Effect of Probiotic Inclusion in the Diet of Broiler Chickens on Performance, Feed Efficiency and Carcass Quality

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ABSTRACT : An experiment was conducted with three hundred and twenty broiler chickens to evaluate the influence of supplementation of probiotic on growth, microbiological status and carcass quality of chickens. The probiotic contained similar proportions of six strains of variable organisms namely *Lactobacillus acidophilus*, *Lactobacillus casei*, *Bifidobacterium bifidum*, *Aspergillus oryzae*, *Streptococcus faecium* and *Torulopsis sps* and was fed at 100 mg/kg diet. The body weight and feed conversion of probiotic fed groups were superior ($p<0.05$) compared to the control group in the 4^{th}, 5^{th} and 6^{th} weeks. The chickens fed the diet with probiotic had lower ($p<0.05$) numbers of coliforms and *Campylobacter* than chickens fed the control diet. All chickens' carcasses on the control diet were positive for *Salmonella* while only 16 of the 40 carcasses were positive from chickens fed diets containing probiotic. The leg and breast meat of probiotic fed chickens were higher ($p<0.05$) in moisture, protein and ash, and lower in fat as compared to the leg and breast meat of control chickens. ***(Asian-Aust. J. Anim. Sci. 2005. Vol 18, No. 8 : 1153-1156)***

Key Words : Probiotic, Chicken, Growth, Carcass

INTRODUCTION

The extensive uses of antibiotics in animal farms to promote growth rate, increasing feed efficiency and prevention of intestinal infections have led to the development of antibiotic-resistant bacteria in the gastrointestinal tract and drug residuals in meat. The use of probiotics in order to competitively exclude the colonization of intestinal pathogens has been proposed for poultry, specially after some countries banned certain antibiotics being frequently included in rations as growth promoters. Probiotics are defined as viable microorganisms (bacteria or yeasts) that exhibit a beneficial effect on the health of the host when they are ingested (Salminen et al., 1998).

Salmonella and *campylobacter* (jejuni) have often been considered responsible for human gastroenteritis and poultry have often been implicated as source of these human infections.

Intestinal colonization of *salmonella*, *campylobacter* and *coliforms* in the chickens play a role in carcasses contamination at slaughter, thus, reducing *salmonella*, *campylobacter* and *coliforms* colonization in chickens may potentially reduce incidence of infections in humans. Maruta et al. (1996) reported that administering probiotic (*Bacillus subtilis C - 3102*) to chickens reduced the level and incidence of *campylobacter* and *salmonella* in the intestinal tract of broilers, however, scanty information are available on the aspects of poultry meat quality influenced by probiotic feeding. The present study was conducted to study the effect of probiotic feeding on performance, microbiological status and carcass quality of broiler chickens.

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MATERIALS AND METHODS

Three hundred and twenty day old commercial broiler chickens (Ross), were weighed and distributed randomly into two groups of 160 chickens. Subsequently, the chickens in each group were distributed to 20 replicates of eight chickens and raised on wood shavings litter.

The chickens were allowed to have free access to a starter diet during the first 3 wks and then to a finisher diet during the second 3 wks (Table 1) and free access to water. The control group was fed a basal diet, whereas the experimental group was fed the same basal diet but supplemented with probiotic provide 100 mg per kg diet. The probiotic used in the experiment contained similar proportion of six strains of variable organisms namely *Lactobacillus acidophilus, Lactobacillus casei, Bifidobacterium bifidum*, *Aspergillus oryzae*, *Streptococcus faecium* and *Torulopsis sps*. The room temperature with continuous lighting was maintained at 34°C initially, and then reduced by 3°C/wk until it reached 21°C, at which temperature the room was maintained for the rest of the feeding period. Body weight gain and feed consumption were monitored weekly and feed conversion rate was calculated as feed consumed per unit of weight gain.

At the end of the sixth week, 40 chickens from each

Table 1.Composition of basal diet (%).

