Original Research

Effect of Mannan Oligosaccharide Prebiotic Supplementation on Growth and Production Performance of Broiler Chickens

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Abstract

Effect of mannan oligosaccharide (MOS) supplementation on growth and production performance of broiler chickens was evaluated by distributing 180 unsexed Cobb-400 chicks of 7 days old to 18 floor pens (10 birds in each) following completely randomized design and assigning six pens to each of the three dietary treatments viz., M_0 (control; basal diet without MOS supplementation), $M_{0.5}$ (basal diet with 0.5% MOS) and M_1 (basal diet with 1% MOS) and managed uniformly for next 5 weeks. The final body weight and weight gain was significantly higher ($P<0.05$) in $M_{0.5}$ as compared to M_1 and M_0. Average feed intake remained similar and consequently, significantly better feed conversion ratio (FCR) was found in $M_{0.5}$ over control M_0 and M_1. Cost of production was lower ($P<0.05$) in $M_{0.5}$ over M_0 and M_1. Supplementation of diet with 0.5% MOS in the poultry ration was found better in terms of growth, feed intake, FCR and cost of production.

Key words: Cost of Production, Feed Conversion Ratio, Gut Health, MOS, Prebiotic

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Introduction

Consumption and production of poultry meat is increasing with higher demand and healthier diet (FAO, 2017). Broiler meat is cheaper than another animal meat and consumed as animal protein source (Adikari *et al*., 2018). Economical and profitable feeding is the biggest challenged in poultry production (Buragohain and Kalita, 2015). Antibiotics are used for increased production which leads to imbalance of micro flora, appearance of resistant in bacteria as well as drug residues in birds (Muaz *et al.*, 2018). Thus, use of natural alternatives to sub-therapeutic antimicrobials is increasing to improve performance and safety of broiler products (Abudabos *et al.,* 2018). One such alternative is mannan oligosaccharide (MOS) made up of repeating units of mannose monosaccharide in different forms of a main chain with branches and is one of the structural cell wall component of the bread yeast *Sacchoromyces cerevisiae* (Gelibolu *et al.*, 2018; Beynen, 2019). MOS has been well known as non-digestible feed ingredient beneficial for the host by improving the growth or metabolic activity of beneficial gut microorganisms (Chand *et al.*, 2016). Iqbal *et al.* (2017) fed birds with MOS and found significant effects on body and egg mass, egg weight and egg number, in breeders of quail. It can improve the energy utilization, feed efficiency by modulatory impacts on the GIT microflora in broilers (Yang *et al.*, 2008). MOS supplementation improves growth performance, immune system and gut health of broiler chickens (Rosen, 2007; Hooge, 2004; Spring *et al.*, 2000). MOS can tolerate temperatures of 120°C for 20 minutes without losing its capability to bind pathogenic bacteria and can be used for feed processing (Shane, 2001). There are variable reports on the level of MOS inclusion in the poultry diets and their effect on health and production parameters. With this background, the current research papers deals with validating the optimum level of inclusion of MOS in the poultry diets and to investigate its effects on growth and production performance.

Materials and Methods

Experimental Design and Stock Management

One hundred and eighty unsexed Cobb-400 chicks of 7 days old were weighed and randomly distributed to 18 floor pens (with 10 birds in each pen) following completely randomized design. Six pens were assigned to each of the three treatment groups *viz.*, M_0, $M_{0.5}$ and M_1. All the birds were kept under uniform management conditions throughout the experimental period.

Feeds and Feeding

The chicks of all the groups were fed different experimental diets. The ingredient and chemical composition of the reference diets for starter phase (which was used for first 3 weeks of experiment) and finisher phase (used during 4 - 5 weeks of experiment) is presented in Table 1. The reference diet was formulated as per BIS standard for broiler ration. The three dietary treatments were M_0 (control; basal diet without MOS supplementation), $M_{0.5}$ (basal diet with 0.5% MOS) and M_1 (basal diet with 1% MOS) and the birds among all three treatments were managed uniformly for next 5 weeks.

Growth Performance

Initial body weight, weekly live weight gain, weekly feed intake on pen basis were recorded and feed conversion ratio (FCR) were calculated by dividing total feed intake by total weight gain for a specified period. Mortality of the birds was monitored daily.

