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Influence of Probiotic and Prebiotic on broiler chickens performance and immune status

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ABSTRACT: This experiment was conducted to study the effect of probiotic and prebiotic as growth promoting agents and as a potential alternative to antibiotic, on performance and immune responses in broiler chickens.Each diet was fed ad libitum to six replicates for three treatment groups consisted of twenty birds in each pen from 1 to 42 day old. Body mass gain and feed efficiency at 21 and 42 days of age were affected ($P<0.05$) by supplementing prebiotic in broiler diet. Antibody production to Newcastle disease vaccination and sheep red blood cell were affected ($P<0.05$) by probiotic-treated birds. Furthermore, the supplementation of the diet led to the improvement of performance and immune status in treated groups with prebiotic and probiotic respectively.

***Keywords*:** Probiotic, Prebiotic, Performance, immunity.

INTRODUCTION

The sub therapeutic use of antibiotic growth promoters (AGP) in animals has been banned due to the risk of their possible residual effects and ability to cause cross resistance with antibiotics used in human medicine (Ganan et al., 2012). With the removal of AGPs from poultry diets in European Union (Cross et al., 2007), probable future ban on the use of antibiotics in other countries, and also increased concerns over food safety, environmental contamination, and general health risks, the search for growth promoting and immune system-strengthening alternatives is necessary (Dong et al., 2007).

Probiotics are live microorganisms that confer a health benefit to a host (Mercenier et al., 2003). Perhaps the most commonly used probiotic species belong to the genus Lactobacillus. One of the potential probiotic benefits is improving resistance to enteric pathogens through competitive exclusion (Nava et al., 2005).Commercial probiotic preparations containing lactobacilli are used in the egg and poultry industry to improve performance parameters, including mean egg weight, market-aged body weight, and feed conversion ratio (Talebi et al., 2008).

Prebiotics are nondigestible carbohydrates, such as fructooligosaccharides (FOS) and annanoligosaccharides (MOS), which beneficially affect the host by selectively stimulating the growth, activity, or both of one or a limited number of bacteria in the gut (Pharmaceutiques, 1995).

The aim of this present study was to investigate the possible productive and immunolological responses to dietary supplementation with probiotic and prebiotic and the possibility of using them instead of antibiotic in broilers.

MATERIALS AND METHODS

Birds, Management, and Diets

A six-week experiment was carried out with 360 one-day-old Arbor Acres male broilers with three treatments, six replicate pens per treatment and 20 chicks per pen. Birds were reared in floor pens (165×230 cm) with five cm wood shaving as litter, and Feed and water were provided *ad libitum*. The treatments were as follows: negative control (basal diet) (NRC, 1994), probiotic (basal diet containing 100 gr/ton Protexin®), and prebiotic (basal diet containing 1 g/kg Turbo Tox®). The study lasted for 42 days. The initial room temperature was 33 °C and decreased by 3 °C every week until it reached 21 °C at week 5 and remained constant at this point. The lighting program was 24 h light throughout the trial.

Performance

The body weights (BW) of the birds were measured individually and feed intake per pen was recorded at 1, 21 and 42 days of age. Feed conversion ratio (FCR) was calculated.

Immune Responses

Broilers were vaccinated against ND by ocular route at the 8th and 28th day of age with Lasota strain (Nobilis®ND Clone 30, Intervet). At 35 days of age, blood was from brachial vein collected and sera were separated. Antibody titers against ND vaccine were measured with ELISA.

In order to assay the immune response, at day 35 five chicks per pen were injected intramuscularly (breast muscle) with 1 mL suspension of seven percent sheep red blood cell (SRBC) in phosphate buffer saline. At seventh day after injection (day 42), blood was obtained and serum was collected by centrifugation at 2655×g for 10 min and stored at −20 °C for further analysis.Total antibody titers against SRBC were determined by agglutination, according to Wegmann and Smithies(1966). Antibody titers measured against SRBC were expressed as the log 2 of the reciprocal of the highest serum dilution giving complete agglutination.

Statistical analysis

Each bird was considered a replicate. All data were subjected to one-way ANOVA using SPSS 15.0 for Windows (SPSS, Chicago, IL). Mean values of treatment groups were compared using the Tukey test and differences were considered statistically significant at $P < 0.05$.

RESULTS AND DISCUSSION

Results

Growth performance

The effects of different treatments on broilers BW and FCR are shown in Table 2. Totally, results obtained from BW and FCR represented a significant difference ($P<0.05$) between prebiotic group with Control and probiotic groups but there was not any statistical differences among Control and probiotic groups. These data indicate that prebiotic improves performances of broiler chicks.

