POULTRY NUTRITION

Evaluation of a Commercial Probiotic Culture in Broiler Rations

A. A. Alyaseen, E. E. Murray, R. D. Morrison, R. H. Thayer and G. W. Newell

Story in Brief

Two eight-week feeding trials were conducted using a commercial strain of chicken broilers. The first feeding trial (Trial I) was completed during the summer of 1978 (June 13 to August 1) when the maximum environmental temperature each day approached or exceeded 100°F. The second feeding trial (Trial II) was held during the fall of 1978 (October 17 to December 12) when environmental conditions from a temperature standpoint were in the range from 30 to 85°F.

The broiler rations fed included a standard commercial broiler ration currently being used under practical production conditions, as well as, corn-soybean meal type broiler rations without fish meal or feather meal which had been formulated to contain both marginal and adequate levels of dietary protein and methionine. These rations were fed with and without the addition of a commercial probiotic culture in order to obtain comparative data.

The purpose of these two feeding trials with broilers was (1) to determine if a probiotic culture as prepared and sold commercially when added to broiler rations with substandard dietary nutrient levels would increase rate of growth and improve efficiency of feed utilization, and (2) to determine if such a probiotic culture would alleviate the stress imposed on broilers when environmental temperatures exceed 90 to 95°F during the growing period.

Criteria used to measure the effect of the probiotic culture were body weight at intervals during the growing period, efficiency of feed utilization at the same time intervals, feed cost per lb of broiler produced at market age and dressed market grade.

In the feeding trial conducted during the summer months (Trial I), there were no statistically significant differences in body weight among the broilers fed the different rations. This trial included a commercial ration, the commercial ration plus the probiotic culture, and a corn-soybean meal type broiler ration which contained adequate dietary levels of protein and methionine with no probiotic culture. In addition, a corn-soybean meal type broiler ration was fed which had been formulated to contain dietary levels of protein and methionine at 87 percent and 79 percent of dietary standards, respectively, with the probiotic culture added.

There was a numerical difference in body weight in favor of the broilers fed the corn-soybean type ration with substandard levels of dietary protein and methionine which contained the probiotic culture as compared to the unsupplemented corn-soybean type ration which contained adequate protein and methionine. However, the broilers fed this ration were not equal to those fed the commercial ration or the commercial ration plus the probiotic culture insofar as body weight was concerned.

The addition of the probiotic culture to the commercial ration did not increase body weight or improve efficiency of feed utilization as compared to the results obtained when no probiotic culture was fed. In addition, a statistically significant difference ($P < .05$) in lb of feed per lb of broiler produced was observed in favor of the commercial ration and the commercial ration plus the probiotic culture.

The results from Trial I lead to the conclusion that efficiency of protein and methionine utilization may have been enhanced by the addition of the probiotic culture as indicated by body weight. Under the conditions of Trial I, the addition of the probiotic culture did not improve growth rate or increase efficiency of feed utilization when added to a ration calculated to be nutritionally adequate in every respect. A comparison of feed cost per lb of broiler produced (Trial I) shows that there was no economic advantage to be gained under the conditions of this feeding trial in supplementing with the commercial probiotic culture.

In Trial II, a series of broiler rations was formulated with both cost and nutritional adequacy being taken into consideration. On one end of the series, nutritional adequacy was obtained at an economically feasible ingredient cost (broiler ration used under practical production conditions). At the other end of the series, ingredient cost was given primary consideration and nutritional adequacy in terms of total dietary protein, dietary methionine level and dietary energy level as allowed to drop below accepted nutritional standards.

In this trial (Trial II), statistically significant differences ($P < .05$) in both body weight and efficiency of feed conversion were observed among the broilers fed the eight experimental rations. A cost analysis based upon ingredient cost and expressed in terms of feed cost per lb of broiler produced did not justify the use of the commercial probiotic culture as a supplement to any ration regardless of its position in the formulation series.

There were no differences among any of the broilers in either trial insofar as market grades were concerned in terms of fleshing and finish. Thus, it can be concluded that the treatments imposed had no adverse effect.

