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PERFORMANCE OF BROILER CHICKENS FED MANNAN OLIGOSACCHARIDES AS ALTERNATIVES TO ANTIBIOTICS FROM ONE TO TWENTY-TWO DAYS OF AGE

Z. Kamran, M. A. Mirza[a], S. Ahmad, H. A. Samad, M. U. Sohail and M. Saadullah[b]

University College of Veterinary and Animal Sciences, The Islamia University of Bahawalpur-63100, Pakistan
[a]Institute of Animal Nutrition and Feed Technology, University of Agriculture, Faisalabad-38040, Pakistan
[b]Department of Livestock Production, University of Veterinary and Animal Sciences, Lahore-54000, Pakistan
Corresponding author e-mail: zahid.kamran@iub.edu.pk

ABSTRACT

The present study was planned to evaluate the efficacy of mannan oligosaccharides (MOS) as alternatives to antibiotic growth promoters (AGP) in broiler diets from one to 22 days of age. A total of 200 day-old Hubbard broiler chicks were randomly divided into 20 experimental units of 10 chicks each. A basal diet was formulated containing 21% CP with 2750 kcal/kg ME. The treatment 1 contained basal diet without any supplementation. In treatments 2, 3, 4 and 5, the basal diet was supplemented with MOS (1 kg/ton of feed), zinc bacitracin 10% (0.5 kg/ton of feed), furazolidone (0.1 kg/ton of feed) and enramycin (0.12 kg/ton of feed), respectively. Each experimental diet was assigned randomly to 4 replicate pens. Results showed that feeding of either MOS or any of the AGP did not significantly affect the feed intake of birds. The weight gain and feed conversion ratio of birds fed MOS diet were superior ($P<0.05$) to those of control group while inferior ($P<0.05$) to all of AGP fed groups. However, weight gain and feed conversion ratio were not significantly different among birds fed diets containing various AGP. Mortality was also non-significant among dietary treatments. Economic evaluation of the growth data showed that use of AGP in feed was more cost effective as compared to other groups. In conclusion, the use of MOS in broiler starter diets was not found to replace AGP commonly used in feed.

Key words: Broilers, mannan oligosaccharides; antibiotic growth promoters; growth performance.

INTRODUCTION

Antibiotic growth promoters (AGP) are thought to maintain intestinal health in poultry by keeping microbial populations in check resulting in increased nutrient availability and growth (Engberg *et al*., 2000). However, there has been a recent increase in public concern about the use of AGP due to antibiotic-resistant bacteria and the decreased effectiveness of antibiotics used for humans (Dibner and Richards, 2005). This has caused a ban on the use of AGP in some countries and thus, led the nutritionists to search for natural alternatives. It has been suggested that mannan oligosaccharides (MOS), derived from cell wall of yeast *Saccharomyces cerevisiae* may provide an alternative to AGP (Hooge, 2004; Rosen, 2007). The addition of MOS in broiler diets has been found to improve growth performance while preventing bacterial colonization (Hooge, 2003; Rosen, 2007). This is particularly true during early age growth period when response to MOS appears to be more pronounced (Yang *et al*., 2005). This may be related to less balanced gut micro flora in younger birds which is found to be improved by MOS supplementation (Denev *et al*., 2006; Baurhoo *et al*., 2009).

However, in countries where AGP are still in use, the natural alternatives like MOS are less preferred in broiler diets due to economic reasons. In addition, no conclusive work has been done on the production responses of MOS in broilers particularly during early age. Therefore, the present study was conducted to determine whether the addition of commonly recommended dosage level of MOS could allow for more consistent and cost effective production responses as compared to commonly used AGP during one to twenty-two days of age.

MATERIALS AND METHODS

Birds and housing: A total of 200 day-old Hubbard broiler chicks were randomly divided into 20 experimental units of 10 chicks each. Birds were vaccinated against Newcastle disease and Infectious Bronchitis on day 2 and Gumboro disease on day 13. The birds were kept under standard management conditions. The brooding temperature was kept at 35°C during first week and was gradually decreased by 2°C after each week. Twenty-four hours light was provided by electric tube lights in the broiler house throughout the experimental period. Fresh water and feed were provided *ad libitum* throughout the experimental period.

