Effects of a Probiotic and Other Feed Additives on Performance and Immune Response of Broiler Chicks

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Abstract: The effects of dietary supplementation of a probiotic, Toxiban, Formycine and probiotic-Toxiban mixture on performance and immune response of broiler chicks were investigated. In a completely randomized design, one hundred fifty 14-days-old broiler chicks were assigned to 5 treatments with 5 replicates and 6 chicks in experimental unit. The experimental treatments were added to basal (starter and finisher) diets as follow: T (1): control group (C) that received starter and finisher diets, T (2): C plus 0.15 percent probiotic, T (3): C plus 0.1 percent Toxiban, T (4): C plus 0.1 percent Formycine and T (5): C plus mixture of 0.15 percent probiotic with 0.1 percent Toxiban. Additives except Toxiban, significantly (p<0.05) increased blood Newcastle antibody titer compared with the control group. Regarding Influenza antibody titer, there was significant differences between treatments except Formycine feeding. Only probiotic caused a significant (p<0.05) increased in blood Bronchitis antibody titer. Consumption of Formycine and probiotic+Toxiban mixture resulted in a significant decrease in blood Gamboro antibody titer (p<0.05). Chicks fed diets supplemented with Toxiban significantly (p<0.01) had higher body weight and better Feed Conversion Ratio (FCR) than other treatments. Results indicated that, consumption of Toxiban had the most positive effect on performance and probiotic alone or combination of probiotic and Toxiban had the best effect on blood antibody titers of broiler chicks.

Key words: Probiotic, Toxiban, Formycine, broilers, immune response

Introduction
Probiotics are as a source of live micro-organisms that includes bacteria, fungi and yeasts (Fox, 1988; Miles and Bootwalla, 1991). Lactic acid bacteria such as Lactobacilli streptococi and Bifidobacteria are the most common organisms used in probiotics preparations. The mechanism of action of probiotics has not been fully explained although there are several hypothesis (Ahmad, 2006). Its inhibitory action against pathogens may be mediated by competition for receptors on the gut mucosa, competition for nutrients, the production of antibacterial substances and the stimulation of immunity (Piard and Desmazeaud, 1991; Perdigon and Alvare, 1992; Bal et al., 2004).

As feed additive, probiotics has a good impact on the poultry performance (Stavic and Kornegay, 1995). These live organisms after residing intestinal tract and their metabolites can act as immunomodulatory agent by activating specific and non-specific host immune responses in chicks, which in turn help in prevention and control of various infectious diseases (Fuller, 1992; Koenen et al., 2004).

The most important advantage of probiotic is that doesn’t have any residues in animal production and in contrast to antibiotics which could have serious consequences such as drug resistance and harmful alternation of bacterial population in the intestine (Abe et al., 1995), probiotics are not made any resistance by consumption. Therefore, some researchers have replaced antibiotics with probiotics as therapeutic and growth promoting agent (Donovan et al., 2002; Martins et al., 2005).

The dietary supplementation of probiotic benefit the host animal by stimulating appetite (Nahashon et al., 1992), stimulate the immune system (Toms and Powie, 2001; Koenen et al., 2004), improve microbial balance (Fuller, 1989), produce the digestive enzymes (Saarela et al., 2000), stimulate lactic acid (Bailey, 1987), decrease pH and release bact eriocins (Rolfe, 2000), synthesize vitamins (Coates and Fuller, 1977), improve egg production, egg weight and egg size in layers and turkey (Thayer et al., 1978; Nahashon et al., 1992; Jin et al., 1998), feed consumption in layers and broilers (Nahashon et al., 1994; Kim et al., 2003), lower serum and egg yolk cholesterol levels in hens (Mohan et al., 1995; Jin et al., 1998; Haddad et al., 2001; Kim et al., 2003; Kurtoglu et al., 2004; Hajjaj et al., 2005) improve feed conversion ratio of the host (Raymane, 2000; Cavit, 2003), lower motility rate in broiler (Samantha and Biswas, 1995) and have beneficial effect on the health of the host (Soomro et al., 2002). The strain of selected microorganisms in propiotics, method of preparation, the dosage and condition of animals could be partially responsible for such description (Huang et al., 2004).

