THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF ANIMAL SCIENCES

EFFECT OF NUTRAFITO PLUS ON THE PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILERS FED ABF-NAP PROGRAMS WITH DIFFERENT PREBIOTIC/DFM COMBINATIONS

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ABSTRACT

The objective of this study was to evaluate the effect of NutrafitoPlus on performance and carcass characteristics of broilers fed antibiotic-free (ABF) programs with different prebiotic/direct-fed microbial (DFM) combinations. In addition, ammonia emissions were measured to determine the effect of NutrafitoPlus on sequestering ammonia. 1,728 one-day-old straight-run broiler chicks were separated into 48 pens with 36 birds/pen. There were 4 different dietary treatments with 12 replicate pens. The treatments differed in the inclusion or exclusion of NutrafitoPlus, and the inclusion or exclusion of prebiotic/DFM and/or NutrafitoPlus in the finisher. No significant differences in body weight, feed consumption, or feed conversion occurred between treatments. The averages for body weight and feed conversion were 2.768 kg at 42 days and 1.757 kg feed/kg body weight gained, respectively. Early mortality was higher than expected at 4.630 percent during the first 18 days; however no significant differences in mortality were detected among treatment groups. No differences in carcass weights or yield were found for the treatments. There was no significant difference in ammonia emissions between treatments. The addition of NutrafitoPlus as a feed additive to these ABF programs was ineffective in significantly improving performance, improving carcass characteristics, or decreasing ammonia emissions.

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Chapter 1

Description of Problem

NutrafitoPlus is a feed additive from Prince Agri Products, Inc. [1]. Its two active ingredients are Yucca *schidigera* whole plant powder and Quillaja *saponaria* powder [1]. Yucca *schidigera* is a member of the lily family found in the southwestern United States and Mexico [2]. Quillaja *saponaria*, often referred to as the Soapbark tree, is native to Chile, and the powder is harvested from its bark [3]. Yucca and quillaja are harvested as a source of saponins [4]. These compounds are both lipid- and water-soluble due to their lipophilic nucleus and hydrophilic carbohydrate side chains [4]. Due to this natural surfactant property, saponins can bind to cholesterol and prevent its recycling, thus reducing blood cholesterol levels [4]. In addition, saponins often form complexes with the cholesterol present in the membranes of harmful intestinal protozoa and cause lysis, thus acting as an antiprotozoal [2]. Polyphenolics, another type of compound in both yucca and quillaja, decrease diversion of nutrients from growth to immune reactions, and have been reported to reduce inflammation [4].

A commercial livestock nutrition company currently uses combinations of a prebiotic and a direct-fed microbial (DFM) in antibiotic-free (ABF) broiler feeding programs. Different combinations are used and rotated throughout the year. Research conducted at the company's research barn confirms the benefit of the prebiotic/DFM combination in the ABF broiler feeding program. However, no research has been done to evaluate the value of NutrafitoPlus with the prebiotic/DFM. Additionally, no research has been done to evaluate the benefit of DFM and prebiotics fed through the entire program. In the past, DFM has typically been included in the

starter and grower diets and excluded from the finisher due to questionable effectiveness and cost. This research will consider the benefit of DFM and prebiotics, as well as NutrafitoPlus, in the finisher.

The objective of this study is to evaluate how NutrafitoPlus affects broiler growth, carcass characteristics, and ammonia emissions when added to an ABF program with a prebiotic/DFM combination.

Chapter 2

Materials and Methods

Experimental Chickens and Diets

This project was conducted at the Pennsylvania State University according to standard operating procedures for 42-day broiler studies at Penn State. A total of 1,728 one-day-old broiler chicks were placed into 48 experimental pens in the Penn State Poultry Unit with 36 birds in each pen. Each pen had an initial bird density of 0.75 square feet/bird. 4 different dietary treatments were administered with 12 replicate pens of each treatment or 432 birds per treatment. The 4 treatments contained a corn-soybean meal diet supplemented with different combinations of NutrafitoPlus and prebiotic/DFM. Feed and water were provided ad libitum for the entire study. Chemical analysis of feed is provided in Table 1. Feed samples were analyzed in triplicate by Barrow Agee Laboratories (Memphis, TN).

