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Research Article

EFFICACY OF PROBIOTICS, PREBIOTICS AND ENZYMES AS GROWTH PROMOTERS ON THE PERFORMANCE OF BROILER CHICKEN

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ABSTRACT

To evaluate the effects of supplementing prebiotic (mannan-oligosaccharides), probiotics (mixture of *Saccharomyces cerevisiae*, *Lactobacillus acidophilus*, *Lactobacillus sporogenes*, *Bacillus subtilis*) and multi-enzyme (enzyme mixture containing amylase, xylanase, pectinase, cellulase, glucanase and protease) on growth performance in broiler chickens, 320 day-old commercial broiler chicks, were randomly divided into 4 treatment groups having 8 replicates in each treatment and each replicate had 10 birds each. The control group (T_1) was given maize-soybean meal based basal diet, while in treatment groups T_2, T_3 and T_4, basal diet was supplemented with prebiotics, probiotics and multi-enzymes @ 100, 50 and 50g/100kg feed, respectively. The average body weight, feed intake and feed conversion ratio (FCR) were recorded biweekly during experimental period of 42 days. A metabolism trial was conducted during 6th week of the experiment. The body weight gain at all intervals was significantly ($P<0.05$) higher in groups T_2 and T_4 as compared to T_1 and it increased by 9.4 and 10.7%, respectively. FCR was significantly ($P<0.05$) higher in group T_4 followed by T_2 with an improvement of 9.7 and 5.5% in feed efficiency in these groups. Performance index also improved significantly ($P<0.05$) in T_2, T_3 and T_4 groups as compared to group T_1. Nitrogen retention improved in groups T_2 and T_4 as compared to T_1. There was no effect of growth promoters on dry matter digestibility and gross energy metabolizability. The results of this study indicate that multi-enzyme supplementation as growth promoter improved the growth performance of broilers significantly followed by prebiotics and probiotics as compared to control group.

Key words: Broiler chickens, growth promoters, probiotics, prebiotics, multi-enzymes

The biggest challenge to commercial poultry production is the availability of quality feeds on sustainable basis at stable prices. The trade volume of poultry products has increased due to rapid growth in global poultry meat and egg production (FAO, 2009). With the advent of excluding antibiotic growth promoters in poultry production in Europe and America, the issue of controlling enteric infections caused by pathogenic bacteria without the use of antibiotics has become challenging. Such infections are responsible for reduced growth rates and consequent economic losses in poultry. Antibiotics are the main tools utilized to prevent or treat enteric infections. Feed additives such as probiotics, prebiotics and enzymes can modulate the gut microflora and performance of broiler chickens (Choct, 2009). Prebiotics have advantage compared to probiotics that normally present gut bacteria are stimulated which are already adapted to that environment (Snel *et al*., 2002). In diets of monogastric animals, exogenous enzymes are used to improve digestibility of a wide range of food components (Choct and Annison, 1992). However, there have been many conflicting reports on the efficacy of these growth promoters on broiler performances and nutrient utilization. Hence the present work was undertaken to study the efficacy of the growth promoters in broiler chickens.

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MATERIALS AND METHODS

Three hundred and twenty, day-old commercial broiler chicks were randomly distributed into four dietary treatments (T_1 to T_4) having eight replicates and each replicate had ten birds. Starter and finisher rations of the control group (T_1) were formulated as per BIS (1992) to meet the metabolizable energy (ME), crude protein and limiting amino acids (lysine and methionine) and vitamins requirements of the birds. In treatment groups, prebiotics (T_2; mannan-oligosaccharides), probiotics (T_3; mixture of *Saccharomyces cerevisiae*, *Lactobacillus acidophilus*, *Lactobacillus sporogenes* and *Bacillus subtilis*) and multi-enzymes (T_4; mixture containing amylase, xylanase, pectinase, cellulase, glucanase and protease) were added @ 100, 50 and 50 gm/100 kg basal diet, respectively. Ingredients composition of experimental diets and nutrients content of feed ingredients has been given in Tables 1 and 2, respectively. The chicks were reared under deep litter system in well ventilated pens with *ad lib* feed and water. All the birds were kept under uniform management conditions throughout the experimental period. Average body weight and feed consumption of the experimental

birds were recorded biweekly. Feed conversion ratio (FCR) and performance index were calculated for all the treatments. A metabolism trial was conducted during 6th week of growth period to study the balance of nitrogen and energy. One bird from each replicate was randomly selected and transferred to metabolic cages. A preliminary period of three days was given for adaptation to the birds to new system of housing and management, followed by a collection period of three days. Daily feed intake, residues left and faeces voided were recorded and representative samples were collected accordingly. Samples of feed offered and faeces were analyzed for proximate nutrients (AOAC, 1995). Data were analysed statistically as per the methods described by Snedecor and Cochran (1994). The Institutional Animal Ethics Committee approval was obtained prior to conduct of this study.

