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Effects of Probiotics Supplementation on Growth Performance, Feed Conversion Ratio and Economics of Broilers

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ABSTRACT

Two hundred and forty (n=240), day-old broiler chicks of strain 'cobb400' were divided equally into 3 groups of 80 chicks each in group to observe the effect of probiotics (Protexin) supplementation on growth performance and economics of feeding in broilers. Different dietary treatments were T_1–basal diet without probiotics supplementation (control), T_2–T_1 + probiotics supplementation (50 g/ton of feed) and T_3– T_1 + probiotics supplementation (100 g/ton of feed). Average daily body weight gain (BWG) was significantly higher ($P \leq 0.01$) in T_3 compared to T_2 and T_1 (41.63 ± 0.25 g vs 39.48 ± 0.15, 39.99 ± 0.10). Feed intake during starter, finisher and overall study period remained statistically ($P \geq 0.05$) at par. Feed conversion ratio was significantly ($P \leq 0.01$) improved with probiotics supplementation @100 g/ton of feed compared to control. Dressing percentage and organ weights (% Body Weight) remained statistically ($P \geq 0.05$) similar. Mortality (%) was lower for group T_3 (1.25) compared to T_2 (3.75) and T_1 (5.00) but differences were non-significant ($P \geq 0.05$). The return over feed cost was significantly ($P \leq 0.01$) higher in T_2 (₹30.99) compared to T_1 (₹ 27.82) and control (₹ 26.45). The profit per bird over control in group T_2 and T_3 was ₹ 1.37 and ₹ 4.54, respectively. Thus, the dietary supplementation of probiotics at 100 g/ton of feed significantly enhanced body weight gain along with better feed conversion ratio and profit without any adverse effect on feed intake, mortality and carcass characteristics.

Keywords: Broiler, Economics, FCR, Growth and Probiotics.

The sub therapeutic use of antibiotic growth promoters has been an economically viable method of raising animal performance for many years. However, repeated use of antibiotics in poultry diets resulted in severe problems like resistance of pathogen to antibiotics, accumulation of antibiotics residue in their products and environment, imbalance of normal microflora and reduction in beneficial intestinal microflora (Barton, 2000). This resulted into severe restriction or total ban on the use of antibiotics in animal and poultry industry in many countries in the world. As a result, the poultry industry must focus on alternative to antibiotics for maintaining health and performance under commercial conditions. Apart from this, the efficiency of poultry to convert the feed into meat plays also a key role in economics of broiler industry. Therefore, it is highly essential to improve the feed efficiency of poultry to produce meat economically. So, for better utilization of feed and to improve the feed efficiency use of probiotics as feed additives is one of the recent biotechnological interventions. A probiotics can be defined as a 'live microbial feed supplement that beneficially affects the host animal by improving its microbial intestinal balance' (Fuller, 1989). The proposed modes of action of probiotics in poultry are 1) maintaining a beneficial microbial population by competitive exclusion and antagonism (Fuller, 1989), 2) improving feed intake and digestion (Nahanshon *et al.,* 1993), and 3) altering bacterial metabolism (Jin *et al.,* 1997). Probiotics represent potential replacements for antibiotics in the animal food industry because of their reported ability to reduce enteric disease in poultry and potential food borne pathogen contamination of poultry or poultry products (Reid and Friendship, 2002; Patterson and Burkholder, 2003). Numerous studies showed that addition of probiotics have positive effects on growth rate, feed utilization, feed efficiency and mortality rate (Sen *et al.,* 2012; Manal, 2012). However, the efficacy of probiotics depends upon the selection of more efficient strains, gene manipulation, combination of several strains and the combination of probiotics and synergistically acting components. The use of multi-strain probiotics seems to be the best way of potentiating the efficacy of probiotics as it beneficially affects the host by improving the growth-promoting bacteria with competitive antagonism of pathogenic bacteria in the gastrointestinal tract. Hence, keeping in view multi-strain probiotics was used to evaluate the effect of probiotics supplementation on growth performance, feed consumption, feed conversion ratio, carcass characteristics, mortality and economics of feeding in broiler chicks.

MATERIALS AND METHODS

Location

The present experiment was carried out for six weeks from 20th November to 31st December, 2012 at a private farm located at Modasa, Sabarkantha district, Gujarat.