Ingredients and composition	Starter	Grower
Corn	54.5	60.5
Soybean meal	38	32
Fish meal	2.5	2.5
Vegetable oil	1.4	1.6
Dicalcium phosphate	1.5	1.5
Calcium carbonate	1.3	1.2
Vitamin-mineral premix[1]	0.5	0.5
DL-methionine	0.2	0.15
L-lysine	0.05	0.00
Salt	0.05	0.05
Calculated composition		
Crude protein	21.5	19.5
ME (Mcal/kg)	2,900	3,050

[1] The broiler premix provided the following per kilogram of diet: vitamin A, 10,000 IU; cholecalciferol, 82.5 µg; vitamin E, 25 IU; riboflavin, 8 mg; niacin, 50 mg; d-pantothenic acid, 15 mg; folic acid, 1 mg; vitamin B12, 15 µg; choline chloride, 1,000 mg; thiamine, 2.5 mg; biotin, 0.1 mg; ethoxyquin, 100 mg; menadione sodium bisulfite, 3.3 mg; pridoxine 1 mg; manganese, 15 mg; zinc, 50 mg; iodine, 1.5 mg; iron, 30 mg; copper, 6 mg and Selenium, 0.2 mg.

group were randomly selected and slaughtered. Proximate composition (AOAC, 1994) and microbiological status of carcasses were determined. Chickens were removed from feed, but not water, for 8 h prior to slaughter, chickens on the control feed were first. After these chickens were processed, scald water was changed, all equipment cleaned and sanitized using a commercial sanitizer, and the treated chickens were then processed. Feed withdrawal times were staggered to account for differences between processing intervals. Pre-chilled carcasses were sampled using the whole carcasses rinse technique of Cox et al. (1983) modified to 400 ml BPD rinse solution. Each sample rinse was evaluated for *salmonella* incidence (positive/total), *coliforms* and *campylobacter* counts by approved methods (FDA, 1992).

The data were evaluated by using Student's test to compare results for control and experimental groups. probability was based on $p<0.05$.

RESULTS AND DISCUSSION

Performance

The results obtained of chickens performance (Table 2) showed that the live weight of the group receiving probiotic on the 4th, 5th and 6th weeks (respectively; 878 g, 1,300 g and 1,700 g), was higher ($p<0.05$) than control. No differences were observed in feed intake between groups.

The feed conversion rate (FCR) of the probiotic fed group was superior ($p<0.05$) compared to the control group on 4th, 5th and 6th weeks.

The data suggest that there is a lag phase of 21 d before the effects of the probiotic preparation are seen. Mohan et al. (1996) also stated that the use of probiotic in feed had a beneficial effect on body weight gain of broiler chicks from 4th to 6th week of age. Other studies also report favorable response of inclusion of probiotic in poultry diets. Fritts et al. (2000) noted that inclusion of calsporin (*Bacillus subtilis C-3102*) in broiler diets resulted in a significant improvement in 42 day body weight and feed conversion during the 21 to 42 d period. Jin et al. (1996) found that inclusion of probiotic (*Lactobacilli* and *Bacillus subtilis*) in diet stimulated favorable microbial balance in gut and consequently improved feed efficiency and growth performance in bloilers. Chiang and Hsieh (1995) reported that broilers fed probiotic-supplemented diet had better weight gain and feed efficiency when compared to the broilers fed the unsupplemented diet.

Table 2. Effect of probiotic on performance of chickens

Measurment	Control	Probiotic	Pooled SEM
Body weight (g)			
Day 0	49	49	0.29
Day 7	135	140	1.54
Day 14	280	286	4.60
Day 21	510	525	9.85
Day 28	840^{a}	878^{b}	10.70
Day 35	1,240^{a}	1,300^{b}	15.50
Day 42	1,620^{a}	1,700^{b}	18.60
Feed intake, (g/chickens)			
Day 0-7	146.91	153.36	5.22
Day 7-14	249.78	250.30	7.90
Day 14-21	420.20	430.25	12.20
Day 21-28	646.80	671.00	22.71
Day 28-35	802.20	810.10	23.86
Day 35-42	780.40	790.33	25.23
Feed conversion ratio (Feed/gain)			
Day 0-7	1.70	1.68	0.03
Day 7-14	1.72	1.72	0.02
Day 14-21	1.82	1.80	0.02
Day 21-28	1.96^{a}	1.90^{b}	0.01
Day 28-35	2.00^{a}	1.92^{b}	0.02
Day 35-42	2.05^{a}	1.97^{b}	0.01