This study was conducted to investigate the effects of dietary supplementation of a probiotic and other additives available in Iran market on performance and immune response of broiler chicks.
**Materials and Methods**

A total of one hundred fifty 14-days-old broiler chicks (Lohman strain) were obtained from the local market and were divided into 25 groups of 6 with similar average body weight (255±10 g). All birds were fed a standard commercial diet based on corn and soybean meal (starter diet) during the first 14 days of life and then each treatment switched to their respective experimental diets. Each experimental treatment was repeated 5 times and fed experimental diets for 28 days. Experiment was conducted as completely randomized design and five dietary treatments were utilized. The chicks were fed diets based on soybean meal and corn (without added antibiotics, coecociostats or growth promoters). The composition of starter and finisher diets is shown in Table 1. The basal diets (starter and finisher) were formulated to meet or exceed National Research Council (1994) nutrient requirements of broiler chicks and were fed from days 14-42. The treatments were:

T (1): control groups (C) that received starter and finisher diets, T (2): C plus 0.1 percent of a commercial probiotic (Bactocill, Pakoostar Parand, Tehran, Iran), T (3): C plus 0.1 percent Toxiban, T (4): C plus 0.1 percent Formycin and T (5): C plus mixture of 0.15 percent probiotic with 0.1 percent Toxiban. These levels of supplementsations selected based on optimum recommended levels in some researches. Strict sanitation practices were maintained in the house before and during the course of experiment. The probiotic contained *Pediococcus acidilactici* (MA185M) with a minimum of $1 \times 10^{10}$ CFU/1 gr of the product. Formycin (a mixture of formaldehyde, propionic acid, sodium bentonite and ammonia) and Toxiban (a mixture of aluminosilicate and ammonium propionate), are two commercial feed additives available in Iran marketed by IQF, Spain.

The chicks were housed in temperature controlled room with continuous lighting and feed and water were provided ad libitum throughout the experiment. Feed intake (hen-day) and body weight were determined weekly and their Feed Conversion Ratio (FCR) was calculated. FCR was corrected for mortality. Birds were vaccinated against Gambro (Biomen+D78), Newcastle (Lascota) according to laboratory recommendations. At the end of experiment (42 d), five birds from each treatment were bled by wing vein for serum antibody titer analysis. All serum samples were tested using HI test (Newcastle) according to Xu et al. (1997) and indirect antibody enzyme-linked immunosorbent assay (ELISA) kit (Influenza, Bronchitis and Gambro) according to the manufacturer’s (Svanova Biotech, Uppsala, Sweeden) instruction (Loraine and Clarke, 1982).

Analysis of variance was performed on the data using the General Linear Model of SAS software (2002). Means were compared using Duncan’s multiple range test. Level of significance used in all results was 0.05.

**Results and Discussion**

The main effect of treatments on broiler performance and antibody titers are presented in Table 2. Only treatment 4 (Formycin, commercial product 2) decreased (p<0.01) feed consumption by 7.1 percent as compared with the control diet. This product (Formycin) contained formaldehyde acid which coagulate cytoplasmic proteins of pathogenic bacteria through releasing aldehyde and increasing the population of unpathogenic microflora in the gut (Roser, 2006; Kralik et al., 2004). Also this product could maintain acidic condition in the gut and lower the population of saprophytic bacteria. Treatment 5 (probiotic+Toxiban) resulted in non-significantly lower feed consumption, which indicate the beneficial effects of probiotic, formaldehyde acid and zeolites on feed consumption (Bailey et al., 1998). Probiotic alone had no significant on feed consumption which is in agreement with findings of Miazze et al. (2000), Ledoux et al. (1999) and Mutus et al. (2006) but not in the line of the findings of Jernigan et al. (1985) and Yeo and Kim (1997) who reported that the use of probiotic in broiler chicks diets significantly improved the daily body weight gain, feed intake and feed efficiency. The reason of variable effect of biological additives may be confounded by variations in gut flora and environmental conditions (Mahdavi et al., 2005).

