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EFFECT OF DIETARY SUPPLEMENTATION OF MULTI-STRAIN PROBIOTIC ON BROILER GROWTH PERFORMANCE

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ABSTRACT

The effects of a multi-strain probiotic (protexin) on broiler growth performance, carcass parameters and economic efficiency were studied. For this purpose, 270 day-old broiler chicks were randomly divided into three experimental groups A, B and C, with 90 chicks in each group having three replicates. Group A was fed commercial broiler diet without supplementation of protexin (control) and groups B and C were fed diets containing protexin 100 and 110g/t in starter and 50 and 55 g/t in finisher diets, respectively. Feed and water were offered *ad libitum*. The results showed that weight gain and feed conversion ratio were significantly ($p<0.05$) improved in chicks fed on protexin-supplemented diets compared to control diets. Weight gain of the chicks fed on diet C was significantly ($p<0.05$) better than chicks on diet B. Feed conversion ratio was non-significantly different in both the protexin-supplemented groups. Differences in feed intake, meat composition, dressing percentage and empty organ weights among all the diets were non-significant. However, abdominal fat content was reduced significantly ($P<0.05$) in supplemented groups. The study suggests that protexin supplementation is beneficial for better weight gains, feed efficiency and economic efficiency in broiler chicks.

Key words: Probiotic, broilers, growth, carcass characteristics.

INTRODUCTION

Probiotics include viable microbial and microbial fermentation products which are beneficial to decrease the undesirable microflora population in the gastro-intestinal tract of chicks (Chiang and Hsieh, 1995) and build-up resistance against diseases by stimulating the immune system (Cheeke, 1991; Patterson and Burkholder, 2003). Majority of the probiotic products are based mainly on *Lactobacillus acidophilus*, although other organisms such as *Streptococcus faecium*, *Bacillus subtilis* and yeast are also used (Cheeke, 1991).

Substitution of conventional and prohibited antibiotics-based growth promoters with probiotics has received much attention in the recent past. One of the major reasons for increased interest in the use of probiotics is because they are natural alternatives to antibiotics for poultry production.

Protexin is a multi-strain probiotic used in poultry production (Probiotics International Limited, UK). It contains naturally occurring nine different species of beneficial microflora which are generally regarded as safe by the American Food and Drug Administration (Fuller, 1989). However, information on the use of probiotics, their levels in broiler diets and its effect on growth performance during summer is scanty in Pakistan. The objective of the present study was to investigate the effect of dietary supplementation of probiotic (Protexin) on body weight gain, feed consumption, feed conversion ratio, carcass evaluation characteristics and economic efficiency in broiler chicks.

MATERIALS AND METHODS

Birds and management

Two hundred and seventy day-old broiler chicks of mixed sexes were obtained from a commercial hatchery. These birds (average 45 $\pm$ 0.4g body weight) were weighed individually, and then randomly assigned to three treatment groups A, B and C following completely randomized design. There were 30 chicks per replicate and three replicates per treatment group. The chicks in each replicate were kept in separate pens measuring 10ft long, 3ft wide and 3ft in heigh, which were disinfected and then fumigated before the start of experiment. A layer of 3-4 inch saw dust was used as litter in each pen, which was stirred regularly during the experiment to keep it dry. Birds were vaccinated against Newcastle disease, infectious bronchitis, infectious bursal disease and Hydropericardium syndrome, as per recommended schedule in Pakistan. All the recommended practices for broiler rearing were followed throughout the experimental period. Experimental diets (mash) and water were offered *ad libitum*. Experiment lasted for 42 days during summer 2003. Meteorological data including maximum and minimum daily ambient temperature, morning and afternoon relative humidity, wind speed and rain fall during the experimental period were obtained from Water Resources Research Programme, National Agricultural Research Centre, Islamabad and are shown in Table 1.

Diets preparation and feeding

Protexin is a multi-strain probiotic in dry white powder form ($2x10^9$ cfu/g) containing *Streptococcus salivarius spp. Thermophilus, Lactobacillus (L) delbruckii sub spp. bulgaricus, L. acidophilus, L. plantarum, L. rhamnosus, Bifidobacterium bifidum, Enterococcus faecium, Candida pintolopesii, and Asperigillus oryzae* which were used for supplementation of diets.

Commercial starter and finisher diets were obtained from a commercial feed mill and protexin was supplemented in feed as follows:

Group A: No addition of protexin (control),
Group B: Addition of protexin 100g/t in starter and 50g/t in finisher diets.
Group C: Addition of protexin 110g/t in starter and 55g/t in finisher diets.