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Table 1: Ingredient and nutrient composition of broilers starter and finisher diets

Attributes	Starter Diet	Finisher Diet
Ingredient Composition		
Yellow corn maize	52.87	56.59
Rice polish	5.54	8.07
Soybean meal	30	23.88
Soya oil	2.91	2.88
Fish meal	5.83	5.77
Limestone	1.42	1.47
Dicalcium Phosphate	0.66	0.62
Salt	0.5	0.5
DL-methionine	0.12	0.09
Lysine	0.02	0
Vitamin AB2D3 K mix (Hyblend)[1]	0.01	0.01
Vitamin B-complex (Meriplex)[2]	0.02	0.02
Trace mineral mixture (Ultra-TM)[3]	0.1	0.1
Total	100	100
Chemical Composition		
Dry matter	86.46	87
ME (kcal/kg)	3100	3200
Crude protein	22	20
Crude fiber	3.75	3.67
Ether extract	3.48	4
Calcium	1	1
Phosphorous	0.7	0.7
Lysine	1.2	1.03
Methionine	0.5	0.45

[1]One gram of vitamin A B D K supplement contained 82500 IU of vitamin A, 50 mg of vitamin-B_{12}, 12000 IU of vitamin-D_3 and 10 mg of vitamin-K. [2]One gram of B-complex supplement contained 8 mg of vitamin B_1, 16 mg of vitamin B_6, 80 mg vitamin B_{12}, 80 mg of vitamin E, 120 mg of niacin, 8 mg of folic acid, 80 mg of calcium pantothenate and 86 mg of calcium. [3]One gram of trace mineral contained 54 mg of manganese, 52 mg of zinc, 20 mg of iron, 2 mg of iodine and 1mg of cobalt.

Cost of Production

Cost of MOS supplementation was calculated based on total feed intake, cost of feed consumed and the average live weight gain (LWG) of a broiler per treatment during the research trial. Cost for basal diet and MOS supplemented treatment diets were determined based on the supplier price list of feed ingredients including that of MOS. Cost of production per unit live weight gain (Rs. /kg LWG) and per unit dressed weight (Rs. /kg Dressed Weight) were calculated and compared among treatments to know the cost of MOS supplementation.

Statistical Analysis

All data were expressed as mean and were presented with standard error of mean (SEM) for each group. Treatments were compared using one-way analysis of variance followed by Duncan's multiple range tests

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using standard statistical procedures (Snedecor and Cochran, 1989). Statistical treatments were performed by using SPSS version 20. Significance was declared at (P < 0.05) level.

Results and Discussion

The data on mean weekly body weight, live weight gain, feed intake, FCR and mortality % of broiler chicks fed on MOS supplemented diet has been presented in Table 2. The mean body weight (g) on 28 d was significantly higher (P<0.05) in MOS supplemented groups $M_{0.5}$ and M_1 as compared to M_0 control. However, the final body weight on 42 d was significantly higher in $M_{0.5}$ (2728.82 g) as compared to M_1 and M_0 which had comparable body weights (2553.27 and 2466.08 g, respectively. Similar to the present findings, Rokade *et al.* (2018) reported significantly higher body weight of finisher broiler birds supplemented with MOS at 0.3 and 0.5% levels as compared to control birds without any MOS supplementation. Significantly higher body weight of finisher broiler birds receiving 0.1% MOS in diets were also reported by Galal *et al.* (2016) as compared to control group without MOS or birds supplemented with MOS at the rate of 0.04 to 0.06% in the drinking water.

Table 2: Effect of feeding mannan oligosaccharide supplemented diet on body weight, live weight gain, feed intake, feed conversion ratio and mortality percentage of broiler birds

Attributes	Dietary Treatments			SEM	P- value
	M_0	$M_{0.5}$	M_1		
Body Weight (g)					
Initial (7 d)	198.17	198.83	200.97	1.09	0.817
28 d	1430.75^b	1600.49^a	1519.18^{ab}	19.19	0.013
42 d	2466.08^b	2728.82^a	2553.27^b	29.37	0.006
Live Weight Gain (g)					
7-28 d	1232.58^b	1401.66^a	1318.21^{ab}	18.81	0.009
29-42 d	1035.33^b	1128.33^a	1034.09^b	11.8	0.006
7-42 d	2267.91^b	2529.99^a	2352.31^b	29.08	0.005
Feed Intake (g)					
7-28 d	2029.37	1939.71	2032.34	22.57	0.487
29-42 d	2459.51	2242.77	2403.15	36.76	0.254
7-42 d	4488.88	4182.48	4435.49	51.5	0.22
Feed Conversion Ratio					
7-28 d	1.65^a	1.38^b	1.54^{ab}	0.03	0.031
29-42 d	2.38^a	1.99^b	2.32^a	0.05	0.016
7-42 d	1.98^a	1.65^b	1.89^a	0.04	0.011
Average Mortality %					
7-28 d	0	0	0		
29-42 d	5	3.3	3.3		
7-42 d	5	3.3	3.3		

Mean bearing different superscript in a row differ significantly (P<0.05); d, days; MOS, mannan oligosaccharide; M_0, control; $M_{0.5}$, 0.5% MOS and M_1, 1% MOS supplemented groups.