Introduction

Considerable interest is being shown by poultrymen at the present time in commercial probiotic cultures for use in poultry feeds of all kinds. Published research data with broilers and growing turkeys give some indication that the addition of certain lactobacillus cultures does improve the efficiency with which dietary protein is utilized, particularly when total dietary protein level is substandard. Along this same line, it would appear that a substantial deficiency of dietary methionine, expressed as a percentage of total protein and as much as 20 percent below requirements, can be overcome to a major degree when lactobacillus cultures are added to the ration. In addition, less desirable organisms in the intestinal tract are thought to be replaced by the lactobacillus.

Observations made under practical feeding conditions lead to the conclusion that the various forms of stress which are encountered under commercial production conditions may be alleviated to some degree through the use of commercial probiotic cultures which contain certain lactobacillus cultures among other microorganisms. These stresses include, among others, high bird density, exposure to disease producing organisms and high environmental temperature in excess of 95°F.

Modern poultry management systems are designed to obtain a maximum return per dollar invested. In many instances the procedures followed do not provide for optimum environmental conditions and/or they increase the risk that major production problems will be encountered. As a result, a calculated risk imposed by these stresses will not offset the economic advantages to be gained. Poultrymen are always ready to adopt new feeding or management practices by means of which these stresses can be alleviated at a minimum cost, and the overall risk of production can be reduced.

Commercial probiotic cultures are being manufactured, and a number are being offered for sale in Oklahoma. For this reason, a series of experiments was conducted for the purpose of obtaining data upon which to base some sort of an evaluation of this type of commercial probiotic culture when it is added to a broiler ration.

The two primary objectives of the studies reported herein were (1) to determine if a commercial probiotic culture would increase the efficiency with which total protein and methionine could be utilized, and (2) to determine if the adverse effect of stress (in this case high environmental temperature) could be alleviated. Lowering total dietary protein level and reducing the need for supplemental methionine would be instrumental in reducing ration cost, assuming the efficiency with which these nutrients are utilized was increased (first objective). If stress can be alleviated (second objective), overall production costs related to environment (high bird density, environmental temperature, and disease exposure, among others) might be substantially lowered.

Material and Methods

The housing environment for each of the two feeding trials reported in this paper was the same except that Trial I was conducted in June and July and Trial II in October, November and December. The broilers were housed in 6 x 12 foot pens equipped with infrared brooders, suitable size water fountains and feeders. The pens were arranged on either side of a central isle which adapted well to the randomized block design which was employed in both feeding trials. Standard management practices were followed in caring for the broilers during the entire experimental feeding period.

The same commercial broiler strain was used in both feeding trials and was obtained from a commercial hatchery in Arkansas. Each experimental pen consisted of 15 male and 15 female broilers. The pens on one side of the central isle in the broiler house were considered to be a block (two blocks in the house) and all the experimental rations within a given feeding trial were randomly assigned to each of the two blocks.

The four experimental rations fed in Trial I and the eight experimental rations fed in Trial II are listed in Tables 1, 2 and 3. Emphasis was placed on Trial I on determining the effect of the commercial probiotic culture when added to a commercial broiler ration currently being fed under practical feeding conditions (Table 1, Rations 1 and 2). This was compared to broiler rations (basically corn-soybean type with no fish meal or feather meal) which contained dietary protein and dietary methionine at levels at or below accepted dietary requirement standards (Table 1, Rations 3 and 4). The environmental stress in this case was a daily environmental temperature in excess of 95°F (summer growing conditions).

The approach in Trial II, on the other hand, was to formulate and feed a series of broiler rations with different degrees of nutritional adequacy, both with and without the addition of the commercial probiotic culture. These rations were formulated with consideration being given to both nutritional adequacy and cost. A balance was selected in the case of each experimental ration so that nutritional adequacy was given preference at one end of the series (Table 2 and 3, Ration 1) with cost being what it had to be to meet standards for total dietary protein and dietary methionine. On the other hand, preference was given to the other end of the series (Table 2 and 3, Ration 8) to getting cost as low as possible at the expense of total dietary protein and dietary methionine.

Measurements taken included body weight and feed consumption at the end of three, six, and seven weeks of the growing period in Trial I and at the end of two, four, six and eight weeks in Trial II. Mortality was recorded daily. The broilers were

Table 1. Experimental rations Trial I.

