cholesterol (mg/dl), total protein (g/dl), albumin (g/dl), uric acid (mg/dl), aspartate aminotransferase (IU/L), alanine aminotransferase (IU/L), alkaline phosphates (IU/L) were measured at 6 weeks of age (Table 8). Plasma concentration of cholesterol was similar among the groups and lue ranged from 131.30 to 132.02 mg/dl which was found in the normal range reported by Anon (1980). Similarly, Abdel-Hafeez *et al.* (2017) found that the values of the serum cholesterol in the MOS groups were similar to that of the control. Jahanian and Ashnagar (2015) reported that serum cholesterol level was not significantly affected by supplemental MOS. Yusrizal and Chen(2003) reported that feeding prebiotics reduced serum cholesterol concentration and abdominal fat content in broilers.

Uric acid and blood total protein were also found to be within the normal range reported by Anon (1980). Reports from other worker corroborate our research findings. Hasan *et al.* (2014) showed that supplementation of a prebiotic MOS in broilers during high environmental temperature significantly (P<0.05) increased blood uric acid in the treated groups than control groups. However, other workers (Abdel-Hafeez *et al.* 2017; Soren *et al.* (2018) reported no significant difference in serum total protein between the MOS supplemented groups as compared to control. Contrary to the finding of this experiment, Alonge *et al.* (2017) reported that serum total protein of broiler chickens fed diets containing mannan oligosaccharide were similar to the control group. Liver enzyme ALT and AST did not change with treatment. However, other workers (Yalcinkaya *et al.* 2008; Ali *et al.,* 2018) demonstrated

Table 8. Blood biochemical parameters of broiler chickens at 6 weeks of age fed a diet supplemented with different levels of mannan oligosaccharide

Treatment	Cholesterol (mg/dl)	Total protein (g/dl)	Uric acid (mg/dl)	AST (IU/L)	ALT (IU/L)	ALP (IU/L
T_1	131.30	3.47[ab]	4.57[a]	135.79	10.23	257.36[a]
T_2	131.61	3.36[a]	4.71[ab]	125.48	10.18	259.67[ab]
T_3	131.63	3.76[ab]	4.49[a]	128.37	10.20	258.19[ab]
T_4	132.02	3.80[b]	4.93[b]	132.15	10.06	261.36[b]
SEM	0.26	0.10	0.06	8.96	0.08	0.81
P value	0.33	0.02	<0.01	0.86	0.49	0.02

Means bearing different superscript in a column differ significantly (P<0.05)

that the addition of MOS significantly decreased AST and ALT activity in the blood.

CONCLUSION

It can be concluded that supplementation of prebiotic (MOS) up to the level of 2.5g/kg (0.25%) of feed improved the growth performance and feed utilization in commercial broiler. Similar blood biochemical parameters and liver enzyme activity in the supplemented groups indicated no adverse effect of MOS supplementation.

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