Journal of Cell and Animal Biology Vol. 5(4), pp. 61-65, April 2011
Available online at http://www.academicjournals.org/JCAB
ISSN 1996-0867 ©2011 Academic Journals

Full Length Research Paper

Effects of dietary inclusion of several biological feed additives on growth response of broiler chickens

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Accepted 22 March, 2011

The present study aimed at evaluating the effect of the probiotic Primalac, prebiotic Biolex-MB, a combination of the two supplements (probiotic plus prebiotic) and one growth promoter antibiotic (Flavomycin) on performance results of broiler chickens. Three hundred day old Ross 308 broilers were equally distributed into 30 floor pens and reared for 42 day. A basal diet was also supplemented with Flavomycin (650 g/ton^{-1}), Primalac (900 g/ton^{-1}), Biolex-MB (2000 g/ton^{-1}) and mixture of Primalac plus Biolex-MB (synbiotic) for starter (1 to 21 days) and grower (22 to 42 days) periods, resulting 5 dietary treatments were prepared including control group. Each dietary treatment was fed ad-libitum to six replicate group of 10 birds at the beginning of rearing period. Birds and feed were weighed weekly. The daily body weight gain and feed efficiency were significantly (P<0.05) more improved by the synbiotic treatments compared with the control broilers. The birds under antibiotic treatment had higher breast and thigh percent as compared to control birds (p<0.05). Also, supplementation of broiler's diet with prebiotic significantly (p<0.05) increased gizzard percent. The results of present study showed that probiotic and prebiotic can be used as non-antibiotic growth promoter feed additives to improve broiler chickens growth indices.

Key words: Antibiotic, prebiotic, probiotic, performance.

INTRODUCTION

Antimicrobials have been used as feed supplement for more than 50 years in poultry feed to enhance the growth performance and to prevent diseases in poultry. However, in recent years great concern has arisen about the use of antibiotics as supplement at sub-therapeutic level in poultry feed due to emergence of multiple drug resistant bacteria (Wray and Davies, 2000). As a consequence, it has become necessary to develop alternatives using either beneficial microorgansims or nondigestible ingredients that enhance microbial growth. A probiotic is a culture of a single bacteria strain, or mixture of different strains, that can be fed to an animal to improve some aspect of its health (Griggs and Jacob, 2005). Probiotics are also referred to as direct fed microbials (DFM). On the other hand, a prebiotic was defined as nondigestible food ingredient that beneficially affects the host, selectively stimulating the growth or activity, or both, of one or a limited number of bacteria in the colon (Gibson and Roberfroid, 1995).

The efficacy of probiotics may be potentiated by several methods: the selection of more efficient strains, gene manipulation, the combination of several strains, and the combination of probiotics and synergistically acting components. This approach seems to be the best way of potentiating the efficacy of probiotics and is widely used in practice. A way of potentiating the efficacy of probiotic preparations may be the combination of both probiotics and prebiotics as synbiotics, which may be defined as a mixture of probiotics and prebiotics that beneficially affects the host by improving the survival and implantation of live microbial dietary supplements in the gastrointestinal (GI) tract. Those effects are due to activating the metabolism of one or a limited number of health-promoting bacteria or by selectively stimulating their growth, which improved the welfare of the host, or both (Gibson and Roberfroid, 1995). Lactobacilli and enterococci are among the wide variety of microbial species that have been used extensively as probiotics