Experimental Design

A day old broiler chicks of strain ‘Cobb400’ (n=240) were randomly divided into 3 dietary treatment groups of similar mean weight comprising 80 birds each and each group divided into 4 sub-groups of 20 birds each. The experimental design consisted of three dietary treatments as T_1: Basal diet without probiotics supplementation (Control), T_2: Basal diet + Probiotics supplementation @ 50g/ton of feed and T_3: Basal diet + Probiotics supplementation @ 100g/ton of feed for 6 weeks.

The multi-strain probiotics was (Protexin*, Novartis India Ltd.) was supplemented which contained both bacteria and yeast. Each gram of probiotics contains 2 × 10^9 CFU of *Lactobacillus plantarum, Lactobacillus bulgaricus, Lactobacillus acidophilus, Lactobacillus casei, Streptococcus thermophilus, Streptococcus faecium, Bifidobacterium bifidum, Torulopsis spp*. and *Aspergillus oryzae.*

Table 1: Proportion of feed ingredients and nutrient composition (%) of basal diet

Ingredients	Proportions (%)		
	Pre-starter (0-10 d)	Starter (11-21 d)	Finisher (22-42 d)
Maize	50.28	54.92	60.38
Soyabean meal	42.21	36.73	31.18
Vegetable oil	3.56	4.33	4.85
Dicalcium phosphate	1.93	1.97	1.71
Common salt	0.35	0.35	0.35
Limestone	0.97	1.01	0.93
Maduramycine	0.05	0.05	0.05
Lipocare1	0.10	0.10	0.10
L-Lysine	0.17	0.15	0.14
DL-Methionine	0.15	0.15	0.07
Vitamin premix2	0.05	0.05	0.05
Mineral premix3	0.20	0.20	0.20
Total	100.02	100.01	100.01
Nutrient composition			
ME (kcal/kg)	2800	2950	3020
Crude Protein (%)	22.90	21.30	19.10
Calcium (%)	0.97	0.92	0.86
Phosphorus (%)	0.45	0.45	0.40

[1] Lecithin treated with co-enzyme
[2] Provides per kg of diet: 12500 IU vitamin A; 2500 IU vitamin D3; 12 mg vitamin E; 1.5 mg vitamin K; 1.5 mg vitamin B_1; 5 mg vitamin B_2; 2 mg vitamin B_6, 15 mcg vitamin B_{12}; 15 mg niacin, 10 mg pantothenic acid and 0.5 mg folic acid
[3]Provides per kg of diet: 50 mg iron, 10 mg copper, 50 mg zinc, 80 mg manganese1 mg iodine and 0.2 mg selenium

Housing and management

Birds were reared in deep litter system of housing under uniform and standard managemental conditions. Strict

Table 2: Average total gain in body weight, Feed intake, FCR and economics of broiler chicks fed different levels of probiotics

Replications	Treatments			'P' Value
	T_1	T_2	T_3	
Initial body weight	**42.58 ± 0.38**	**42.27 ± 0.39**	**42.63 ± 0.46**	**NS**
Final body weight	1700.11^{b} ± 16.77	1724.12^{b}±18.22	1790.82^{a} ±17.49	0.001***
Gain in body weight (g/bird)				
Average daily gain	39.48 ± 0.15^{b}	39.99 ± 0.10^{b}	41.63 ± 0.25^{a}	0.001 ***
Starter phase	556.21± 3.56^{c}	568.28 ± 5.83^{b}	579.51 ± 4.01^{a}	0.01 *
Finisher phase	1101.82 ±6.18^{b}	1111.45 ±8.97^{b}	1168.90 ±11.78^{a}	0.001 ***
Overall	1658.02±6.34^{b}	1679.73±4.25^{b}	1748.42 ±10.54^{a}	0.001 ***
Feed intake (g/bird)				
Starter phase	726.27 ± 8.02	727.68 ± 7.37	730.16 ± 2.87	NS
Finisher phase	2414.64 ± 25.15	2407.08 ± 15.26	2435.26 ± 25.02	NS
Overall	3140.91 ± 29.97	3134.76 ± 15.24	3165.42 ± 23.12	NS
Average daily feed intake	74.79 ± 0.71	74.64 ± 0.36	75.37 ± 0.55	NS
FCR (kg feed/kg gain)				
Starter phase	1.30 ± 0.01	1.28 ± 0.01	1.26 ± 0.01	NS
Finisher phase	2.19 ± 0.03^{b}	2.17 ± 0.02^{b}	2.08 ± 0.01^{a}	0.008 **
Overall	1.90 ± 0.02^{b}	1.87 ±0.01^{b}	1.81± 0.01^{a}	0.010 **
Economics of feeding				
Cost of feeding (₹)	84.05 ± 0.80	84.25 ± 0.41	85.43 ± 0.62	NS
Return over feed cost (₹)	26.45± 1.05^{b}	27.82 ± 0.61^{b}	30.99 ± 0.39^{a}	0.001**

Means with different superscripts in a row differ significantly.
*(P < 0.05) ** (P < 0.01) *** (P < 0.001) NS- non-significant

and thorough sanitary measures were adopted to minimize disease occurrence. Appropriate vaccination was done to protect the birds against commonly occurring poultry diseases. The floor were cleaned, disinfected and dried before spreading the bedding material.