Table 1. Chemical Analysis of Feed

DIET		FEED COMPONENT (%)				
		MOISTURE	FAT	CP	CF	ASH
Yellow (Control)						
	Starter	11.94	4.070	21.95	2.430	5.360
	Grower	12.56	4.720	19.13	2.330	4.320
	Finisher	12.35	4.940	18.35	2.630	4.180
Red						
	Starter	10.58	4.310	23.80	2.470	5.110
	Grower	12.79	4.700	19.54	2.230	4.570
	Finisher	12.32	5.070	19.08	2.530	3.940
White						
	Starter	12.05	4.170	21.69	2.600	5.020
	Grower	12.58	4.640	19.85	2.200	4.500
	Finisher	12.40	5.010	18.45	2.430	4.040
Blue						
	Starter	11.88	4.330	21.76	2.330	4.890
	Grower	12.71	5.020	19.24	2.330	4.610
	Finisher	11.83	4.810	18.36	2.430	3.950

The four different dietary treatments included: Yellow, control treatment with prebiotic/DFM in starter and grower; Red, prebiotic/DFM/NutrafitoPlus in starter and grower; White, prebiotic/DFM in starter, grower, and finisher; and Blue, prebiotic/DFM/NutrafitoPlus in starter, grower, and finisher. See Table 2.

Table 2. Dietary Treatments

DIET		PREBIOTIC	DFM	NUTRAFITO PLUS
Yellow (Control)	Starter	+	+	-
	Grower	+	+	-
	Finisher	-	-	-
Red	Starter	+	+	+
	Grower	+	+	+
	Finisher	-	-	-
White	Starter	+	+	-
	Grower	+	+	-
	Finisher	+	+	-
Blue	Starter	+	+	+
	Grower	+	+	+
	Finisher	+	+	+

The feeding program had 3 phases. Starter was fed from days 1-17, grower was fed from days 18-28, and finisher was fed from days 29-42.

Performance

Body weight and feed intake were measured on days 0, 18, 29, and 42 to determine average daily gain, average daily feed disappearance, body weight gain, feed intake, and feed conversion ratio. All mortality was weighed to adjust the body weight gain and feed conversion for the pens.

Physiochemical Characteristics

10 males and 10 females of each treatment type were selected from pens that were closest to the average weight for their treatment. They were transported to the processing facility located within the Poultry Education and Research Center and slaughtered. Measurements collected on carcasses were carcass weight, breast weight, thigh weight, drumsticks weight, wings weight, shell and breast skin weight, abdominal fat pad weight, carcass yield (percent of live weight), breast (percent of live weight), thigh (percent of live weight), drumsticks (percent of live weight), wings (percent of live weight), shell and breast skin (percent of live weight), and abdominal fat pad (percent of live weight). Processing data were analyzed by sex and treatment and then as combined male and female data for the straight run growth of the birds as well as percentage of carcass weights at 42 days of age.

Litter Analysis

On day 42 after the completion of this experiment, ammonia emissions were measured by placing a ventilating cover over the litter for 20 minutes and measuring ammonia emitted from the litter/area covered. 5 pens of each treatment type were tested.

Statistical Analysis

The pen was the experimental unit. There were 4 different diets with 12 replicates. Statistical Analysis Software (SAS) was used to process data, and significance of data was determined to be when P-value < 0.05. Comparisons were performed with four-way analysis of variants. Duncan's Multiple Range Test was used to separate means between treatments. Percentage data was analyzed with an arcsine transformation using analysis of variance (ANOVA).

Chapter 3

Results

Body Weight

Birds and feed were weighed at 0, 18, 29, and 42 days of age to determine average body weight, feed consumption, and feed conversion. The average body weight for the experiment was 2.768 kilograms or 6.102 pounds at 42 days. Body weight in Table 3 shows consistent body weights across treatments with no significant differences.

Table 3. Body Weight (BW)

		BW PER BIRD (kg)			
	n	0 days	18 days	28 days	42 days
1. Yellow (Control)	12	0.04190	0.6620	1.494	2.820
2. Red	12	0.04210	0.6620	1.481	2.815
3. White	12	0.04200	0.6640	1.503	2.811
4. Blue	12	0.04170	0.6650	1.496	2.809
P-value	--	0.5717	0.9958	0.6915	0.9885
Significance		NS	NS	NS	NS

NS = Not Significant (P > 0.05).

Body Weight Gain

Body weight measurements were used to find body weight gains of broilers during three time periods as well as over the entire period of growth. Body weight gain, presented in Table 4, was fairly consistent and was not significantly different by treatment.