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(Patterson and Burkholder, 2003). Primalac is a kind of commercial probiotic that contains at least 1×10^8 CFU g^{-1} *Lactobacillus casei*, *Lactobacillus acidophilus*, *Bifidobacterium thermophilum*, and *Enterococcus faesium* (Chichlowski et al., 2007a, b). After feeding of probiotics, improvements in growth performance and feed efficiency have been reported in broiler chickens (Cavazzoni et al., 1998; Zulkifli et al., 2000; Kabir et al., 2004; Samli et al., 2007). Two of the most commonly studied prebiotic oligosaccharides are fructooligosaccharides (FOS) and mannanoligosaccharides (MOS). FOS can be found naturally in some cereal crops and onions (Bailey et al., 1991). MOS is obtained from the cell wall of yeast (*Saccharomyces cerevisiae*). Biolex–MB is a commercial prebiotic of the mannanoligosaccharides family, which is obtained by extraction from the outer cell wall of the yeast *Saccharomyces cerviciae*. Several typical probiotics contain either of these oligosaccharides, thereby comprising a synbiotic. The combination of a probiotic and prebiotic in one product has been shown to confer benefits beyond those of either on its own (Gallaher and Khil, 1999).

The search for new additives effective on animal growth and free from harmful side effects on consumers health is still continuing. The aim of this study was comparing the effects of the antibiotic flavomycin and primalac and Biolex-MB as alternatives for the growth stimulating antibiotics on growth performance and carcass characteristics of broiler chickens.

MATERIALS AND METHODS

Birds and housing

Three hundred 1 day old broiler chicks (Ross 308) were obtained from a commercial hatchery. The birds were randomly divided into 5 groups (60 birds/group) and housed in pens of identical size (120 × 100 cm) in a deep litter system with a wood shaving floor. Each group had 6 replicates (10 birds/pen). The birds had free access to water and feed. Environmental temperature in the first week of life was 34°C and decreased to 20°C until the end of the experiment.

Diets

A basal diet was formulated and considered as control according to recommendation of NRC, 1994 for starter (1 to 21 days), and grower (22 to 42 days) diets. Four tested diets were formulated by supplemented the basal control diet with antibiotic Flavomycin (650 g/ton^{-1}), probiotic (Primalac, 900 g/ton^{-1}), prebiotic (Biolex-MB, 2000 g/ton^{-1}), and mixture of Primalac (900 g/ton^{-1}) plus Biolex-MB (2000 g/ton^{-1}) as synbiotic, respectively. The composition of the diets are shown in Table 1.

Growth performance traits

All birds were weighed individually after their arrival from the hatchery to the experimental farm (initial weight) and on d 21 and 42. Daily weight gain for each dietary treatment was calculated by difference between two initial and final weight of birds in each growth period (kg)/ number of days in the growth period. Feed consumption was recorded in the course of the whole starter and grower periods for each treatment, and the feed efficiency ratio were calculated subsequently.

Carcass measurements

At the end of the experiment, 12 birds per treatment were randomly taken to study carcass characteristics. Chicks were fasted for approximately 12 h, and then individually weighed, slaughtered, feathered and eviscerated. Weights of breast, thigh, heart, liver, spleen and gizzard were recorded. The percentage (% of live body weight) of carcass parts and organs was calculated.

Statistical analysis

Based a randomized complete design, all data were analyzed using the One-Way Anova procedure of SAS® (SAS, 1998) for analysis of variance. Significant differences among treatments were identified at 5% level by Duncan's multiple range tests (Duncan, 1955).

RESULTS AND DISCUSSION

Growth performance

The results of performance are presented in the Table 2. At the starter period of the experiment (1 to 21 days), birds supplemented with prebiotic and synbiotic had a greater ($P<0.05$) daily body weight gain (BWG) compared with control group. The daily BWG (from day 1 to 42) were increased ($P<0.05$) for birds supplemented with antibiotic and synbiotic compared with control treatment. The inclusion of all treatments, except probiotic, in the feed also promoted feed efficiency (1 to 21 and 1 to 42 days) as compared to the control group ($p<0.05$). Daily feed intake during the experimental period did not differ between treatments ($p>0.05$).