The body weight gain was affected by treatments, except treatment 4 (Formycin). As compared with the control diet, probiotic, Toxiban and probiotic+Toxiban increased...
Table 2: The main effects of treatments on performance and titer of antibodies of broilers

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Treatments*</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>SEM</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed consumption (g/pen/d)</td>
<td></td>
<td>133.48</td>
<td>137.88</td>
<td>131.79</td>
<td>124.02</td>
<td>126.61</td>
<td>1.01</td>
<td>3.92</td>
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<tr>
<td>Body weight gain (g)</td>
<td></td>
<td>1484.64</td>
<td>1680.96</td>
<td>1735.39</td>
<td>1440.39</td>
<td>1588.29</td>
<td>3.34</td>
<td>3.54</td>
</tr>
<tr>
<td>Feed conversion ratio (g/g)</td>
<td></td>
<td>2.49</td>
<td>2.25</td>
<td>2.17</td>
<td>2.37</td>
<td>2.19</td>
<td>0.06</td>
<td>0.92</td>
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<tr>
<td>Antibody titers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newcastle</td>
<td></td>
<td>1.154</td>
<td>1.294*</td>
<td>1.222</td>
<td>1.274*</td>
<td>1.41*</td>
<td>0.47</td>
<td>5.07</td>
</tr>
<tr>
<td>Bronchitis</td>
<td></td>
<td>1.166</td>
<td>1.298*</td>
<td>1.045*</td>
<td>1.110*</td>
<td>1.166*</td>
<td>0.55</td>
<td>11.12</td>
</tr>
<tr>
<td>Influenza</td>
<td></td>
<td>1.313</td>
<td>1.322</td>
<td>1.345*</td>
<td>1.306*</td>
<td>1.370*</td>
<td>0.49</td>
<td>7.11</td>
</tr>
<tr>
<td>Gamboro</td>
<td></td>
<td>1.166</td>
<td>1.268</td>
<td>1.138</td>
<td>0.918*</td>
<td>0.918*</td>
<td>0.45</td>
<td>4.97</td>
</tr>
</tbody>
</table>

*: 1) control, 2) probiotic, 3) Toxiban; commercial product 1; 4) Formycine; commercial product 2 and 5) probiotic + Toxiban.

SEM = Standard Error of the mean, CV = coefficient of variability, * = Significant at p<0.05, ** = Significant at p<0.01

body weight gain by 12.9, 15.6 and 7.7 percent, respectively. Mohan et al. (1995) reported 15.1 percent increase in body weight gain of broilers as compared with the control diet with supplementing diet with probiotic. The higher body weight gain with Toxiban and probiotic+Toxiban might be due to the synergistic effect of probiotic and zeolite+ammonium propionate in Toxiban (Miazzo et al., 2000; Ledoux et al., 1999).

The Feed Conversion Ratio (FCR) was affected (p<0.01) by treatments compared with the control. Probiotic, Toxiban, combination of probiotic and Toxiban and Formycine improved FCR by 9.2, 12.80, 12.0 and 4.8 percent, respectively compared with control diet. The highest (2.49) and the lowest (2.17) FCR was found for control and Toxiban, respectively. The improvement of FCR with feeding probiotic and Toxiban (contained zeolite) is in agreement with the findings of Miazzo et al. (2000), Haddad et al. (2001), Pelicia et al. (2004) and Papaioannou et al. (2005).

The manipulation of gut microbiota via the administration of probiotics influences the development of the immune response (McCracken and Gaskins, 1999). Blood Newcastle antibody titer was affected (p<0.05) by treatments (except feeding Toxiban). The highest value was seen with combination of probiotic and Toxiban followed by probiotic feeding. The positive effect of feeding probiotic on immunity response is in agreement with the findings of Fuller (1992), Zulkifli et al. (2000), Dalloul et al. (2003) and Koenen et al. (2004). Combination of probiotic and Toxiban, probiotic and Formycine increased the Newcastle antibody titer by 22.18, 12.10 and 10.4 percent compared with the control diet. Only feeding probiotic increased (p<0.05) but Toxiban and Formycine resulted in lower (p<0.05) bronchitis antibody titration. In the case of influenza, feeding probiotic (p>0.05), Toxiban and combination of probiotic and Toxiban increased and formycine decreased (p<0.05) antibody titration. Gamboro antibody titration decreased with feeding Formycine and combination probiotic and Toxiban but increased (p>0.05) with feeding probiotic (Kostiuk et al., 1992; Koenen et al., 2004). The strains of selected microorganisms in probiotics, method of preparation, the dosage and condition of birds could be reasons for any observed discrepancies of the effect of probiotics (Huang et al., 2004).

Based on the results of the current study, feeding Toxiban (a mixture of aluminosilicate and ammonium propionate) had the most positive effects on performance parameters and probiotic alone or probiotic+Toxiban supplementations had the best effect on immunity response of broiler chicks.

References


Rowghani et al.: Dietary Supplementation of a Probiotic and Other Additives Available in Iran