RESULTS AND DISCUSSION

Data pertaining to feed intake, body weight gain, feed efficiency, dry matter digestibility and gross energy metabolizability are presented in Table 3. The feed intake of birds did not vary significantly among treatments at different intervals. Similar observations were recorded by Baurhoo *et al.* (2009) and Islam *et al.* (2010). Weight gain was significantly (P<0.05) higher in groups T_2 and T_4 as compared to T_1, where as non-significant improvement in these parameters was recorded in T_3 group. These results are in accordance with the findings of Islam *et al.* (2010) and Kayastha *et al.* (2011). Contrary to this, non-significant improvement in body weight was reported with enzyme supplementation (Omojola and Adesehinwa, 2007) or prebiotic supplementation (Baurhoo *et al.*, 2009).

The metabolizable energy (ME) of soybean meal is generally low for birds due to the presence of non-starch polysaccharides (NSPs; Parsons *et al*., 2000). Approximately 10% of the protein in soybean meal is located within the cell wall matrix (Chesson, 2001) and it can be made available to the broiler chicks by its degradation by carbohydrases (Mandels, 1985). The improvement in weight gain of broiler chickens in T_4 group as observed in the present study may be attributed to the fact that the digestibility of crude protein and energy present in the form of NSPs might have increased thus increasing availability to the birds for utilization and overall improvement of body weight. The improvement in body weight gain of broilers in T_2 group in the present study could also be due to control of pathogenic bacteria and modulation of intestinal morphology and expression of mucin and brush border enzyme.

Table 1
Composition of experimental diets during grower and finisher phases in broiler chickens

Ingredient (kg/100 kg feed)	Composition of diets during	
	0-4 weeks	4-6 weeks
Maize	49.11	57.58
Soybean meal	28.38	20.12
Rice polish	10.0	10.0
Fish meal	10.0	10.0
Mineral mixture	2.5	2.5
Feed additives (g/100kg of ration)		
Spectromix	10	10
Spectro BE	20	20
Veldot	50	50
Choline chloride	50	50
Bio-Moss	100	100
Provilacc	50	50
Provizyme-Bro	50	50
Lysine	50	50
DL-methionine	150	150

Spectromix (powder, each gm contained Vit. A-82,500 IU, Vit. D3-12,000 IU, Vit. B2-50 mg and Vit. K-10mg); Spectro BE (powder, each gm contained Vit.B1-8 mg, Vit.B6-16 mg, Vit.B12-80 mg, niacin-120mg, calcium pentothenate -80mg, Vit. E-160 mg, lysine hydrochloride-10 mg, DL-methionine- 10 mg and calcium- 260mg); Veldot (Dinitro- O –Toluamide), Choline chloride (contained 60 percent choline); Lysine (contained 98% lysine); DL- methionine (contained 98% methionine); Bio-Moss (powder containing Mannan-oligosaccharides); Provilacc (Probiotic powder: S*accharomyces cerevisiae* 5855 billion CFU, *Lactobacillus acidophilus* 14040 million CFU, *Lactobacillus sporogenes* 14040 million CFU, *Bacillus subtilis* 1500 million CFU/kg); Provizyme-Bro (enzyme mixture containing amylase, xylanase, pectinase, cellulase, glucanase, protease).