Table 4. Body Weight Gain (BWG)

		BWG PER BIRD (kg)			
	n	0-18 days	18-28 days	28-42 days	0-56 days
1. Yellow (Control)	12	0.6160	0.8280	1.285	2.773
2. Red	12	0.6190	0.8170	1.290	2.770
3. White	12	0.6200	0.8370	1.256	2.766
4. Blue	12	0.6220	0.8280	1.276	2.765
P-value	--	0.9773	0.4631	0.8099	0.9953
Significance		NS	NS	NS	NS

NS = Not Significant (P > 0.05).

Feed Intake and Feed Conversion

Feed consumption was consistent across all treatment groups with no significant differences (Figure 1). Average feed conversion for the experiment was 1.757 kilograms feed per kilogram body weight gained.

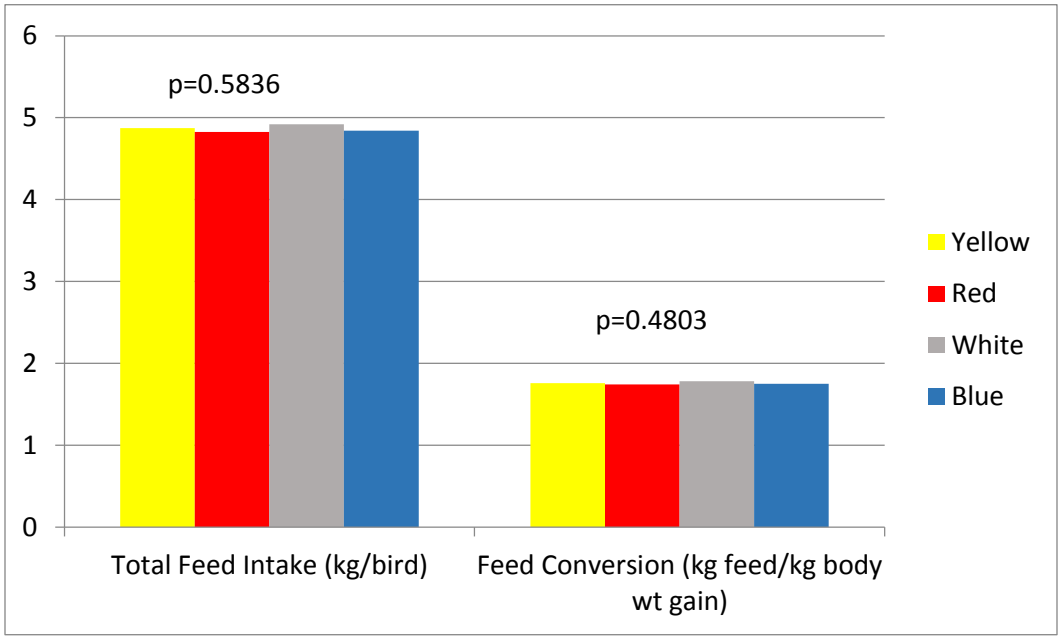

Figure 1. Feed Intake and Feed Conversion

Mortality

Early mortality was much higher than expected and was determined to be of a hatchery origin. Across all treatments, birds averaged 4.630 percent mortality in the first 18 days when 1.000 percent was normally achieved during Penn State broiler studies. Mortality was lowest during days 18 – 28 and was then below 1.000 percent. During the last 13 days of production, average percent mortality rose to 2.750 percent.

High variability was present among replicates in the treatments, which caused low relative significance in mortality. No significant differences between dietary treatments were found for percent mortality (Figure 2).

