Effect of a *Lactobacillus* Species-Based Probiotic and Dietary Lactose Prebiotic on Turkey Poult Performance With or Without *Salmonella Enteritidis* Challenge

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Primary Audience: Veterinarians, Flock Supervisors, Researchers

SUMMARY

To evaluate the effect of a probiotic culture in combination with dietary lactose as a prebiotic, 2 experiments were performed. Treated poults (*Lactobacillus* spp.-based probiotic culture) received dietary lactose (0.1%) continuously in the feed and probiotic culture (∼10⁶ cfu/mL) in the drinking water. Controls received no treatments. Three hundred twenty selected female poult were tagged and randomly divided in 2 treatments with 4 replicates each (n = 40). In experiment 1, poult were challenged with ∼10⁴ cfu of *Salmonella* Enteritidis; however, in experiment 2, no challenge was provided to poult. Body weight was evaluated on d 1, 7, and 14 (experiment 1, trial 1 and 2, experiment 2, trial 3) and on d 1, 8, and 18 (experiment 2, trial 4). Body weight and FCR were significantly (*P* < 0.05) improved by treatment in *Salmonella*-challenged poults (trials 1 and 2). In contrast, unchallenged turkey poult (trials 3 and 4) showed no difference (*P* > 0.05) in either BW or FCR. These data suggest that dietary lactose with appropriate probiotic organisms may enhance performance of poults following a mild pathogenic challenge.

Key words: probiotic, prebiotic, lactose, *Salmonella*, poult, performance


DESCRIPTION OF PROBLEM

The poultry industry produces a highly nutritious food for human consumption in a very short period. To maximize the genetic potential of turkey poult for production, they must be free from disease as well as have diets that meet their requirements for optimal production. The use of probiotic cultures in the poultry industry for pathogen control and performance enhancement has gained attention recently due to the increasing restriction of antibiotics as growth-promoting agents. Probiotic organisms, like those of the genera *Lactobacillus, Pediococcus, Bifidobacterium*, and others, consist of live microorganisms that exert a beneficial effect on the host by enhancing immune response, nutrient absorption, and control of pathogens [1, 2, 3, 4]. On the other hand, a prebiotic is defined as “a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of 1 or a limited number of bacteria” [5]. This selectivity was shown for bifidobacteria, which may be promoted by the...
ingestion of substances such as fructooligosaccharides and inulin [6, 7]. The aim of this study was to evaluate the effect of a commercially available *Lactobacillus* spp.-based probiotic culture in combination with dietary lactose (0.1%) as prebiotic on turkey poult performance with or without *Salmonella* Enteritidis challenge on the day of hatch.

**MATERIALS AND METHODS**

**Turkey Poults**

Day-of-hatch female commercial cross turkey poult (Nicholas) were obtained from a commercial hatchery and allocated randomly in floor pens with new pine shaving litter. Due to the high variability in BW at hatch, 100 poult were weighed to determine the mean BW. Three hundred twenty poult with BW within the mean ± 1 SD were included in each trial. Antibiotic-free poult starter feed from the University of Arkansas feed mill, formulated to meet or exceed NRC recommendation for critical nutrients for day-of-hatch poult [8] and water ad libitum were provided during both experiments according to the experimental design. Whey permeate [9] was added to the starter ration at a rate of 1.25 kg/metric ton to produce treated feed containing 0.1% lactose.

**Experiment 1**

For both trials, turkey poult were placed in an isolation room of the Poultry Health Research Laboratory of the University of Arkansas, where they were maintained at optimum temperatures, and received feed and water ad libitum. Poult were randomly grouped into 2 treatments with 4 replicates each (n = 40 poult). Before placement, all poult were challenged with *Salmonella* Enteritidis (≈10⁴ cfu) by oral gavage [10]. The treated group (*Lactobacillus* spp.) received a probiotic culture [10] for the first 3 d at a concentration of 10⁶ cfu/mL in the drinking water, and dietary lactose (0.1%) continuously in the feed. The untreated group received untreated feed and no probiotic culture. Body weights of individual poult were recorded on d 1, 7, and 14 in both trials 1 and 2. Feed was also weighed in both trials on the specified days to evaluate FCR.

**Experiment 2**

This experiment and its replicate were performed using the same methods as experiment 1, with the exception that poult were not challenged with *Salmonella* Enteritidis. Briefly, female poult were randomly assigned to 1 of 2 treatments, with 4 replicate pens per treatment (n = 40). The treated poult also received the probiotic culture [11] for the first 3 d, at a concentration of 10⁶ cfu/mL in the drinking water, and dietary lactose (0.1%) continuously in the feed, as in the first experiment. Nontreated control poult received untreated feed and no probiotic culture. Body weights of individual poult were recorded on d 1, 7, and 14 in trial 3 and on d 1, 8, and 18 in trial 4. Feed was also weighed in both trials on the specified days to evaluate FCR.

**Statistical Analysis**

Differences in BW and FCR between groups were determined by 1-way ANOVA using the GLM procedure. Significant differences (P < 0.05) were further separated using Duncan’s multiple range test and commercial statistical analysis software [12].

**RESULTS AND DISCUSSION**

The summary of results for experiments 1 and 2 are shown in Table 1.