In general the positive effects of experimental additives on performance are in agreement with the results reported previously. Fairchild et al. (2001), who showed that flavomycin as antibiotic has favorable effects on the weight gain of broiler chickens. Esteve-garcia et al. (1997), observed that addition of flavomycin to a wheat-based ration could improve significantly the chickens feed efficiency ratio in all breeding periods (1 to 21 days and 22 to 42 days). In the present study, the beneficial effects of a probiotic, prebiotic and synbiotic products on broiler performance parameters including daily BWG and feed efficiency are in agreement with previous studies (Zulkifli et al., 2000; Pelicano et al., 2003; Cavit, 2004; Thitaram et al., 2005; Kermanshahi and Rostami, 2006; Nayebpor et al., 2007; Falaki et al., 2010). In contrast, Gunal et al., (2006), Zhang et al., (2005), Jamroz et al., (2004) and Willis et al., (2007), reported that using these additives shed in the broiler ration had no significant effects on growth performance of broiler chickens. Variance among

Table 1. Ingredient composition (as percent of dry matter) and calculated analysis of the basal diets.

Ingredients	Starter (1-21 days)	Grower (22-42 days)
Corn	58.7	61
Soybian meal	30	29
Wheat bran	5	5
Fish meal	2	0
Soybian oil	1	2
Oister shell meal	1.2	1
DCP	1.07	1
Vitamin and mineral perimix	0.5	0.5
DL- Methionine	0.13	0.1
L-lysine	0.15	0.25
Salt	0.25	0.1
Coccidiostat	0	0.05
Total	100	100
Nutrient content		
ME (Kcal/Kg)	2850	2950
Crude protein (%)	20.48	18.44
Crude fiber (%)	3.89	3.81

Vitamin and mineral provided per kilogram of diet: vitamin A, 360000 IU; vitamin D3, 800000 IU; vitamin E, 7200 IU; vitamin K3, 800 mg; vitamin B1, 720 mg; vitamin B9, 400 mg; vitamin H2, 40 mg; vitamin B2, 2640 mg, vitamin B3, 4000 mg; vitamin B5, 12000 mg; vitamin B6, 1200 mg; vitamin B12, 6 mg; Choline chloraid, 200000 mg, Manganeze, 40000 mg, Iron, 20000 mg; Zinc, 40000 mg, coper, 4000mg; Iodine, 400 mg; Selenium, 80 mg.

Table 2. The main effects of treatments on growth performance of broiler chickens.

	Control	Antibiotic	Probiotic	Prebiotic	Synbiotic
Daily BWG (g)					
1-21	24.35 ^{b}	25.45 ^{ab}	25.07 ^{ab}	26.55 ^{a}	26.70 ^{a}
1-42	47.53 ^{b}	50.65 ^{a}	49.28 ^{ab}	49.47 ^{ab}	51.08 ^{a}
Daily FI (g)					
1-21	49.89	48.72	49.00	49.68	49.68
1-42	106.13	106.24	106.16	105.46	106.26
Feed efficiency (g/g)					
1-21	0.48 ^{b}	0.52 ^{a}	0.51 ^{ab}	0.53 ^{a}	0.53 ^{a}
1-42	0.44 ^{b}	0.47 ^{a}	0.46 ^{ab}	0.47 ^{a}	0.48 ^{a}

^{a,b} means in each row with different superscripts are significantly different ($p<0.05$).
BWG= Body Weigh Gain, FI= Feed Intake.

reports of researchers could be related to differences in the type of probiotics and prebiotics, management and environmental conditions that exist in various experiments. It's suggested that under benefit management and/or environmental conditions, the effect of such feed additives may be worthless. On the other hand, the responses of breeding bird in a warm climate condition similar to the present environmental in south west of Iran to these growth promoters may be better than an ideal condition. The results of some studies shown that growth stimulating antibiotics, increase the growth of broiler chickens by an increase in the uptake of nutrients (especially fatty acids and glucose), fixation of nitrogen and reduction in excretion of fat in the feces and microbial urea (Anderson et al., 1999). Also, antibiotics reduce the number of bacteria, toxins and their

Table 3. The main effects of treatments on carcass characteristic (as percent of live body weight) of 42d broiler chickens.