Experimental diets: Five dietary treatments were made to assess the effect of MOS supplementation on broiler performance. The treatment 1, (basal diet) considered as

control, was formulated to contain 21% CP with 2750 kcal/kg ME. In treatment 2, the basal diet was supplemented with MOS (Bio-Mos®, Alltech Inc., Nicholasville, KY; 1 kg/ton of feed) while treatment 3, 4 and 5, were supplemented with commonly used AGP in local feed industry namely zinc bacitracin 10% (0.5 kg/ton of feed), furazolidone (0.1 kg/ton of feed) and enramycin (0.12 kg/ton of feed), respectively. Analysis of basal diet for proximate and other components matched closely with the calculated values (Table 1). Each experimental diet, assigned randomly to 4 replicate pens, was fed up to 22 days of age.

Data collection and analysis: At the end of experimental period, the average weight gain and average feed intake was calculated. The data on feed intake and weight gain was used to calculate feed conversion ratio (FCR). Complete record of mortality of experimental birds was maintained during the entire experiment and feed intake was adjusted for mortality, if any. The economic evaluation of the experimental diets was done in terms of feed cost and feed cost per kg live weight gain.

Statistical Analysis: The results were subjected to statistical analysis by using General Linear Model ($P<0.05$) and means were compared by Tukey's significant difference test (Minitab, 2000).

RESULTS AND DISCUSSION

Feeding of either MOS or any of the AGP did not significantly affect the feed intake of birds (Table 2). The weight gain and FCR of birds fed MOS diet were better ($P<0.05$) than those of control group while inferior ($P<0.05$) to all of AGP fed groups. However, weight gain and FCR were not significantly different ($P>0.05$) among birds fed diets containing various AGP (Table 2). Mortality was also non-significant ($P>0.05$) among dietary treatments. Economic evaluation revealed that cost per kg of live weight gain was lower with AGP fed groups as compared to control or MOS group (Table 3).

The results regarding feed intake were in line with the findings of many researchers (Yang, 2007; Bozkurt *et al*., 2008; Oliveira *et al*., 2008; Baurhoo *et al*., 2009 and Eseceli *et al*., 2010) who reported non-significant effect of MOS and/or AGP addition to diets on feed intake of young broilers. Weight gain and FCR were significantly improved in the MOS and AGP fed groups as compared to control in the present study. This indicated that MOS can positively affect the growth performance of birds as supported by the findings of Hooge *et al*. (2003), Kocher *et al*. (2004), Rios *et al*. (2005), Denev *et al*. (2006) and Bozkurt *et al*. (2008). However, the growth performance with MOS diet was lower than those of AGP fed groups in the present study. The AGP fed groups also showed better FCR as compared to control and MOS groups. This might be due to better improvements in weight gain that resulted in better FCR than those of control and MOS groups. These results were in accordance with those reported by Yang *et al*. (2007) who reported superior performance of MOS to control but inferior to zinc bacitracin at 21 days of age. Waldroup *et al*. (2003a) also noted that antibiotics addition significantly improved body weight and FCR as compared to control but noticed non-significant effect of MOS addition on these parameters at 21 days of age. However, Hooge *et al*. (2003), Waldroup *et al*. (2003b),

Table 1. Ingredient and nutrient composition of basal diet

Ingredients	Composition (%)
Corn	57.7
Soybean meal	7.14
Canola meal	10.5
Rapeseed meal	5.0
Sunflower meal	9.12
Guar meal	2.0
Corn gluten meal 30%	1.0
Corn gluten meal 60%	1.0
Poultry by-product meal	1.50
Bone meal	2.31
Limetone	0.54
Vitamin/mineral premix[1]	0.50
Salt	0.33
Sodium bicarbonate	0.01
L-Lysine sulphate	1.01
MHA	0.22
L-Threonine	0.12
Total	100
Calculated Nutrient composition (%)	
Metabolizable energy (kcal/kg)	2750
Crude protein	21
Crude fiber	5.0
Ether extract	2.92
Ash	5.14
Calcium	1.0
Total phosphorus	0.61
Available phosphorus	0.43
Lysine[2]	1.10
Methionine[2]	0.49
Threonine[2]	0.73
Analyzed Nutrient composition (%)	
Crude protein	20.9
Crude fiber	5.41
Ether extract	2.6
Ash	5.74
Calcium	1.05
Total phosphorus	0.65