Ingredients	1 Starter (%)	1 Finisher (%)	2 Starter (%)	2 Finisher (%)	3 Starter (%)	3 Finisher (%)	4 Starter (%)	4 Finisher (%)
Tallow, feed grade	5	5	5	5	7	7	4	7
Yellow corn, ground	54.1	59.53	54.1	59.53	41.55	49.05	48.15	45.15
Soybean meal (44%)	29	25	27	23	35	28	33	33
Alfalfa meal (17%)	- -	- -	- -	- -	3	3	3	3
Dried whey (12%)	- -	- -	- -	- -	3	3	3	3
Fish meal (menhaden)	4	4	4	4	- -	- -	- -	- -
Feather meal	2	2	2	2	- -	- -	- -	- -
Live yeast culture (14%)	- -	- -	- -	- -	3	3	3	3
Meat & bone meal (50%	4	2.5	4	2.5	5	5	- -	- -
dl Methionine	0.15	0.12	0.15	0.12	0.1	0.1	- -	- -
Phosphorus supplement (Ca27-P18)	0.6	0.7	0.6	0.7	1.0	1.0	2.0	2.0
Calcium carbonate	0.5	0.5	0.5	0.5	0.5	- -	1.0	1.0
Trace mineral mix[1]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Salt	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5
Broiler vitamin mix[2]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Commercial probiotic culture (soybean meal carrier)[3]	- -	- -	2	2	- -	- -	2	2
Calculated analysis								
Protein (%)	23.9	21.9	23.9	21.9	23.0	20.6	21.0	20.7
Methionine (% of protein)	2.26	2.20	2.26	2.20	1.98	2.00	1.59	1.50
Kcal/lb	1437	1434	1437	1434	1346	1408	1299	1376

[1]Provides in the ration: manganese 120 ppm; zinc 80 ppm; iron 60 ppm; copper 10 ppm and iodine 1.0 ppm.

[2]Contains per pound of vitamin mix: vitamin A 1,400,000 I.U.; vitamin D_3 320,000 I.U.; vitamin E 1,400 I.U.; menadione sodium bisulfite complex 800 mg; riboflavin 1,400 mg; niacin 7,000 mg; d-pantothenic acid 2,000 mg; choline 110,000 mg; thiamine 200 mg; pyridoxine 200 mg; vitamin B_{12} 2.2 mg; d-biotin 20 mg; and folic acid 140 mg.

[3]Combination of *Lactobacillus acidophilus, Lactobacillus casei, Bacterium bifidus, Torulopsis,* and *Aspergillus oryzae.*

Table 2. Experimental starter rations Trial II.

	Ration number							
	1	2	3	4	5	6	7	8
Ingredients	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Tallow, feed grade	5	5	2.5	2.5	5	5	3	3
Yellow corn, ground	53.75	53.75	59.87	59.87	45.45	45.45	49.05	49.05
Soybean meal (44%)	29	27	26.2	24.2	33	31	35	33
Fish meal (menhaden)	4	4	3.4	3.4	- -	- -	- -	- -
Feather meal	2	2	1.7	1.7	- -	- -	- -	- -
Meat and bone meal (50%)	4	4	3.4	3.4	5	5	- -	- -
Alfalfa meal (17%)	- -	- -	- -	- -	3	3	3	3
Dried whey (12%)	- -	- -	- -	- -	3	3	3	3
Live yeast culture (14%)	- -	- -	- -	- -	3	3	3	3
dl Methionine	0.15	0.15	0.13	0.13	0.1	0.1	- -	- -
Phosphorus supplement (Ca27-P18)	0.6	0.6	1.6	1.6	1.0	1.0	2	2
Calcium carbonate	0.75	0.75	0.35	0.35	0.5	0.5	1.0	1.0
Trace mineral mix[1]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Salt	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5
Broiler vitamin mix[2]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Coban	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Commercial probiotic culture (soybean meal carrier)[3]	- -	2	- -	2	- -	2	- -	2
Calculated analysis								
Protein (%)	23.9	23.9	22.3	22.3	22.4	22.4	21.1	21.1
Methionine (% of protein)	2.25	2.25	2.22	2.22	2.00	2.00	1.58	1.58
Kcal/lb	1404	1404	1367	1367	1317	1317	1279	1279