All the birds were weighed individually at the start of the experiment and at weekly intervals thereafter. Weekly feed consumption of each experimental unit was recorded on per pen basis and feed conversion ratio (FCR) was calculated. Therefore, feed consumption and FCR calculations were made from the average values of each pen. Feed samples from starter and finisher diets were collected for analysis of percent dry matter (88.75 ± 6.5, 89.08 ± 5.2), crude protein (21.72 ± 4.1, 19.87 ± 3.3), crude fat (4.92 ± 1.2, 4.73 ± 1.4), crude fibre (7.64 ± 0.5, 8.49 ± 0.51) and total ash (4.91 ± 0.22, 4.55 ± 0.2), as described earlier (Annonymous, 1990). Nitrogen free extract (49.89 ± 2.0 and 50.88 ± 1.2%) and metabolizable energy (3040 ± 150 and 3170 ± 215 kcal/kg) were calculated by the methods of Wardeh (1981).

Slaughtering and carcass data

At the end of experiment, nine birds per dietary group (three per replicate) were slaughtered. The birds were then immediately eviscerated for collection of abdominal fat content and edible offals i.e. liver, heart and gizzard. Organ body weight ratios were calculated, using the formula described by Sherma *et al*. (1989). Proximate analysis of meat was done by Annonymous (1990) method. Live to dressed body weight percentages of chicks were calculated by the formula: Hot carcass weight/slaughter weight x 100. Hot carcass weight was recorded after removing of skin, head, feathers, lungs, toes with feet and gastro-intestinal tract.

Economic efficiency

Economic analysis of live weight gain of broiler chicks was calculated. For this purpose, net expenditure cost of chick was deducted from the net profit of the live weight gain.

Statistical analysis

The data obtained through this experiment were analysed using analysis of variance technique in completely randomized design and means were compared using least significant differences test at 5 percent level of probability (Steel and Torrie, 1986).

RESULTS

Details of growth performance of broiler chicks fed commercial diets without protexin to group A and diets containing protexin 100 and 110 g/t in starter and 50 and 55 g/t in finisher to groups B and C, respectively are presented in Table 2. Average live weight gain of broiler chicks was found to be higher ($P<0.05$) in protexin-supplemented diets during starter (0-4 week), finisher (5-6 week) and overall (0-6 week) growing periods. Whereas between the supplemented groups the higher ($P<0.05$) weight gain was found (0-4 and 0-6 week) in group C compared to group B. There was no significant effect of protexin supplementation on feed intake of broiler chicks. However, feed conversion ratio (amount of feed consumed to gain per unit body weight) was found to be lower ($P<0.05$) in protexin treated groups compared to control group during finisher and overall growing period, whereas, between the supplemented groups (B and C) no significant difference was observed.

The data of content of protein, moisture, fat and ash of carcasses, dressing percentages and weights of edible offals is presented in Table 3. All these parameters showed non-significant difference among treatments. However, abdominal fat was significantly reduced ($P<0.05$) by protexin supplementation. Interaction between weather data and animal performance was found to be non-significant among all the groups.

The results of this study revealed that per bird total return on sale was Rs.90.14, 93.0 and 94.58 at total expenditure of Rs.56.76, 56.25 and 58.32 for groups A, B and C, respectively. The net per bird income was Rs.33.38, 36.76 and 36.26 of groups A, B and C, respectively. The economic analysis of data showed that supplementation of broiler starter and finisher diets with protexin at 100g/t in starter and 50g/t in finisher diets was economically more beneficial (Table 4).

Table 1: Meteorological data during the experimental period

Week	Temperature (°C) Maximum	Temperature (°C) Minimum	Relative humidity (%) 800hrs	Relative humidity (%) 1400hrs	Wind speed (km/h)	Rainfall (mm)
1st	38.04 ± 0.49	17.00 ± 1.16	34.14 ± 2.92	17.85 ± 1.47	86.00 ± 9.32	--
2nd	34.42 ± 0.66	18.68 ± 0.35	59.00 ± 6.26	26.28 ± 2.50	91.68 ± 12.08	2.75
3rd	40.35 ± 0.84	19.42 ± 0.68	35.28 ± 1.64	13.00 ± 2.10	106.92 ± 9.92	--
4th	46.54 ± 1.37	21.07 ± 1.24	42.71 ± 4.26	22.14 ± 5.41	123.24 ± 15.4	3.21
5th	40.42 ± 0.92	22.08 ± 0.95	45.57 ± 3.71	23.71 ± 2.47	92.60 ± 16.15	0.67
6th	37.21 ± 0.77	23.42 ± 0.83	66.00 ± 4.69	38.00 ± 3.10	97.39 ± 9.65	3.14

Table 2: Performance of broiler chicks fed diets supplemented with different levels of protexin

