

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

J. Vicente, A. Wolfenden, A. Torres-Rodriguez,
S. Higgins, G. Tellez, and B. Hargis¹

Department of Poultry Science, Center of Excellence for Poultry Science,
University of Arkansas, Fayetteville 72701

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 poult (*Lactobacillus* spp.-based probiotic culture) received dietary lactose (0.1%) continuously in the feed and probiotic culture ($\sim 10^6$ cfu/mL) in the drinking water. Controls received no treatments. Three hundred twenty selected female poults were tagged and randomly divided in 2 treatments with 4 replicates each ($n = 40$). In experiment 1, poults were challenged with $\sim 10^4$ cfu of *Salmonella* Enteritidis; however, in experiment 2, no challenge was provided to poults. 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 poults (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

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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 poults 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

¹Corresponding author: bhargis@uark.edu

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 poults (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 poults were weighed to determine the mean BW. Three hundred twenty poults with BW within the mean \pm 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 poults [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 poults 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. Poults were randomly grouped into 2 treatments with 4 replicates each ($n = 40$ poults). Before placement, all poults were challenged with *Salmonella* Enteritidis ($\sim 10^4$ cfu) by oral gavage [10]. The treated group (*Lactobacillus* spp.) received a probiotic culture [10] for the first 3 d at a concentration of 10^6 cfu/mL in the drinking water, and dietary lactose (0.1%) was received continuously in the feed. The untreated group received untreated water and feed. Body weights of individual poults were recorded on d 1, 7, and 14 in both trials 1 and 2. Feed was also weighed on these days to evaluate FCR.

Experiment 2

This experiment and its replicate were performed using the same methods as experiment 1, with the exception that poults were not challenged with *Salmonella* Enteritidis. Briefly, female poults were randomly assigned to 1 of 2 treatments, with 4 replicate pens per treatment ($n = 40$). The treated poults also received the probiotic culture [11] for the first 3 d, at a concentration of 10^6 cfu/mL in the drinking water, and dietary lactose (0.1%) continuously in the feed, as in the first experiment. Nontreated control poults received untreated feed and no probiotic culture. Body weights of individual poults 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 poults 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 poults 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 poults were not challenged with *Salmonella* Enteritidis, there were no significant differences in BW or FCR on d 14 or 18. Control poults did have a statistically significant increase in BW compared with treated poults 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 poult with (experiment 1) or without (experiment 2) *Salmonella* Enteritidis challenge ($\sim 10^4$ cfu)

Trial number	Treatment	<i>Salmonella</i> Enteritidis challenge	BW \pm SEM (g)			FCR \pm SEM
			d 1	d 7	d 14	d 1 to 14
Experiment 1						
Trial 1	Control	Yes	56.3 \pm 0.18 ^a	163.3 \pm 1.97 ^b	344.4 \pm 3.60 ^b	2.022 \pm 0.087 ^a
	LPC	Yes	56.3 \pm 0.19 ^a	175.5 \pm 1.62 ^a	382.3 \pm 3.58 ^a	1.772 \pm 0.065 ^b
Trial 2	Control	Yes	50.8 \pm 0.23 ^a	96.1 \pm 1.23 ^b	206.1 \pm 2.68 ^b	2.102 \pm 0.033 ^a
	LPC	Yes	50.7 \pm 0.24 ^a	104.3 \pm 1.25 ^a	226.8 \pm 2.69 ^a	1.967 \pm 0.042 ^b
Experiment 2						
Trial 3	Control	No	58.9 \pm 0.23 ^a	156.4 \pm 1.35 ^a	363.1 \pm 3.28 ^a	1.500 \pm 0.045 ^a
	LPC	No	58.0 \pm 0.23 ^a	151.7 \pm 1.21 ^b	361.4 \pm 3.43 ^a	1.525 \pm 0.024 ^a
Trial 4	Control	No	d 1	d 8	d 18	d 1 to 18
	LPC	No	51.3 \pm 0.31 ^a	138.2 \pm 1.49 ^a	356.2 \pm 6.29 ^a	1.614 \pm 0.056 ^a
			51.2 \pm 0.28 ^a	134.9 \pm 1.35 ^a	352.6 \pm 3.70 ^a	1.681 \pm 0.018 ^a

^{a,b}Data with different superscripts in the same column and trial indicate statistical difference ($P < 0.05$).

trations on *Salmonella* infection. *Salmonella* reduction has been associated with an increased concentration of acetic, propionic, lactic, and butyric acid in the ceca [13, 15], which is a primary place of *Salmonella* multiplication. Gulsen et al. [14] reported that inclusion of lactose (2.5%) and dried whey (3.8%) during the grow-out period increased performance in broiler chicks. This was associated with an increase in intestinal villi length during the starter period, which was postulated to improve nutrient absorption.

Additionally, competitive exclusion and probiotic cultures have been shown to reduce *Sal-*

monella colonization in turkey poult [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 poult 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.

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

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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 $1.864 \times g$, 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-

tively determined by spread-plating on XLD agar containing novobiocin (25 µg/mL) and nalidixic acid (20 µg/mL), followed by enumeration for each experiment. Actual determined colony-forming units for each experiment are reported.

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.

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