Table 1. Composition (g/kg on an as fed basis) and chemical nutrients of basal diet

Ingredients (g/kg)	Starter (0–3 weeks)	Grower (4–6 weeks)
Maize	519.2	588.0
Soybean meal	396.8	332.4
Soybean oil	42	42.7
Dicalcium phosphate	17	13
Limestone	13	14
DL-Methionine	1.7	0.6
Salt	2.5	2.5
Sodium bicarbonate	2.8	1.8
Vitamin premix[a]	2.5	2.5
Mineral premix[b]	2.5	2.5
Calculated chemical nutrients		
Metabolizable energy	12.5	12.9
Crude protein	216.2	193.5
Available phosphorus	4.2	3.4
Calcium	9.3	8.7
Sodium	1.9	1.5
Methionine	5.1	3.7
Methionine + cysteine	8.6	6.9
Lysine	13	10.4

[a]Vitamin concentrations per kilogram of diet: retinol 2.94 mg, cholecalciferol 0.05 mg, α-tocopherol acetate 22 mg, vitamin K3 2 mg, thiamine 3 mg, riboflavin 6.6 mg, niacin 40 mg, pantothenic acid 29.7 mg, pyridoxine 10 mg, folic acid 1 mg, vitamin B12 0.015 mg, biotin 1 mg, choline chloride 500 mg and ethoxyquin 125 mg.

[b]Mineral concentrations per kilogram of diet: Mn 100 mg, Fe 50 mg, Zn 85 mg, Cu 10 mg, I 1 mg, Se 0.3 mg

Table 2. Effect of probiotic and prebiotic on broiler growth performance

Groups	21 days body weight (g)	FCR	42 days body weight (g)	FCR
Control	665.1[a]	1.43[a]	2025.4[a]	1.75[a]
Probiotic	674.7[a]	1.40[a]	2040.1[a]	1.73[a]
Prebiotic	802.04[b]	1.24[b]	2296.7[b]	1.60[b]
SEM	6.15	0.005	28.3	0.008

Means within the same row with different superscripts differ significantly (P<0.05)

Immune response

To demonstrate the humoral immune response, sheep red blood cells (SRBCs) were used as non-pathogenic antigens for stimulating T-cell dependent response (Kundu, 1999). Results revealed that probiotic resulted in significantly higher (p<0.05) total immunoglobulins titers against SRBCs At seventh day after injection of SRBC as compared to the prebiotic and control groups (Table 3). However, difference among the prebiotic and control groups was statistically nonsignificant (p>0.05).

Results showed that probiotic significantly (P<0.05) improved bird immune response to the NDV vaccine in comparison to the prebiotic and control groups (Table 3).

Table 3. Effect of dietary supplementation with prebiotic and probiotic on immune response of broilers

Items	Treatment			SEM
	control	probiotic	prebiotic	
SRBC antibody titer (log2)	2.63[a]	3.07[b]	2.81[a]	0.195
ND titre, ELISA	6.051[a]	9.407[b]	6.658[a]	0.139

Means within the same row with different superscripts differ significantly (P<0.05)
SEM standard error mean

Discussion

This study was designed to investigate the influence of probiotic and prebiotic on growth performance and parameters of immunity in broiler chickens.

Body weights of prebiotic-treated birds were higher compared with the other treatment groups. In addition, the recommended level of prebiotic resulted in a better FCR. Some researchers have reported positive effects of prebiotics (Xu et al., 2003; Chee et al., 2010) on performance, others (Yang et al., 2008; Baurhoo et al., 2009; Yang et al., 2009; Alzueta et al., 2010) have not found a positive effect. (Chee et al., 2010) reported that dietary supplementation with MOS resulted in a significant improvement in broiler performance (Chee et al., 2010). Contrary to our findings, (Morales-Lopez et al., 2009) did not find a positive effect of MOS or an antibiotic (avilamycin) on the growth performance of broilers (Morales-López et al., 2009). This inconsistency in the effectiveness of prebiotics may be due to the effects of different factors. Environment, management, nutrition, type of additive, and dosage as well as bird characteristics (age, species, stage of production) can affect the response of broilers to prebiotics (Yang et al., 2009) and thus account for the contradictory results.

Dietary supplementation with probiotic showed significant influence on immune response to the NDV vaccine in broilers. On the other hand probiotic resulted in higher anti-SRBC antibody titers as compared to other groups, indicating their stimulatory effects on humoral immunity. Applying probiotic could improve level of immunity response in broiler chickens (Roberfroid, 2002). This compound which is in markets in commercial forms, could be likely used to develop humoral immunity system and increase chickens' resistance against infections and diseases. On the other hand high and active immunity system could make vaccination plan successful which finally lead to developing production factors that is final goal of aviculture industry. It seems that probiotics don't have any significant effect on the broiler chicken performance since enzymes and digestive acids atrophy them during their way to the target site. Therefore, they wouldn't be able to compete with other pathogens so as to adhere to intestine mucosa receptors. Probiotic effects, however, on immune system can be attributed to the release of immunomodulator polysaccharides within these cells.

CONCULSION

On these accounts, we suggest that in places prone to the high risk probiotics can be applied to improve the immune system while in safe places, prebiotics tend to improve performance.

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