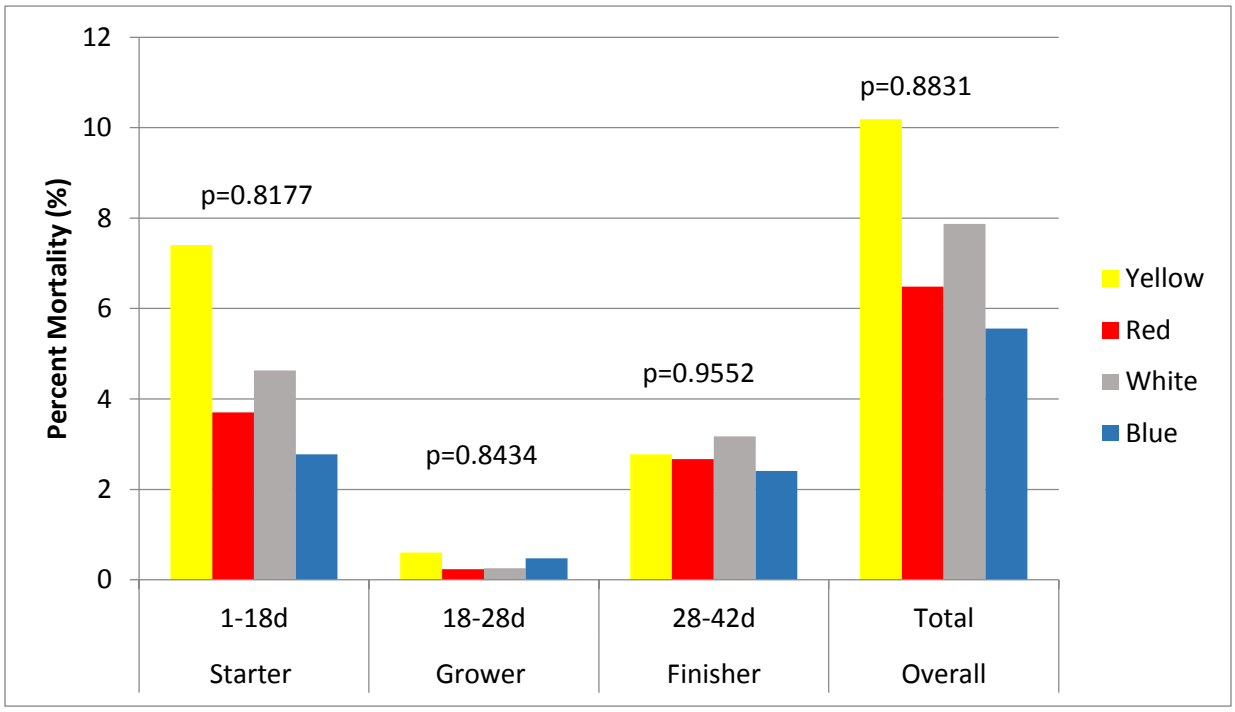

Figure 2. Percent Mortality

Carcass Quality

Processing data were analyzed by sex and treatment and then as combined male and female data for the straight run growth of the birds as well as percentage of carcass weights at 42 days of age. The percentage data indicates no significant differences in carcass qualities of birds from different treatments (Figure 3).

