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Effect of a *Lactobacillus Spp*-Based Probiotic Culture Product on Broiler Chicks Performance under Commercial Conditions

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Abstract: Concern about antimicrobial resistance has led to increased attention to alternatives for controlling infections and increasing performance in animal production. Probiotics and organic acids have gained attention as options in poultry industry. Our laboratory has been working in the selection of lactic acid bacteria, mainly from the genus *Lactobacillus*, as potential probiotic candidates. Previous data indicates that these selected probiotic bacteria are able to reduce *Salmonella* infection and improve performance in broiler and turkey under experimental and commercial trials in the USA. The selected probiotic organisms were used in field trials to evaluate their efficacy in commercial conditions in Mexico. In the present report, the probiotic culture significantly reduced mortality ($p<0.01$) compared to the control houses. Also, a consistent improvement of body weight (2.06%) and reduction of FCR (3.5%) was observed in the treated flocks. The results of this report suggest that this *Lactobacillus*-based probiotic culture could be useful to reduce mortality in commercial poultry farms.

Key words: *Lactobacillus spp*-based probiotic culture, broiler chicks, mortality and performance

Introduction

Poultry producers are challenged to improve production while using fewer antibiotics due to increased restriction on antimicrobial usage. Researchers worldwide are working on organic alternatives due to the ban of a wide range of drugs for animal production. Probiotics consisting of live or dead organisms and spores (Patterson and Burkholder, 2003), non-traditional chemicals (Moore *et al*., 2006), bacteriophages (Higgins *et al*., 2005a) and others have emerged in the last decades as some of the tools that could be potentially useful in the near future for pathogen control and poultry performance improvement. Our laboratory has been working toward isolation, selection and further evaluation of probiotic organisms to control food borne pathogens (Tellez *et al*., 2006). Experimental and commercial studies conducted by our laboratory in the U.S.A. have shown that these selected probiotic organisms are able to reduce idiopathic diarrhea in commercial turkey brooding houses (Higgins *et al*., 2005b) and also to significant reduce *Salmonella* colonization in turkeys (Vicente *et al*., 2005) and broilers (Drake *et al*., 2003; Higgins *et al*., 2007). The aim of this study was to extend our research and examine the effect of a defined probiotic on broiler performance under commercial conditions in Mexico.

Materials and Methods

Houses and chicks: A series of trials were conducted in a total of 24 commercial chicken lots houses, that included 459,277 one-day old broiler chicks from a commercial broiler cross line. These chicks were randomly assigned within service technician geographic areas, to probiotic treatment (12 lots received probiotic FM-B11™, Sigrah-Zellet Mexico, S.A. de C.V., Cuernavaca, Morelos Mexico) or controls with no probiotic administered (12 control chicken lots). The studies were conducted during spring and summer of 2006.

Administration of treatments: Probiotic was administered in drinking water, following directions by the supplier to achieve a final concentration of 10^6 CFU/mL. Three doses of probiotic bacteria were administered during the grow-out period according to the following scheme: First dose: between days 2-4; second dose: between days 10-12; and the third dose: between 21-24 days. Briefly, FM-B11™ was provided by Sigrah-Zellet Mexico S.A. de C.V. A bottle of 70 g of total product with a total concentration of 10^{11} cfu of live *Lactobacillus* strains was added per every 1000 L water directly into the water tank (no chlorine was added prior to or during probiotic administration) to achieve a final concentration of 10^6 cfu/mL. In order to protect the probiotic organisms, 0.5 kg of powder milk or a bag of vaccine carrier was also added.

An organic acid product (Perform/Max Optimizer II™, Sigrah-Zellet Mexico, S.A. de C.V., Cuernavaca, Morelos Mexico) was used 8 h before the second and third application of the probiotic culture at a dose of

Table 1: Effect of a *Lactobacillus spp*-based probiotic culture on mortality and feed conversion ratio in broilers under Commercial conditions

		Control Houses				Treated Houses			
Farm	DOA-Sex	No. Birds	Mort (%)		FCR ± STDEV	No. Birds	Mort (%)		FCR ± STDEV
A	42d-F	30,000	1479	(4.93)[a]	1.815	30,000	1491	(4.97)[a]	1.779
B	42d-F	30,000	1848	(6.16)[a]	1.910	30,000	1662	(5.54)[b]	1.879
C	49d-F&M	9,800	689	(7.03)[a]	1.859	10,000	594	(5.94)[b]	1.815
D	52d-F&M	14,720	880	(5.98)[a]	NA	14,729	776	(5.27)[b]	NA
E	54d-F&M	27,098	2512	(9.27)[a]	2.103	27,158	1920	(7.07)[b]	2.040
F	56d-M	5,000	423	(8.46)[a]	1,896	5,600	458	(8.18)[a]	1.737
Total		116,618	7831	(6.72)[a]	1917±0.049	117,497	6901	(5.87)[b]	1.850±0.053

DOA: Day of age, NA: Data not available, [a,b]Different superscripts within rows indicates significant ($p<0.05$) differences

Table 2: Effect of a *Lactobacillus spp*-based probiotic culture on broiler performance under commercial conditions