Means in the same row with no common superscript differ significantly ($p<0.05$).

Mortality

The cumulative mortality of chickens on the experimental was 1.8 per cent while 5 per cent of the control group chickens was the case. Cmiljanic et al. (2001) also noted similar findings.

Microbiological status of carcasses

The microbiological status of chickens carcasses (Table 3) fed the diet with probiotic had lower numbers ($p<0.05$) of *coliforms* and *campylobacter* than chickens fed the control diet. All carcasses of chickens on the control diet were positive for *salmonella*, while only 16 of the 40 carcasses from chickens fed diets containing probiotic.

Table 3. Effect of probiotic on microbial status of carcasses meat

Measurement	Control	Probiotic	Pooled SEM
Salmonella (number positive/total)	40/40[a]	16/40[b]	
Log CFU/ml campylobacter	3.04[a]	2.67[b]	0.09
Log CFU/ml coliforms	2.52[a]	1.55[b]	0.11

Means in the same row with no common superscript differ significantly ($p<0.05$).

Table 4. Effect of probiotic on proximat composition of leg and breast meat of chickens

		Control	Probiotic	Pooled SEM
Moisture %	Leg	71.35[a]	72.40[b]	0.04
	Breast	72.87[c]	73.77[d]	0.05
Protein %	Leg	20.67[a]	21.77[b]	0.02
	Breast	21.99[c]	22.97[d]	0.04
Fat %	Leg	7.06[a]	4.87[b]	0.06
	Breast	3.95[c]	1.99[d]	0.07
Ash %	Leg	0.92[a]	0.96[b]	0.004
	Breast	1.19[c]	1.25[d]	0.002

Means in the same row with no common superscript differ significantly ($p<0.05$).

Fritts et al. (2000) also reported that carcasses of birds fed diets with probiotic (calsporin) had significantly lower *salmonella* incidence and *coliforms*, *campylobacter* and aerobic plate count than birds fed the control diet.

Composition of leg and breast

The mean values for carcass and proximate composition (Moisture %, Protein % and Ash %) of leg and breast meat (Table 3) increased ($p<0.05$) in probiotic fed chickens, whereas, the fat % of leg and breast meat was lower ($p<0.05$) in probiotic fed chickens. This indicates a better retention of minerals especially calcium, phosphorus, nitrogen and improved protein efficiency ratio (Nahashon et al., 1992, 1994; Mohan et al., 1996; Kumprecht and Zobac, 1998) in probiotic fed birds as compared to control birds. Pietras (2001) also reported meat of chickens given probiotic (*Lactobacillus acidophilus and streptococcus faecium* bacteria) on the whole rearing period had significantly higher protein content, while crude fat and total cholesterol contents tended to decrease.

Endo and Nakano (1999) reported that addition probiotic included species of *Bacillus, Lactobacillus, Streptococcus, Clostridium, Saccharomyces* and *Candida* to broilers diets, decreased cholesterol concentration in thigh meat and increased linolenic acid and unsaturated fatty acid / saturated fatty acid ratio in pectoral and thigh meat. In contrast, Joy and Samuel (1997) noted that inclusion of *Lactobacillus sporogenes* in broiler diets did not influence carcass protein, carcass fat and fat pad thickness.