Experimental diets

The basal diet was obtained from commercial feed mill and considered as control. The Broiler chicks were fed in three phases *viz*. pre-starter (0–10 days), starter (11–21 days) and finisher (22–42 days). Feed and water were offered *ad libitium* to each group throughout experimental period. The details regarding the proportions of feed ingredients used for manufacturing of basal diet and calculated nutrient composition of basal diet are given in Table 1. Nutrient levels of the diets for broilers were based on the NRC (1994) recommendations of nutrient requirements of broiler chickens. The proximate analysis of experimental diets was carried out as per AOAC (1995) method. All the experimental chicks were properly vaccinated against various diseases like New Castle Disease, Infectious Bursal Disease etc.

Sampling and Analytical Methods

Accurate body weight of the individual experimental chicks were recorded in the morning hours before feeding with the help of digital weighing balance at day old and thereafter at weekly interval till six weeks of age. Feed consumption was measured by weighed quantity of feed offered to each group and at the end of week feed left over was weighed and recorded. On the basis of that average weekly feed intake and FCR was calculated. At the end of experiment, four birds from each treatment were randomly selected and slaughtered. The dressed weight of each bird was obtained separately by complete bleeding and removal of feathers, head, neck, shanks and viscera. Heart, liver, gizzard and spleen were also weighed individually and their percentages in relation to body weight were calculated. Mortality was recorded as and when occurred. Mortality rate (%) was calculated from the records of dead birds up to end of the study against total number of birds. Relative economics to predict effect of probiotics on the performance of broiler chicks was calculated for raising broilers up to 6 weeks of age under different treatments. Return over feed cost was calculated by subtracting the cost of feeding from the output of bird sold at ₹.65 per kg live weight.

Statistical Analysis

All the recorded and calculated data were subjected to statistical analysis by applying "Factorial and Completely Randomized Design" (FCRD) employing one-way analysis of variance as per Snedecor and Cochran (1994). A p-value of < 0.05 was considered a significant difference among groups and the comparison of means was made using Duncan multiple range test (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Average daily body weight gain

Average daily body weight gain (g) for T_1, T_2 and T_3 was 39.48 ± 0.15, 39.99 ± 0.10 and 41.63 ± 0.25, respectively and it was significantly ($P \leq 0.01$) higher in treatment group T_3 compared to treatment groups T_2 and T_1 (Table 2).

Table 3. Carcass characteristics, organ weight (%) relative to body weight and mortality rate of broilers fed different levels of probiotics

Parameters	Treatments		
	T_1	T_2	T_3
Live body wt. (g)	1795.25 ± 50.72	1769.25 ± 56.01	1813.75 ± 38.70
Eviscerated carcass wt. (g)	1302.50± 44.84	1272.75± 48.24	1326.25± 39.28
Dressing percentage (%)	72.52 ± 0.47	71.90 ±0.52	73.09 ± 0.73
Liver Wt. (% BW)	2.69 ± 0.03	2.66 ± 0.03	2.73 ± 0.04
Heart Wt. (% BW)	0.54 ± 0.02	0.53 ± 0.02	0.55 ± 0.03
Gizzard Wt. (% BW)	2.25 ± 0.02	2.28± 0.03	2.31 ± 0.01
Spleen Wt. (% BW)	0.11 ± 0.01	0.11 ± 0.01	0.12 ± 0.01
Total Mortality	4	3	1
Mortality (%)	5.00	3.75	1.25

Average body weight gain (during different phases)

The average total body weight gain (BWG) during starter phase (0–3 wks), finisher phase (4-6 wk) and overall period (0-6 wks) are presented in Table 2. BWG during different phases i.e., starter phase, finisher phase and overall phase was significantly ($P \leq 0.05$) improved in group T_3 compared to T_2 and T_1. Panda *et al*. (2005) observed significantly ($P \leq 0.05$) higher BWG in probiotics supplemented broilers (1508.0 g) compared to control broilers (1398.0 g) during overall experimental period (0–6 wks). Anjum *et al*. (2005) and Singh *et al*. (2009) also observed similar kind of results.