		Control Houses			Treated Houses		
Farm	DOA-Sex	No. Chicks	Avg BW (KG) ±STDER	ADG (g) ±STDER	No. Chicks	Avg BW (KG) ±STDER	ADG (g) ±STDER
A	42d-F	30,000	1.791	42.6	30,000	1.809	43.1
B	42d-F	30,000	1.776	42.3	30,000	1.805	43.0
C	49d-F&M	9,800	2.377	48.5	10,000	2.470	50.4
D	52d-F&M	14,720	2.596	49.9	14,729	2.624	50.5
E	54d-F&M	27,098	2.439	45.2	27,158	2.506	46.4
F	56d-M	5,000	3.411	60.9	5,600	3.450	61.6
G	41d-F	51,852	1.808	44.1	51,852	1.767	43.1
H	42d-F	12,000	1.719	40.9	18,000	1.773	42.2
I	50d-M	10,809	2.766	55.3	6,300	2.843	56.9
J	51d-M	23,469	2.818	55.3	27,902	2.856	56.0
K	52d-M	13,148	2.802	53.9	3,840	2.841	54.6
L	52d- F&M	2,160	2.843	54.7	3,840	3.003	57.8
Total		230,056[a]	2.429±0.157[a]	49.5±1,88[a]	229,221	2,479±0.164[a]	50.5±1.98[a]

DOA: Day of age, [a,b]Different superscripts within rows indicates significant ($p<0.05$) differences

(1L/1,000L water) according to manufacturer's directions. Organic acid (Perform-max Optimizer II) product is a combination of 5 different organic acids (lactic, acetic, tannic, propionic and caprylic acids).

Data collection: Data was collected at market age for mortality, Body Weight (BW) and feed consumption. Estimation of cost benefits (Cents/kg live broiler) was performed by formulas used by the broiler operation. Mortality, BW, Average Daily Gain (ADG) and Feed Conversion Ratio (FCR) were the main variables evaluated. Data collected were subjected to one-way analysis of variance for market body weight, average daily gain and feed conversion ratio using SAS software (SAS Institute, 1988). The experimental design included treatment (probiotic or control) as main effect, age as covariable and the interaction between treatment and age. Mortality data were analyzed through the chi-square test of independence (Steel and Torrie, 1960). Statistical significance was considered at $p<0.05$.

Results and Discussion

The use of defined probiotic cultures in the poultry industry has recently become more common. However, few conclusive studies regarding their efficacy under commercial conditions have been reported in the scientific literature. In this study, mortality, BW, Average Daily Weight Gains (ADG) and FCR were determined at the market age.

Data for mortality and FCR was obtained for 6 operations (Table 1). The average lot size was 19,509 broilers with a range of 5,000 to 30,000 birds per house. Control group had a total of 116,618 whereas the treated group had 117,487 broilers. The sample size was 234,105 chicks divided in 12 houses (6 control and 6 treated). General comparison between treatments showed a significant reduction on mortality ($p<0.01$) in the treated houses (6,901/117,487; 5.87%) *versus* control houses (7,831/116,618; 6.72%). Feed conversion ratio (FCR: Control: 1.917±0.049kg *vs*. Treated: 1.850±0.053kg) was not significantly ($p>0.05$) different between groups.

Data for BW and ADG are presented in Table 2. Total chicks for the control and probiotic treatments were 230,056 and 229,221 respectively from 12 different houses (lot size from 2,160 to 30,000 broilers). The observed numerical improvement in market BW (0.050kg, 2.06%) by the probiotic treatment (Control:

2.429±0.157kg *vs*. Treated: 2.479±0.164kg) was not significantly (p>0.05) different between groups. Average daily gain was improved by 1.8% in the treated flocks (50.4±1.98g) compared to the control (49.5±1.88g) with P = 0.06.

Economic estimates provided by the integrators suggested that production cost between treatment groups in this study was lower in the probiotic treatment due to significant reduction in mortality (0.85%), improvement in FCR and BW (0.050kg). Estimation of the cost benefits using probiotic in these farms by the integrators suggested a 1:15 return on investment after deducting the cost of the probiotic. Data used for these calculations were not made available to the authors. However, performance and condemnation rate analysis of commercial turkey flocks treated with the *Lactobacillus spp*.-based probiotic in previous studies resulted in increased market BW and reduced cost of production (Torres-Rodriguez *et al*., 2007).

The significant decrease in mortality in the treated houses could be related to a reduction in colonization of enteropathogens in the gastrointestinal tract and invasion, although not directly evaluated in this field study. Studies conducted in our laboratory have demonstrated that administration of this probiotic culture for 1 or 3 consecutive days was able to reduce *Salmonella* colonization in one day-old broiler chicks (Drake *et al*., 2003; Higgins *et al*., 2007) and turkey poults (Vicente *et al*., 2005). Recently, in a study in turkey poults with idiophatic diarrhea conducted by Higgins *et al.* (2005a,b), administration of three doses of this probiotic culture was reported to improve BW gain similar to the response obtained with therapeutic antibiotic administration.

The results of this field report demonstrated that selected *Lactobacillus* strains used as a probiotic significantly reduced mortality in poultry farms. Also, better broiler chick performance may result from the administration of selected probiotic cultures in commercial poultry farms. The use of probiotic cultures in combination with some organic acid products may help to reduce the cost of medication in commercial broiler farms, although more studies are needed to support this hypothesis.

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