Effects of *Lactobacillus*-probiotic on the Growth Performance, and Systemic and Mucosal Intestinal Immunity of Chickens

Y. W. Ho, D. D. Vickneswary, N. Abdullah and M. Zamri Saad.

Institute of Bioscience
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Key words: Probiotic, broilers, *Lactobacillus*, immune response, growth performance

Introduction

Continued use of sub-therapeutic levels of antibiotics in animal feeds may result in the presence of antibiotic residues in animal products and the development of antibiotic-resistant bacteria in humans. Over the last two decades, probiotics, (direct-fed microbials) which include *Lactobacillus* cultures, have been used as an alternative to antibiotic-growth-promoters in animal production. The probiotics, which upon ingestion, contribute some beneficial functions in the intestinal tract of the animal and exert health effects beyond inherent basic nutrition.

Studies have shown that broiler chickens fed *Lactobacillus*-probiotic have better growth rate and feed conversion ratio, lower mortality rate, less pathogenic bacteria such as *E. coli* and *Salmonella* in their gastrointestinal tract, less noxious bacterial enzymes such as β-glucuronidase and β-glucosidase in their intestine, less body fat and less cholesterol than chickens fed without probiotic (1, 2, 3, 4). Probiotics have also been found to exert an immunomodulatory effect on the host. Supplementing *Lactobacillus* cultures to the diets of newly hatched chicks and poults increased the production of anti-salmonella antibodies and function of T-cells (5). The present study was conducted to determine the effects of *Lactobacillus*-probiotic on the growth performance, and serum and intestinal immunoglobulin (IgA and IgG) levels of broilers.

Materials and Methods

The *Lactobacillus* strains used and the method of preparation of the strains as a probiotic feed supplement were the same as those described by Jin *et al.* (2, 6).

Two hundred and seventy 1-day-old male broiler chicks (Avian 43) were randomly assigned to 18 cages of 15 chicks each. The chicks were divided into three dietary treatment groups (6 cages per treatment). The diets were: (i) a basal diet (control), (ii) a basal diet + 0.1% *Lactobacillus*-probiotic, (iii) a basal diet + 0.05g of oxytetracycline/kg feed. The experimental period was 42 days. The chicks were weighed weekly on cage basis. Feed consumed was recorded daily (on cage basis), the uneaten discarded, and feed efficiencies were calculated. Mortality was recorded as it occurred and percentage mortality was determined at the end of the study. At the end of the experimental period, one bird from each cage was randomly selected and euthanized by severing the jugular vein. The blood was collected in a tube and serum was separated by centrifugation. The carcasses were immediately opened and the intestines removed and cut open. Intestinal scrapings were collected in tubes and stored at –70°C until used for analysis. The liver, spleen and bursa were removed and weighed. Enzyme linked immunosorbent assay (ELISA) and resultant color absorbance at 405 nm (A_{405}) were used to measure the immunoglobulin (IgA and IgG) levels in serum and supernatant of intestinal scrapings.

Results and Discussion

The results showed that the feed conversion ratio of broilers fed *Lactobacillus*-probiotic (1.72) was significantly ($P<0.05$) better than that of control broilers (2.06) or broilers fed antibiotic (1.93). The feed:gain ratio of probiotic-fed chickens from 1 to 42 days of age decreased by 0.21 units compared to those fed antibiotic, and 0.34 units compared to the control chicks. The body weight gain of probiotic-fed chickens (1957.0g) was significantly ($P<0.05$) more than that of antibiotic-fed (1922.6g) or control chickens (1690.0g). Mortality rate was also significantly ($P<0.05$) lower in chickens fed *Lactobacillus*-probiotic (2.57%) than in antibiotic-fed (15.17%) or control (12.51%) chickens.

There was no significant difference in organ weights among the chickens fed the three dietary treatments. The livers of broilers from the three treatments ranged from 2.12% to 2.48% of body weight, the spleen ranged from 0.20% to 0.29% of body weight and the bursa ranged from 0.08% to 0.11% of body weight. This showed that there was no inflammatory response by the chickens to the *Lactobacillus*-probiotic. Thus, using *Lactobacillus*-probiotic as an immunomodulator has an advantage over other immunomodulators as it did not produce spleenomegaly or hepatomegaly, which are very common effects of other immunomodulators (7).