Parameters	Diets* A	Diets* B	Diets* C
Starter phase (0-4 week)			
Average initial body weight (g/bird)	45 ± 0.08[a]	44 ± 0.89[a]	45 ± 0.86[a]
Average total body weight gain (g/bird)	1023 ± 16[c]	1048 ± 14[b]	1083 ± 18[a]
Average total feed intake (g/bird)	1732 ± 02[a]	1726 ± 05[a]	1746 ± 03[a]
Feed efficiency	1.69 ± 0.02[a]	1.65 ± 0.02[a]	1.61 ± 0.05[a]
Finisher phase (5-6 weeks)			
Average total body weight gain (g/bird)	835 ± 15[b]	874 ± 20[a]	872 ± 14[a]
Average total feed intake (g/bird)	1835 ± 06[a]	1809 ± 06[a]	1865 ± 10[a]
Feed efficiency	2.196 ± 0.01[a]	2.07 ± 0.05[b]	2.14 ± 0.03[ab]
Overall (0-6 week)			
Average total body weight gain (g/bird)	1904 ± 17[c]	1967 ± 09[b]	2000 ± 18[a]
Average total feed intake (g/bird)	3567 ± 05[a]	3535 ± 09[a]	3611 ± 11[a]
Feed efficiency	1.87 ± 0.01[a]	1.80 ± 0.01[b]	1.81 ± 0.01[b]

[a,b,c] Means (± SEM) in a row with different superscripts differ significantly ($p<0.05$).
* A: Diet without protexin (control); B: with protexin at 100g/t in starter and 50 g/t in finisher and C: with protexin at 110g/t in starter and 55 g/t in finisher diet.

Table 3: Carcass characteristics and organs weight of broilers fed diets supplemented with different levels of protexin

Parameters	Diets* A	Diets* B	Diets* C
Average total live body weight (BW, g/bird)	1965 ± 44[a]	1952 ± 72[a]	1975 ± 55[a]
Average dressed carcass weight (g/bird)	1179 ± 69[a]	1171 ± 50[a]	1205 ± 49[a]
Dressing percentage	60.00 ± 0.4[a]	59.99 ± 0.6[a]	61.01 ± 0.6[a]
Average liver weight (% BW)	2.30 ± 0.1[a]	2.16 ± 0.0[a]	2.12 ± 0.1[a]
Average heart weight (% BW)	0.39 ± 0.02[a]	0.41 ± 0.01[a]	0.39 ± 0.01[a]
Average gizzard weight (% BW)	1.48 ± 0.07[a]	1.58 ± 0.02[a]	1.47 ± 0.03[a]
Average abdominal fat (% BW)	1.71 ± 0.06[a]	1.54 ± 0.06[b]	1.44 ± 0.05[b]
Meat composition (%)			
Moisture	67.8 ± 1.5[a]	67.0 ± 1.3[a]	67.7 ± 1.5[a]
Crude protein	22.5 ± 1.1[a]	23.0 ± 0.9[a]	22.2 ± 1.5[a]
Crude fat	11.5 ± 0.5[a]	10.9 ± 0.3[a]	10.7 ± 0.4[a]
Total ash	4.1 ± 0.7[a]	4.1 ± 0.4[a]	4.4 ± 0.5[a]

[a,b] Mean values (± SEM) in a row with different superscripts differ significantly ($p<0.05$).
Values of each parameter are means of 9 observations.
* A: Diet without protexin (control); B: with protexin at 100g/t in starter and 50 g/t in finisher and C: with protexin at 110 g/t in starter and 55 g/t in finisher diet.

Table 4: Economic analysis of broilers fed diets supplemented with different levels of protexin

Parameters	Diets*		
	A	**B**	**C**
Chick cost (Rs.[1])	18	18	18
Feed intake (g/bird)			
Starter	1732	1726	1746
Finisher	1835	1809	1865
Cost of feed eaten (Rs/bird)[2]			
Starter	19.05	18.98	19.20
Finisher	19.71	19.37	20.14
Protexin cost (Rs.)	-	0.88	0.98
Total cost (Rs.)	56.76	56.25	58.32
Average live weight after 42 days (g)	1949	2011	2045
Return on sale @ Rs. 46.25/kg (Rs.)	90.14	93.01	94.58
Per bird net profit (Rs.)	33.38	36.76	36.26
Profit per bird over control group (Rs.)	-	1.10	1.08

[1] One US $ was equal to about 58 Pakistani Rupees (Rs).
[2]Cost of Starter diet=Rs.11/kg; Finisher diet =Rs. 10.8/kg and Protexin (supplement) =Rs.3.4/g.
* A: Diet with out protexin (control); B: with protexin at 100g/t in starter and 50 g/t in finisher and C: with protexin at 110g/t in starter and 55 g/t in finisher diet.