[1]Provides in the ration: manganese 120 ppm; zinc 80 ppm; iron 60 ppm; copper 10 ppm and iodine 1.0 ppm.
[2]Contains per pound of vitamin mix: vitamin A 1,400,000 I.U.; vitamin D_3 320,000 I.U.; vitamin E 1,400 I.U.; menadione sodium bisulfite complex 800 mg; riboflavin 1,400 mg; niacin 7,000 mg; d-pantothenic acid 2,000 mg; choline 110,000 mg; thiamine 200 mg; pyridoxine 200 mg; vitamin B_{12} 2.2 mg; d-biotin 20 mg; and folic acid 140 mg.
[3]Combination of *Lactobacillus acidophilus, Lactobacillus casei, Bacterium bifidus, Torulopsis,* and *Aspergillus oryzae.*

Table 3. Experimental finisher rations Trial II.

	Ration number							
	1	2	3	4	5	6	7	8
Ingredients	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Tallow, feed grade	5	5	1.5	1.5	2	2	1.5	1.5
Yellow corn, ground	59.5	59.5	67.1	67.1	56.5	56.5	56.6	56.6
Soybean meal (44%)	25	23	22	20	27	25	29	27
Fish meal (menhaden)	4	4	3.4	3.4	- -	- -	- -	- -
Feather meal	2	2	1.7	1.7	- -	- -	- -	- -
Meat & bone meal (50%)	2.5	2.5	2	2	2	2	- -	- -
Alfalfa meal (17%)	- -	- -	- -	- -	3	3	3	3
Dried whey (12%)	- -	- -	- -	- -	3	3	3	3
Live yeast culture (14%)	- -	- -	- -	- -	3	3	3	3
dl Methionine	0.12	0.12	0.1	0.1	0.1	0.1	- -	- -
Phosphorus supplement (Ca27-P18)	0.7	0.7	1.0	1.0	2	2	2	2
Calcium carbonate	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.0
Trace mineral mix[1]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Salt	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5
Broiler vitamin mix[2]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Coban	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Commercial probiotic culture (soybean meal carrier)[3]	- -	2	- -	2	- -	2	- -	2
Calculated analysis								
Protein	21.9	21.9	20.3	20.3	19.3	19.3	19.1	19.1
Methionine (% of protein)	2.20	2.20	2.17	2.17	2.12	2.12	1.61	1.61
Kcal/lb	1437	1437	1385	1385	1293	1293	1263	1263

[1]Provides in the ration: manganese 120 ppm; zinc 80 ppm; iron 60 ppm; copper 10 ppm and iodine 1.0 ppm.
[2]Contain per pound of vitamin mix: vitamin A 1,400,000 I.U.; vitamin D_3 320,000 I.U.; vitamin E 1,400 I.U.; menadione sodium bisulfite complex 800 mg; riboflavin 1,400 mg; niacin 7,000 mg; d-pantothenic acid 2,000 mg; choline 110,000 mg; thiamine 200 mg; pyridoxine 200 mg; vitamin B_{12} 2.2 mg; d-biotin 20 mg; and folic acid 140 mg.
[3]Combination of *Lactobacillus acidophilus, Lactobacillus casei, Bacterium bifidus, Torulopsis,* and *Aspergillus oryzae.*

processed and given a dressed market grade for both fleshing and finish at the end of seven weeks in Trial I and eight weeks in Trial II. From the body weight and feed consumption data, calculations were made for feed cost per lb of broiler produced.

Results and Discussion

Data on body weight, efficiency of feed conversion and feed cost per lb of broiler produced which were obtained when the broilers were six-weeks-old are listed in Table 4. A statistical analysis of these data indicates that there were no statistically significant differences in body weight among the broilers fed the four experimental rations. However, it did require more lbs of feed per lb of broiler for the broilers fed Rations 3 and 4 than it did for the broilers fed Rations 1 and 2 ($P < .05$).