In both trials of experiment 1, BW was significantly increased in *Lactobacillus* spp.-treated poult by d 7 (12.2- and 8.2-g increase compared with controls). By d 14, these differences persisted and increased, representing 11 and 10% improvements in the BW of treated poult in trials 1 and 2, respectively. Feed conversion ratio was likewise significantly improved in the treated groups of the first 2 trials by 0.25 and 0.135 points. However, in experiment 2, in which poult were not challenged with *Salmonella* Enteritidis, there were no significant differences in BW or FCR on d 14 or 18. Control poult did have a statistically significant increase in BW compared with treated poult on d 7 in trial 3, but this difference was no longer detected by d 14.

Several papers have been published about the beneficial effect of using dietary [13, 14] or soluble lactose in feed [15] at different concen-
Table 1. Effect of a *Lactobacillus* spp.-based probiotic culture (LPC) combined with a dietary lactose (0.1%) prebiotic on performance of turkey poults with (experiment 1) or without (experiment 2) *Salmonella Enteritidis* challenge (\(\sim 10^4\) cfu)

<table>
<thead>
<tr>
<th>Trial number</th>
<th>Treatment</th>
<th>Salmonella Enteritidis challenge</th>
<th>BW ± SEM (g)</th>
<th>FCR ± SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>d 1</td>
<td>d 7</td>
<td>d 14</td>
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<tr>
<td><strong>Experiment 1</strong></td>
<td></td>
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<tr>
<td>Trial 1</td>
<td>Control</td>
<td>Yes</td>
<td>56.3 ± 0.18&lt;sup&gt;a&lt;/sup&gt;</td>
<td>163.3 ± 1.97&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>LPC</td>
<td>Yes</td>
<td>56.3 ± 0.19&lt;sup&gt;a&lt;/sup&gt;</td>
<td>175.5 ± 1.62&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Trial 2</td>
<td>Control</td>
<td>Yes</td>
<td>50.8 ± 0.23&lt;sup&gt;a&lt;/sup&gt;</td>
<td>96.1 ± 1.23&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>LPC</td>
<td>Yes</td>
<td>50.7 ± 0.24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>104.3 ± 1.25&lt;sup&gt;a&lt;/sup&gt;</td>
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<td><strong>Experiment 2</strong></td>
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<tr>
<td>Trial 3</td>
<td>Control</td>
<td>No</td>
<td>58.9 ± 0.23&lt;sup&gt;a&lt;/sup&gt;</td>
<td>156.4 ± 1.35&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>LPC</td>
<td>No</td>
<td>58.0 ± 0.23&lt;sup&gt;a&lt;/sup&gt;</td>
<td>151.7 ± 1.21&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Trial 4</td>
<td>Control</td>
<td>No</td>
<td>51.3 ± 0.31&lt;sup&gt;a&lt;/sup&gt;</td>
<td>138.2 ± 1.49&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>LPC</td>
<td>No</td>
<td>51.2 ± 0.28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>134.9 ± 1.35&lt;sup&gt;a&lt;/sup&gt;</td>
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</tbody>
</table>

<sup>a,b</sup>Data with different superscripts in the same column and trial indicate statistical difference (\(P < 0.05\)).

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<tbody>
<tr>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
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</table>

CONCLUSIONS AND APPLICATIONS

1. The combination of a *Lactobacillus* spp.-based probiotic culture and dietary lactose (0.1%) continuously in feed improved BW and FCR in *Salmonella*-challenged turkey poults.

2. No difference in performance between treated and nontreated poults was observed when no *Salmonella* challenge was administered.

REFERENCES AND NOTES


4. Jin, L. Z., Y. W. Ho, N. Abdullah, and S. Jalaludin. 1998. Growth performance, intestinal microbial populations, and serum concentration of *Salmonella* colonization in turkey poults [1] and improve poult performance [2]. The combination of a probiotic culture, mainly *Lactobacillus* strains and different prebiotics (galactose, lactose), has been reported to improve broiler chick performance [3, 4]. The results of Higgins et al. [2] showed a beneficial effect of the probiotic culture following antibiotics when poults were experiencing a moderate *Salmonella* infection under commercial conditions. The present results support the findings of Higgins et al. [2] and suggest that performance-related benefits of some probiotic and prebiotic cultures may be most apparent when low-level enteric challenge, such as *Salmonella* infection, is present.


9. Whey permeate containing 80% lactose was obtained from Berner Foods Inc (Roscoe, IL).

10. *Salmonella* Enteritidis PT13A was grown in tryptic soy broth at 37°C for 8 h and passed to fresh tryptic soy broth for 3 incubation periods. Cells were washed 3 times in sterile saline by centrifugation at 1,864 × g, and the concentration was estimated with a spectrophotometer, using a previously generated standard curve, to approximately 108 cfu/mL in sterile saline. The culture was then diluted to inoculated concentrations as described below. Concentrations of *Salmonella* Enteritidis and *Salmonella* Typhimurium were retrospec-

11. Probiotic culture (FM-B11TM, Ivesco LLC, Iowa Falls, IA) was prepared according to the direction of the supplier. Probiotic culture containing 109 cfu/mL was diluted 10-fold in Mann-Rogosa-Sharp broth. Thirty-five milliliters was then added to 3,425 mL of fresh drinking water and given to the chicks approximately 1 h after *Salmonella Enteritidis* challenge.