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The mean live weight gain (g) was significantly higher (P<0.05) in MOS supplemented groups $M_{0.5}$ and M_1 as compared to M_0 control during 7-21 d. However, during 29 - 42 d and 7 - 42 d, $M_{0.5}$ broiler birds were found to have significantly higher (P<0.05) mean live weight gain (g) as compared to both M_1 and M_0 which had comparable live weights during these periods. Galal *et al.* (2016) found significantly higher body weight gain in broiler birds with 0.1% MOS in diets as compared to control group without MOS or birds supplemented with MOS at the rate of 0.05 to 0.06% in the drinking water. Average feed intake remained similar (P>0.05) among all the groups during 7-28 d, 29-42 d. Similar findings were reported by Rokade *et al.* (2018) and Jahanian *et al.* (2016) regarding the feed intake in MOS supplemented broiler birds.

During 7-28 d, significantly (P<0.05) better FCR was observed in $M_{0.5}$ (1.38) as compared to M_0 (1.65). However, FCR in M_1 (1.54) broiler birds remained comparable with both M_0 and $M_{0.5}$. During overall experimental duration of 7-42 d and in finisher phase 28-42 d, significantly better FCR was recorded in $M_{0.5}$ (1.99 and 1.65) over M_0 (2.38 and 1.98) and M_1 (2.32 and 1.89), respectively. Jahanian *et al.* (2016) reported that 0.2% MOS in diet can improve FCR in broiler chicks exposed to aflatoxins. Yang *et al*. (2008) reported improved total tract digestibility of fiber to the tune of 61.5 to 147% on supplementation of MOS at 0.3-0.5% in broiler chicken diets which may be one of the important factors to improve FCR in broiler birds. No mortality was found during 7-28 d but some mortality (3.3 to 5%) was recorded during 29-42 d among all the groups, the higher being in control. Similar findings were reported by Spais *et al.* (2003) and Hooge (2004) in their experiments with MOS supplemented diets in broiler birds. Nevertheless, the total mortality during the trial was considered acceptable and the deaths were not related to dietary treatments.

Effect of feeding MOS supplemented diet on cost of ration to produce live weight gain and dressed weight is presented in Table 3.

Table 3: Effect of feeding mannan oligosaccharide supplemented diets on cost of ration for per unit live weight gain and per unit dressed weight

Attributes	Dietary Treatments			SEM	P- value
	M_0	**$M_{0.5}$**	**M_1**		
Ration cost (Rs.)	36	36.55	37.1		
Total live weight gain (g)	2267.91^b	2529.99^a	2352.31^b	29.08	0.005
Feed intake (g)	4488.88	4182.48	4435.49	51.51	0.22
Total feed Cost (Rs.)	161.6	152.87	164.56	1.9	0.215
FCR	1.98^a	1.65^b	1.89^a	0.04	0.011
Dressed weight (% of live weight)	70.43	71.57	73.68	0.42	0.065
Cost /kg live wt (Rs.)	71.26^a	60.42^b	70.02^a	1.25	0.014
Cost/kg dressed wt (Rs.)	101.16^a	84.43^b	94.96^a	1.6	0.003

Mean bearing different superscript in a row differ significantly (P<0.05); MOS, mannan oligosaccharide; M_0, control; $M_{0.5}$, 0.5% MOS and M_1, 1% MOS supplemented groups.

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Cost of ration increased marginally but proportionately with increased level of feed additive i.e., MOS incorporation in the diets of the broiler chickens. Significant differences were found among all the groups for average total weight gain (P<0.05), better FCR (P<0.05), cost/kg live weight gain (P<0.05) and cost/kg dressed weight (P<0.05); however, feed intake, total cost of feed and dressed weight remained similar among all the groups. Average cost per kg live weight gain (Rs.) was found significantly lower (P<0.05) in $M_{0.5}$ (60.42) over M_0 and M_1 (71.26 and 70.01, respectively). Similar trend was found for cost/kg dressed weight also. Eseceli *et al.* (2010) reported similar feed cost for live weight gain in broiler birds fed on diet supplemented with MOS as compared to control diets added with antibiotics.

Conclusion

Supplementation of diet with MOS in the poultry ration resulted in improved growth performance, feed intake and FCR resulting in low cost of production of broiler birds leading to better profitability. The optimum MOS level was found to be 0.5% of the basal diet for improved growth and production performances of broiler chickens.

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