DISCUSSION

The results of the present study showed that protexin supplementation had no difference on feed intake. These results are in line with the findings of Chiang and Hsieh (1995). However, Santoso *et al.* (2001) reported that 0.5% fermented product from *Bacillus subtilis* inclusion reduced consumption significantly (P<0.05) as compared to control. The reasons for these discrepancies are not known.

The highest average body weight gain was found in chicks fed diet C compared to the chicks fed diets B and A during starter and overall growing period. Wenk (2000) reported that probiotics supplementation had more pronounced effect in young growing animals which substantiates the findings of our study during starter phase. However, feed conversion of broiler chicks was similar on both protexin-supplemented groups. The present results are in accordance with the findings of Chiang and Hsieh (1995), Santoso *et al.* (2001) and Fuller (2001). Therefore, when both feed conversion ratio and body weight gain are considered for gaining maximum profit, the inclusion of protexin at 100g/t in starter and 50g/t in finisher diets may be recommended.

In this study, only one percent bird mortality was recorded in protexin-supplemented groups throughout the experiment. There were no disease or pathological lesions obtained in the organs of slaughtered birds. Furthermore, no medication was required for the chicken during the experimental period. This may be due to the fact that continuous feeding of protexin might have suppressed the undesirable microorganisms that lead to improved health status (build-up resistance) and ultimately improved growth and overall performance. Fuller (2001) and Patterson and Burkholder (2003) had explained the mechanism of probitics to pathogen inhibition by competition for nutrients, production of toxic condition and compounds (volatile fatty acids, low pH, and bacteriocins), competition for binding sites on the intestinal epithelium and stimulation of the immune system.

Furthermore, the present study showed that protexin supplementation did not change the broiler meat composition, nor dressing percentage and organs weights. However, abdominal fat content was reduced significantly. Data generated during this study on meat composition and abdominal fat content of broiler chicks are in agreement with the findings of Santoso *et al.* (2001). According to these workers, certain micro-flora present in gastro-intestinal tract of a bird impaired the absorption of cholesterol and bile acid. So there is a possibility that microorganisms in protexin may cause lower absorption and deposition of fat content around the abdomen.

Finally, the economic of protexin was more encouraging where treated groups generated more profit than the control group. The feed cost per kg broiler produced was less in supplemented groups compared to non-supplemented group. Economic data clearly indicated that protexin supplementation is more feasible and economical to obtain maximum profitability from broiler production.

In conclusion, it is summarized that supple-mentation of broiler starter and finisher diets with protexin 100g/t in starter and 50 g/t in finisher rations was beneficial in terms of weight gain, feed efficiency and economic viability. Feeding of protexin reduced ($p<0.05$) abdominal fat contents also. However, interaction of treatments with environment and effect of treatments on dressing percentage, organs weights and meat composition were found to be non-significant.

REFERENCES

Annonymous. 1990. Official Methods of Analysis. Association of Official Analytical Chemicsts (15th edn) Washington, DC, USA.

Chiang, S. H. and W. M. Hsieh, 1995. Effect of direct fed microorganism on broiler growth performance and litter ammonia level. Asian-Aust. J. Anim. Sci., 8:159-162.

Cheeke, P. R., 1991. Applied Animal Nutrition: Feeds and Feeding. MacMillan Publishing Company, New York, USA.

Fuller, R., 2001. The chicken gut microflora and probiotic supplements (Review). J. Poult. Sci., 38: 189-196.

Fuller, R., 1989. Probiotics in man and animals. J. Appl. Bacteriol., 66: 365-378.

Patterson, J. A. and K. M. Burkholder, 2003. Application of prebiotics and probiotics in poultry production (Review). Poult. Sci., 82: 627-631.

Santoso, O. U., K. Tanake., S. Ohtani and M. Sakaida, 2001. Effect of fermented product from *Bacillus subtilis* on feed conversion efficiency, lipid accumulation and ammonia production in broiler chicks. Asian-Aust. J. Anim. Sci., 14: 333-337.

Sharma, J. M., J. E. Dohms and A. L. Metz, 1989. Comparative pathogenesis of serotype and variant serotype I isolates of IBDV and their effect on humoral and cellular immune competence of specific pathogen free chickens. Avian Dis., 33: 112-124.

Steel, R. G. D. and J. H. Torrie, 1986. Principles and Procedures of Statistics. Intern. Student Ed., McGraw Hill, Tokyo, Japan.

Wenk, C., 2000. Recent advances in animal feed additives such as metabolic modifier, antimicrobial agents, probiotics, enzymes and available minerals. (Review) Asian-Aust. J. Anim. Sci., 13: 86-95.

Wardeh, M. F., 1981. Methods for estimating energy and protein utilization for feed. PhD Dissertation; Utah. State University, Logan.