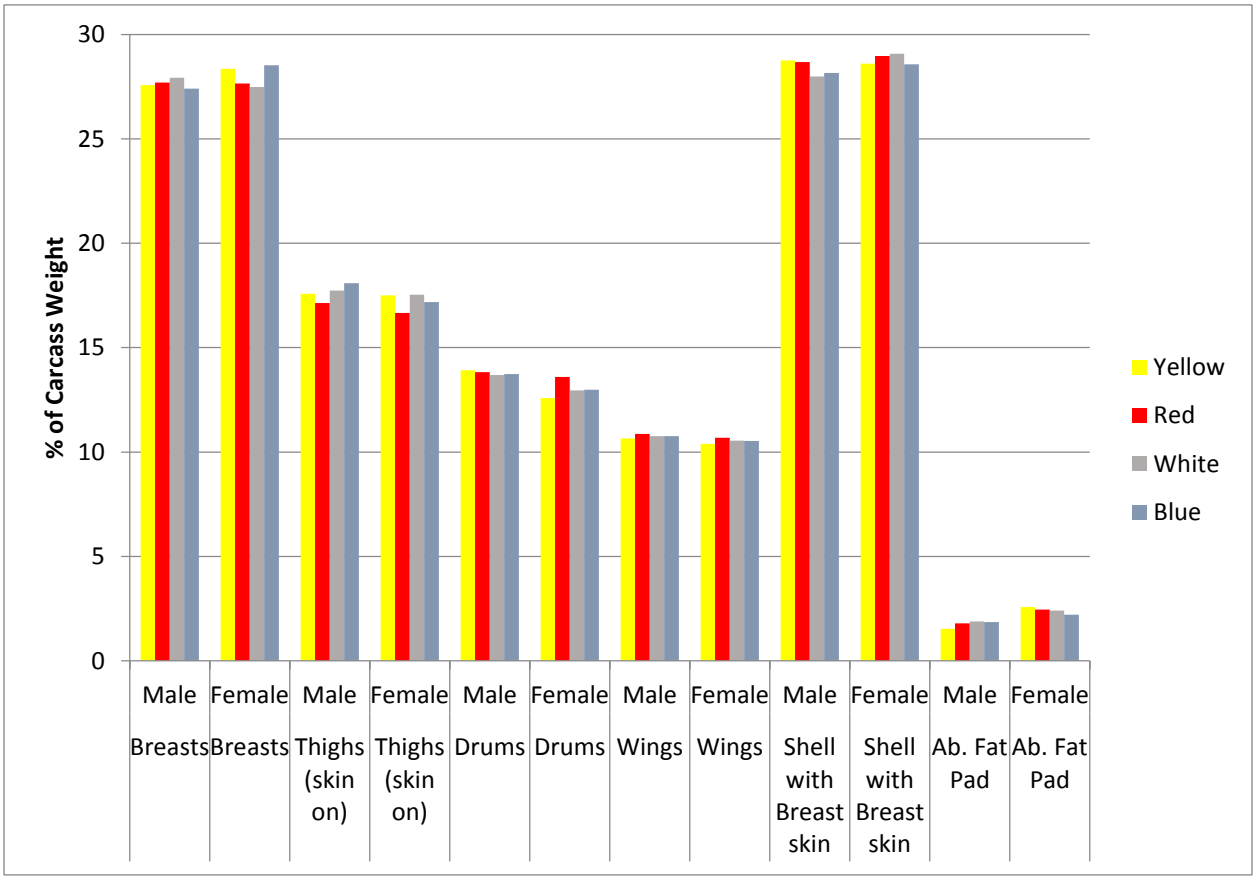

Figure 3. Mean Processing Weight as a Percentage of Carcass Weight*

*No Statistical Differences

Carcass Yield

Carcass yield was calculated as carcass weight / bled weight. Yield was evaluated between males and females. No significant differences in carcass yield were found between the treatments (Figure 4).

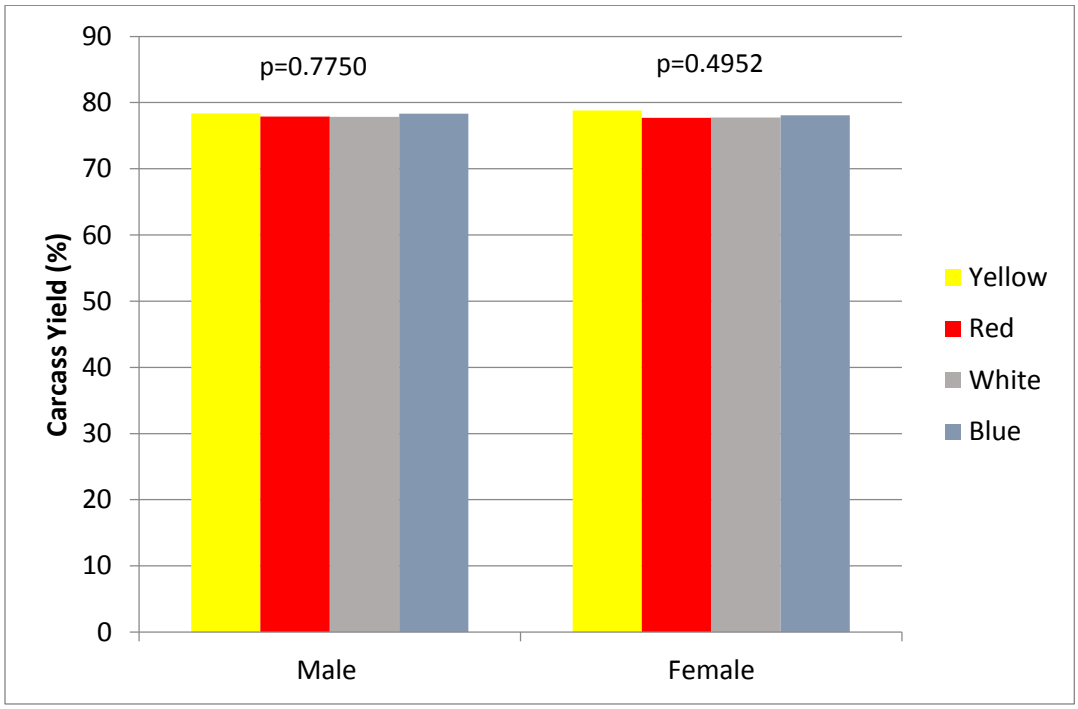

Figure 4. Carcass Yield

Ammonia Emissions

Ammonia emissions were not significantly different between treatments (Figure 5). The average ammonia emission for the experiment was 13.90 mg/m^2/min.