The serum and intestinal IgA levels (A_{405} of 0.64 and 0.92, respectively) in chickens fed *Lactobacillus*-probiotic were significantly ($P<0.05$) higher than those in antibiotic-fed (A_{405} of 0.26 and 0.52, respectively) or control (A_{405} of 0.18 and 0.42, respectively) chickens. This indicated that the *Lactobacillus*-probiotic could enhance the serum and mucosal intestinal immunity of chickens. Studies on mice have shown that oral administration of some lactic acid bacteria increased the systemic immune response (8,9). An important feature of immunological defence at the mucosal surface is the predominance of IgA. Symbiotic and indigenous microflorae contribute to the host's defence by increasing the number of IgA plasma cells in the mucosal surface of the intestinal wall. Perdigon *et al.* (10) had reported that *L. casei* increased the IgA production secreted to the intestinal lumen of mice, providing adequate defences at mucosal surfaces.

There was no significant difference in the serum and intestinal IgG levels among chickens fed the three dietary treatments. The serum IgG levels ranged from A_{405} of 0.053 to 0.55 and the intestinal IgG levels ranged from A_{405} of 0.40 to 0.42 in the chickens fed the three dietary treatments. The results indicated the absence of inflammatory processes. Elevated level of IgG occurs in a more energetic and usually inflammatory response involving pathogens, which could cause tissue damage.

Conclusions

The results of the study showed that *Lactobacillus*-probiotic could enhance the growth performance, and the systemic and mucosal intestinal immune response in broiler chickens.

Benefits from the study

The *Lactobacillus*-probiotic could be used as an alternative to antibiotics as a growth promoter. It could also be used as an oral adjuvant especially to prevent enteric infections.

Literature cited in the text

1. Jin, L. Z., Ho, Y. W., Abdullah, N. and Jalaludin, S. 1997. Probiotics in poultry: modes of action. World's Poult. Sci. J. 53: 351-368.

2. Jin, L. Z., Ho, Y. W., Abdullah, N. and Jalaludin, S. 1998. Growth performance, intestinal microbial populations and serum cholesterol of broiler diets containing *Lactobacillus* cultures. Poult. Sci. 77: 1259-1265.

3 Jin, L. Z., Ho, Y. W., Abdullah, N., Ali, M. A. and Jalaludin, S. 1998. Effects of adherent *Lactobacillus* cultures on growth, weight of organs and intestinal microflora and volatile fatty acids in broilers. Anim. Feed Sci. Technol. 70: 197-209.

4. Jin, L. Z., Ho, Y. W., Abdullah, N. and Jalaludin, S. 2000. Digestive and bacterial enzyme activities in broilers fed diets supplemented with *Lactobacillus* cultures. Poult. Sci. 79: 886-891.

5. Dunham, H. J., Willialms, C., Edens, F. W., Casas, I. A. and Dobrogosz, W. J. 1993. *Lactobacillus reuteri* immunomodulation of stressor-associated diseases in newly hatched chickens and turkeys. Poult. Sci. 72: 103.

6. Jin, L. Z., Ho, Y. W., Ali, M. A., Abdullah, N., Ong, B. K. and Jalaludin, S. 1996. Adhesion of *Lactobacillus* isolates to intestinal epithelial cells of chicken. Lett. Appl. Microbiol. 22: 229-232.

7. Yasutake, N., Onwaki, M., Yokokura, T. and Mutai, M. 1984. Comparison of antitumor activity of *Lactobacillus casei* with other bacterial immunopotentiators. Med. Microbiol. Immunol. 173: 113-125.

8. Perdigon, G., Nader de Macias, M. E., Alvarez, S., Medici, M., Oliver, G. and Pesce de Ruiz Holgado, A. 1986. Effect of a mixture of *Lactobacillus acidophilus* administered orally on the immune system in mice. J. Food Prot. 49: 986-990.

9. Perigon, G., Nader de Macias, M. E., Alvarez, S., Medici, M., Oliver, G. and Pesce de Ruiz Holgado, A. 1987. Enhancement of immune response in mice fed with *Streptococcus thermophilus* and *Lactobacillus acidophilus*. J. Dairy Sci. 70: 919-926.

10. Perigon, G., Alvarez, S., Nader de Macias, M. E., Roux, M. E. and Pesce de Ruiz Holgado, A. 1990. The oral administration of lactic acid bacteria increase the mucosal intestinal immunity in response to enteropathogens. J. Food Prot. 53: 404-410.

Project Publications in Refereed Journals

1. Zulklfi, I., Abdullah, N., Mohd. Azrin, N. and Ho, Y. W. 2000. Growth performance and immune response of two commercial broiler strains fed diets containing *Lactobacillus* cultures and oxytetracycline under heat stress conditions. Brit. Poult. Sci. 41: 593-597.

Expertise Development

Name of Graduate	Degree Awarded	Field of Expertise	Graduation Year
Vickeswary David Dharmadas	MSc	Microbilogy	On-going

IRPA Project number: 01-02-04-0455
UPM Research Cluster :AFF
Project Leader Ho Yin Wan