CONCLUSIONS

The supplementation of probiotic to the diet significantly improved the live weight and feed conversion rate on 4th, 5th, 6th weeks indicates a lag time and the chickens carcasses fed the diet with probiotic had lower numbers of *coliforms* and *compylobacter*. The leg and breast meat of probiotic fed chickens were higher in moisture, protein, ash and lower fat per cent as compared to the leg and breast meat of control chickens.

REFERENCES

AOAC. 1994. Official Methods of Analysis, 14th Ed., Association of Official Analytical Chemists. 2:431-443. Washington, DC.

Chiang, S. H. and W. M. Hsieh. 1995. Effect of direct-fed microorganisms on broiler growth performance and litter ammonia level. Asian-Aust. J. Anim. Sci. 8(2):159-162.

Cmiljanic, R., M. Lukic and S. Trenkovski. 2001. The effect of "paciflor-c" probiotic on gain, feed conversion and mortality of fattening chicks. Biotec. Anim. Husb. 17(3-4):33-38.

Cox, N. A., J. E. Thomson and J. S. Baily. 1983. Procedure for the isolation and identification of Salmonella from poultry carcasses. Agriculture Handbook No. 603. USDA, Agric. Res. Service, Washington, DC.

Endo, T. and M. Nakano. 1999. Influence of a probiotic on productivity, meat components, lipid metabolism, caecal flora and metabolites, and raising environment in broiler production. Anim. Sci. J. 70(4):207-218.

Fritts, C. A., J. H. Kersey, M. A. Motl, E. C. Kroger, F. Yan, J. Si, Q. Jiang, M. M. Compos, A. L. Waldroup and P. W. Waldroup. 2000. *Bacillus subtilis C-3102* (*calsporin*) improves live performance and microbiological status of broiler chicken. J. Appl. Poult. Sci. 9:149-155.

Food and Drug Administration. 1992. Bacteriological Analytical Manual. 7th Ed. Food and Drug Admin. And Assn. Offic. Anal. Chem., Arlington, VA.

Jin, L. Z., Y. W. Ho, N. Abdullah and S. Jalaludin. 1996. Influence of dried *Bacillus subtilis* and lactobacilli cultures on intestinal microflora and performance in broilers. Asian-Aust. J. Anim. Sci. 9:397-404.

Joy, A. D. and J. J. Samuel. 1997. Effect of probiotic supplementation on the performance of broiler. J. Vet. Anim. Sci. 28(1):10-14.

Kumprecht, I. and P. Zobac. 1998. The effect of Bacillus sp. based probiotic preparations in diets with different protein contents on performance and nitrogen metabolism in chick broilers. Czech. J. Anim. Sci. 43(7):327-335.

Maruta, K., H. Miyazaki, SH. Masuda, M. Takahashi, T. Marubashi, Y. Tadano and H. Takahashi. 1996. Exclusion of intestinal pathogens by continuous feeding with *Bacillus subtilis C-3102* and its influence on the intestinal microflora in broilers. Anim. Sci. Tech. 67(3):273-280.

Mohan, B., R. Kadirvel, A. Natarajan and M. Bhaskaran. 1996. Effect of probiotic supplementation on growth, nitrogen utilisation and serum cholesterol in broilers. Br. Poult. Sci. 37:395-401.

Nahashon, S. N., H. S. Nakaue and L. W. Mirosh. 1992. Effect of direct-fed microbials on nutrient retention production parameters of laying pullets. Poult. Sci. 71(suppl.1):111.

Nahashon, S. N., H. S. Nakaue and L. W. Mirosh. 1994. Production variable and nutrient retention in single comb white leghorn laying pullets fed diets supplemented with direct-fed microbials. Poult. Sci. 73:1699-1711.

Pietras, M. 2001. The effect of probiotic on selected blood and meat parameters of broiler chickens. J. Anim. Feed. Sci. 10 (suppl 2):297-302.

Salminen, S., A. von Wright, L. Morelli, P. Martean, D. Brassart, W. M. de Vos, R. Fonden and T. Matills-Sandholm. 1998. Demonstration of safety of probiotic-A Review. Intl. J. Food Microbiol. 44:93-106.