Even though there were no statistically significant differences in body weight, the broilers fed Ration 4, which contained the commercial probiotic culture, were substantially heavier than those fed Ration 3. Since Ration 4 was formulated to be substandard in both total protein and methionine, it would appear that the addition of the commercial probiotic culture improved the efficiency with which these two nutrients were utilized. On the other hand, it must be noted that the addition of the commercial probiotic culture did not improve the growth performance of the commercial broiler ration (Table 4, Ration 1 vs Ration 2) as measured by either body weight or lbs of feed per lb of broiler produced.

The real consideration of the broiler producer is feed cost per lb of broiler produced. For this reason, an analysis of feed cost was made utilizing values for body weight and lbs of feed per lb of broiler produced which were obtained when the broilers were six-weeks-old. Only ingredient cost was included in making these calculations. A summary of this analysis is presented in Table 4.

Table 4. Body weight, feed conversion and feed cost data at 6 weeks of age Trial I.

Ration number	Body weight (lb)	Lb feed per lb of broiler	Total feed cost[1] per broiler (cents)	Feed cost per lb of body weight (cents)
1-Commercial	2.95	1.89	41.80	14.17
2-Commercial plus probiotic culture	2.81	1.90	43.15	15.36
3-Corn-soybean type (adequate)	2.63	2.05	42.45	16.14
4-Corn-soybean type (deficient) plus probiotic culture	2.73	2.08	44.91	16.45

[1]Ingredient cost only.

The commercial broiler ration produced a lb of broiler at the lowest feed cost among the four rations which were compared. Feed cost per broiler for Ration 4 was the highest among the four with Ration 2 and 3 intermediate. Even though some increase in efficiency of nutrient utilization may be apparent, the additional cost imposed by the probiotic culture is not offset by the improved growth performance.

Data obtained in Trial II for body weight, lbs of feed required per lb of broiler produced and feed cost per lb of broiler produced are presented in Table 5. A statistical analysis indicates that there are statistically significant differences ($P < .05$) in both body weight and efficiency of feed conversion in favor of Ration 1 (unsupplemented

Table 5. Body weight, feed conversion and feed cost data at 6 weeks of age Trial II.

Ration number	Body weight (lb)	Lb feed per lb of broiler	Total feed cost[1] per broiler (cents)	Feed cost per lb of body weight (cents)
1-Commercial	3.41	1.99	57.31	16.81
2-Commercial plus probiotic culture	3.28	2.05	58.00	17.68
3-Commercial 85%	3.21	2.13	52.71	16.42
4-Commercial 85% plus probiotic culture	3.21	2.12	53.91	16.79
5-Corn-soybean meal type (adequate)	3.05	2.26	55.33	18.14
6-Corn-soybean meal type (adequate) plus probiotic culture	3.05	2.29	57.16	18.74
7-Corn-soybean meal type (deficient)	3.07	2.29	53.32	17.37
8-Corn-soybean meal type (deficient) plus probiotic culture	3.12	2.33	56.77	18.79

[1]Ingredient cost only.

commercial). There was a progressive decrease in both body weight and efficiency of feed conversion from Ration 1 through Ration 8.

Under the conditions of Trial II, there was no advantage either from a growth performance standpoint or an economic standpoint in supplementing any one of the four rations (Rations 1, 3, 5 and 7) with the probiotic culture. It must be pointed out, however, that if environmental stress such as was encountered in Trial I with the high ambient temperature had been imposed in Trial II, growth performance might have been improved with Ration 8 over Ration 7 (Trial II). This was observed to some degree in Trial I with Ration 4 over Ration 3. It is difficult to simulate the stresses inherent in commercial production situations when feeding trials are conducted under controlled experimental conditions.

It should be noted also that the lowest feed cost per lb of broiler produced (Trial II) was obtained with Ration 3, and even the feed cost for Ration 4 was slightly below that for Ration 1. This leads to some speculation that based upon economic considerations, protein quantity and quality might be excessively high in the commercial ration.

A summary of the dressed grades for fleshing and finish are not presented in a table for the reader's consideration. However, from the results which were obtained, the treatments which were imposed had no adverse effect on dressed market grade.