The FCR during entire experimental period was significantly (P<0.05) better in T_4 group followed by T_2 and T_3 groups as compared to T_1 group. In conformity to the present reports, Olukosi *et al*. (2007) and Woyengo *et al*. (2010) also found improved feed to gain ratios in broilers receiving diet supplemented with multi-enzyme as compared to the control group birds. The significant improvement in FCR of broiler chicks in group T_4 could be attributed to efficient utilization of protein and energy present in the form of NSP which could have been made available to birds to its degradation by multi-enzymes in the diet (Bedford and Schulze, 1998). Improved FCR in prebiotic supplemented group could be attributed to the fact that modulation of intestinal morphology might have increased villi length and number of goblet cells which is associated with increased lactobacilli and bifidobacteria colonization in broilers intestines (Baurhoo *et al.*, 2007). Adherent lactobacillus strains significantly (P<0.05) increase the level of amylases in small intestine (Jin *et al.*, 2000) thus improving microbial balance and digestion thereby improving the growth performance and FCR.

Dry matter digestibility did not vary significantly among treatment groups. Nitrogen retention in T_2 group

Table 2
Proximate nutrients, lysine, methionine and ME content of feed ingredients used in broiler rations

Name of ingredient	Crude protein	Ether extract (%)	Crude fiber	Total ash (%)	Lysine*	Methionine*	Metabolizable energy (ME)* Kcal/kg
Maize	9.1	3.44	2.44	2.25	0.18	0.15	3300
Soybean meal	45.2	3.16	3.93	8.47			
2.57	0.76	2230					
Rice polish	12.0	12.2	4.10	14.94	-	-	2937
Fish meal	45.0	13.5	1.79	39.62	1.42	1.42	2600

*Calculated values (Singh and Panda, 1988)
T_1=Control; T_2=Diet supplemented with prebiotics; T_3=Diet supplemented with probiotics; T_4=Diet supplemented with multienzymes

Table 3
Feed intake, body weight gain, feed efficiency, nitrogen and gross energy metabolizability in broiler chickens

Parameters	Treatments			
	T_1	T_2	T_3	T_4
Initial body weight (g)	43.23±0.45	43.36±0.62	42.62±0.46	42.97±0.32
Final body weight (g)	1836.53^a±43.53	2011.10^b±41.64	1888.56^a±24.46	2033.33^b±30.82
Average daily weight gain (g)	42.70^a±0.73	46.84^b±0.30	45.30^a±0.50	47.39^b±0.24
Total feed intake (g/bird)	4339±187.3	4479.8±225.7	4347.0±191.1	4374.5±172.8
Feed conversion ratio	2.36^a±0.03	2.23^{ab}±0.05	2.30^a±0.08	2.13^b±0.05
Performance index	781.96^a±50.97	925.52^b±66.40	828.12^{ab}±38.75	970.82^b±56.23
Dry matter digestibility (%)	65.03±0.03	67.39±0.79	65.67±1.68	64.56±1.24
Nitrogen retention (%)	56.65^c±0.10	58.43^{ab}±0.42	57.56^{bc}±0.32	58.84^a±0.53
Gross energy metabolizability (%)	60.95±0.01	62.20±1.25	63.44±1.46	63.46±1.47

Means bearing different superscripts in a row differ significantly (P<0.05)
T_1=Control; T_2=Diet supplemented with prebiotics; T_3=Diet supplemented with probiotics; T_4=Diet supplemented with multienzymes

was comparable with T_1 and T_3 but marginally higher than T_4 group. Nitrogen metabolizability improved significantly (P<0.05) in T_4 group than the T_1 group. Similar findings were recorded by Rutherfurd *et al.* (2007) and Olukosi *et al*. (2008) in enzyme supplemented poultry ration. Improvement in nitrogen retention in T_4 group could be due to partial hydrolysis of NSPs, thereby reducing the viscosity of gut contents and resulting in improvement of nutrient absorption. Nitrogen retention improved by supplementation of prebiotic in present study may be due to the fact that these additives improved gut health by reducing the load of pathogenic bacteria thereby improving nutrition utilization

Gross energy (GE) retention was the lowest in the T_1 (60.95) group and maximum (63.46) in T_4 group. GE retention improved in all groups as compared to controls, however, the improvement was statistically non-significant. Similar findings were recorded in enzyme supplemented diet (Wang *et al.*, 2005) and prebiotic supplemented diet (Samarsinghe *et al.*, 2003). The ME and GE metbolizability increased non-significantly by supplementation of various growth promoters. The results of this study indicate that multi-enzyme supplementation in diet significantly improved the growth performance of broiler chickens followed by prebiotics and probiotics.

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