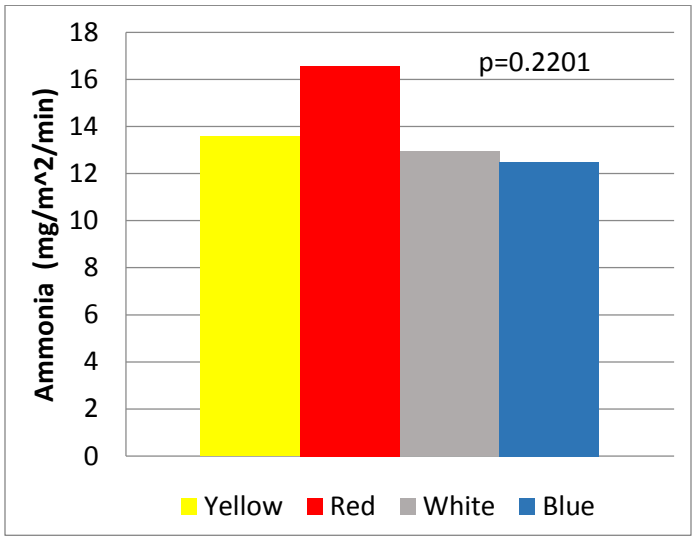

Figure 5. Ammonia Emissions

Chapter 4

Discussion

Research shows that saponins such as those in yucca and quillaja, when fed at an optimum level in a poultry diet, have the potential to increase growth rate and feed efficiency [5]. Saponins as a feed additive have been shown to reduce emission of ammonia from excreta [5].

Research conducted at Southern Poultry Research, Inc. tested the value of NutrafitoPlus in conjunction with a coccidiosis vaccine program. The study found that the addition of NutrafitoPlus to the diet of broilers vaccinated against coccidiosis improved the average weight of 42-day broilers by 72 g and lowered feed conversion ratios by a factor of 5.5 [6].

A study at the International Institute for Animal Research in Mexico showed that the supplementation of NutrafitoPlus caused an improvement in weight gain and feed conversion similar to the effects of antibiotic growth promoters. This study also showed that NutrafitoPlus appeared to lower the ammonia concentration in litter [4].

A study on laying hens fed different amounts of yucca powder revealed no significant effects of yucca saponins on egg production [7]. Hens fed 100 ppm yucca daily had significantly reduced ammonia emissions in the first two days of manure storage [7].

A 1981 study showed that male broilers receiving yucca as a feed additive had significantly larger final weights than the control treatments [8]. This study showed no improvement in ammonia emissions, percent mortality, or feed efficiency of birds receiving yucca compared to the control [8]. However, it raised an interesting suggestion that yucca saponins are most effective on bacteria in stressed conditions [8]. The study theorized that the ammonia levels were low in the experiment, birds were housed in optimal litter conditions, and

the bacteria in the gut and feces of the broilers were not under any stress that could be improved by the yucca saponins [8].

Chapter 5

Conclusions and Applications

In conclusion, for the experiment conducted with prebiotic/DFM and NutrafitoPlus present and absent in the finisher, and with and without NutrafitoPlus, it was found:

1. No differences in body weight gain were found, and average body weight for the straight-run broilers was 2.768 kilograms or 6.102 pounds at 42 days.
2. Birds fed NutrafitoPlus had similar feed intake to those not fed NutrafitoPlus.
3. No differences in feed conversion existed for the birds fed prebiotic/DFM in the finisher or for the birds fed treatments with those additives plus NutrafitoPlus.
4. While percent mortality was not significantly different between dietary treatments, early mortality was greater than desired and seemed to be related to bacterial contamination. Average mortality from 1 – 18 days was 4.630 percent and the overall mean was 7.523 percent. Most of the mortality for the 28 – 42 day period was metabolic in nature (ascites, heart attack, leg problems, etc.).
5. Carcass composition was very uniform, and no significant differences occurred in carcass composition between any treatment groups.
6. No significant difference was found in ammonia emissions from birds fed NutrafitoPlus.

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