Feed Intake

Daily feed intake and average total feed intake during starter phase (0–3 wks), finisher phase (4–6 wks) and overall experimental period (0–6 wks) remained statistically ($P \geq 0.05$) at par (Table 2). Anjum *et al*. (2005) also observed non-significant effect of probiotics supplementation on feed intake of broiler chicks.

Feed conversion ratio

The average overall FCR was 1.90 ± 0.02, 1.87 ± 0.01 and 1.81 ± 0.01 under treatment group T_1, T_2 and T_3, respectively. The results suggested that FCR was significantly (P≤0.01) improved in T_3 compared to T_1 and T_2. The values found in the present study for FCR during overall experimental period (0–6 wks) are similar with the values reported by Aftahi *et al.* (2006) and Anjum *et al.* (2005) for FCR in broilers supplemented with probiotics (1.81) than control (1.87). In contrast, Bandy and Pampori (2006) reported that FCR did not differ significantly (P≥0.05) for probiotics fed group compared to control group (2.2 vs. 2.4).

Cost of feeding and Return over feed cost

Average feed cost (₹) of broilers fed different levels of probiotics was 84.05 ± 0.80, 84.25 ± 0.41 and 85.43 ± 0.62 under treatment T_1, T_2 and T_3, respectively (Table 2). The lowest feed cost was observed in control group (T_1) followed by T_2 and the highest in T_3. However, no significant difference was observed amongst treatment groups. Average gross return over feed cost (₹) of broilers fed different levels of probiotics was 26.45 ± 1.05, 27.82 ± 0.61 and 30.99 ± 0.39 under treatment T_1, T_2 and T_3, respectively. The return over feed cost was highly significantly (P≤ 0.01) for T_3 as compared to T_2 and T_1. The return over feed cost (₹/bird) over control in group T_2 and T_3 was 1.37 and 4.54, respectively. The higher return over feed cost in both the probiotics fed groups might be due to improvement in feed efficiency in broilers fed different levels of probiotics. Anjum *et al*. (2005) and Sultan *et al*. (2006) also found that use of probiotics in broiler chicks was financially profitable.

Carcass characteristics

The mean values for carcass characteristics, dressing percentage and organ weight (%) relative to body weight of broilers have been presented in Table 3. The average dressing percentage for group T_1, T_2 and T_3 was 72.20 ± 0.47, 71.90 ± 0.52 and 73.09 ± 0.73, respectively. Highest dressing percentage was observed in T_3 followed by T_1 and T_2. However, non-significant differences were observed amongst the treatment groups. Thus, inclusion of probiotics in broiler rations had no extra additional benefits on the carcass yield. Khan *et al*. (2002), Panda *et al*. (2005) and Rani *et al*. (2007) also reported that dressing percentage did not differ significantly (P≥0.05) in probiotics fed broilers compared to control broilers. In contrast, Bandy and Risam, (2001), Kabir *et al*. (2004) observed significant (P≤0.05) improvement in dressing percentage in groups supplemented with probiotics.

The mean values of edible organ weight (%) relative to body weight are shown in Table 3. There was no significant difference in the edible organ weight (%) relative to body weight among the treatment groups. Similar results were also obtained by others (Panda *et al*., 2005, Anjum *et al*., 2005).

Mortality

Out of total 240 chicks only 8 chicks died during entire experimental period with 3.33% mortality in all the treatment groups. The mortality of chicks varied from 1.25 to 5.00 percent among different treatment groups (Table 3). The percentage mortality was highest in chicks of group T_1 (5.00 %) followed by T_2 (3.75%) and lowest in T_3 (1.25 %) group but remained statistically (P≥0.05) similar. Necropsy finding revealed that cause of mortality was not associated with any disease. It may be inferred that numerically lower mortality in T_3 followed by T_2 compared to control group T_1 might be due to incorporation of multi-strain probiotics in broilers ration, as they had better effect on livability of broilers (Mountzouris *et al*., 2010 and Katoch *et al*., 2011).

CONCLUSION

Thus, the dietary supplementation of probiotics significantly improved body weight gain along with better feed conversion ratio and profit as compared to control. However, results were more encouraging in T_3 (100 g/ton feed) as compared to T_2 (50g/ton feed). Apart from this dietary supplementation did not show any adverse effects on feed intake, mortality and carcass characteristics.

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