	Control	Antibiotic	Probiotic	Prebiotic	Synbiotic
Breast	18.91 [b]	20.20 [a]	20.41 [a]	18.82 [b]	19.92 [ab]
Thigh	19.28 [c]	20.87 [a]	19.99 [abc]	19.59 [bc]	20.55 [ab]
Heart	0.45	0.46	0.45	0.41	0.41
Spleen	0.15	0.18	0.16	0.20	0.15
Liver	2.24	2.04	2.07	2.29	2.19
Gizzard	1.71 [ab]	1.63 [ab]	1.57 [b]	1.88 [a]	1.85 [ab]
Abdominal Fat pad	1.98 [a]	1.91 [a]	1.74 [ab]	1.62 [b]	1.86 [ab]

[a,b,c] means in each row with different superscripts

secondary products in the GI tract (Gunal et al., 2006). Our findings showed that consumption of synbiotic, like that of antibiotics, had a positive effect on the body weight gain when compared to control treatment. The reason may be ascribed to the synergism of probiotic and prebiotic following the concurrent action of prebiotics fermentation by lactic acid bacteria in the GI tract and production of some acids by this group of bacteria, the pH of the GI tract is further reduced (Fuller, 1989). Reduction in pH is effective in controlling the population of pathogenic bacteria. During the infections due to pathogenic bacteria, lymphocytes crowd up to kill them, and after inflammation the thickness of the muscular layer increases (Gunal et al., 2006). It seems that in our study, due to the synergism between probiotic and prebiotic, followed by absorption of nutrients by the GI system, the birds under synbiotic treatment had the best feed efficiency in both start (1 to 21 days) and whole (1 to 42 days) of experimental periods.

Carcass composition

The effects of dietary treatments on carcass characteristics and some internal organs of 42 days old broilers are shown in Table 3. The efficiency of breast was higher ($p<0.05$) in the antibiotic and probiotic treatments than in the control group, and it in the prebiotic and synbiotic groups did not differ significantly as compared to the control treatment. The antibiotic supplemented group had a greater ($P<0.05$) thigh percent compared with the control and prebiotic supplemented groups. However, the thigh percent did not show significant differences between the probiotic and prebiotic groups with the control treatment. Also, there was no significant difference in mean percentage yield of heart, spleen and liver between the fed additives treatments and control group. The birds under prebiotic treatment, had a higher gizzard percent as compared to the probiotic treatment, whereas the percent of abdominal fat pad was lower than in the antibiotic and control treatments ($p<0.05$).

The benefits of the antibiotic use on carcass characteristics have been reported by other researchers (Woodward et al., 1988; Elwinger et al., 1998; Fidler et al., 2003). Kabir et al. (2004) have reported that adding 2 g probiotic per each liter of water consumed by broiler chickens, would increase the efficiency in their thigh and breast as compared with the control treatment. In Ammerman et al. (1989) study, adding 0.375% oligofructose to the bird's ration, on day 47, decreased the percent of abdominal fat. However, our findings on carcasse composition were in contrast to those of Pelicia et al. (2004); Pelicano et al. (2003); Willis et al. (2007) and Kannan et al. (2005). As pointed out before, these differences between reported results could be related to the mode of action of those feed additives is quite different, particularly their antimicrobial activity, the similar physiologic pattern was probably exerted by modifying intestinal pH, altering the composition and balance of intestinal flora, enhancing nutrient digestibility and improving growth rate and carcass characteristics. Also, by observing a reduction in the abdominal fat level of birds fed by prebiotic, it is suggested that this product may interfere in the accessibility to fat for formation of fat tissue in the birds.

Conclusions

Supplementation of broiler diets with the feed growth promoters improved the growth responses compared with the unsupplemented control treatment. Also, based on obtaining better results for birds fed diets containing growth promoters (synbiotic), particularly in growth response, when compared to control treatment, it is concluded that by using non-antibiotic additives particularly mixing of both probiotic and prebiotic could obtained the advantages of antibiotic (performance) without their disadvantages.

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