[1]Supplied per kilogram of diet: vitamin A (as retinyl acetate), 14,000 IU; vitamin D_3 (as cholecalciferol), 3,500 IU; vitamin K (menadione sodium bisulfite), 2.8 mg; vitamin E (as d-*á*-tocopherol), 42 IU; biotin, 0.07 mg; folic acid, 1.7 mg; niacin, 35 mg; calcium pantothenate, 12.32 mg; pyridoxine, 3.36 mg; riboflavin, 7 mg; thiamin, 1.7 mg; vitamin B_{12}, 12.1 µg; Fe, 98

mg; Mn, 112 mg; Cu, 9.8 mg; Se, 0.07 mg ; Zn, 70 mg; choline chloride, 550 mg. [2]Digestible

Flemming *et al*. (2004), Yang (2007), Oliveira *et al*. (2008) and Baurhoo *et al*. (2009) reported non-significant effect on both body weight and FCR with antibiotics or MOS addition at 21 days of age. The lack of response in those studies might be attributed to the clean conditions of birds rearing. There was no mortality during the entire experimental period, however, this effect was not found to have any relationship with the dietary treatments.

Although weight gain was improved significantly with the use of MOS as compared to control, the cost per kg live weight gain was greater with MOS group. This indicated that an increase in weight gain could not compensate for the increase in feed cost associated with MOS addition. The feed cost was also increased with the use of various AGP as compared to control; however, the significantly improved growth rate decreased the feed cost per kg live weight gain as compared to control and MOS groups. In this respect, the best results were shown by furazolidone group followed by enramycin and zinc bacitracin groups. However, Hooge *et al*. (2003) reported no numerical difference in cost per kg live weight gain among various treatments which was found to be associated with better growth performance of MOS group as compared to control. On the other hand, Eseceli *et al*. (2010) reported better results with avilamycin as compared to MOS showing that the use of AGP in diet was more cost effective resulting in greater economic returns.

In conclusion, MOS showed better performance than control group. However, it was not found to replace the commonly used AGP in feed during broiler starter phase. A higher dose rate of MOS may be evaluated for better results provided that economic parameters are not compromised.

Table 2. Weight gain, feed intake and feed conversion ratio of broilers fed diets containing MOS and various antibiotic growth promoters from 1 to 22 days of age[1]

Diets[2]	Weight gain (g/bird)	Feed intake (g/bird)	Feed conversion ratio (g:g)
Control	789[c]	1227	1.56[a]
MOS	821[b]	1246	1.52[b]
Zinc bacitracin	851[a]	1263	1.49[c]
Furazolidone	862[a]	1271	1.48[c]
Enramycin	863[a]	1280	1.48[c]
Pooled SEM	8.9	12.9	0.006
ANOVA		Probability	
Diets	<0.0001	0.075	<0.0001

[a-c]Means within a column with different superscripts differ significantly (P < 0.05)
[1]Means of 4 replicates with 10 birds in each replicate
[2]Control (no supplementation); MOS (1 kg/ton of feed); zinc bacitracin 10% (0.5 kg/ton of feed); furazolidone (0.1 kg/ton of feed) and enramycin (0.12 kg/ton of feed)

Table 3. Economic evaluation of different diets containing MOS and various antibiotic growth promoters

Item Diets[3]	Cost of feed[1] (Rs)	Cost/kg live weight[2] (Rs)
Control	26.0	40.43
MOS	26.7	40.52
Zinc bacitracin	26.07	38.72
Furazolidone	26.11	38.51
Enramycin	26.11	38.70

[1]Feed cost per kg in Rs
[2]Feed cost per kg live weight gain in Rs
[3]Control (no supplementation); MOS (1 kg/ton of feed); zinc bacitracin 10% (0.5 kg/ton of feed); furazolidone (0.1 kg/ton of feed) and enramycin (0.12 kg/ton of feed)

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