The Ag forum
by JONES-HAMILTON CO.
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Effects of PLT® on Ammonia and Broiler Performance as Compared to other Litter Treatments

Project number: PLT® Research Trial JHL-1-98
Location: Colorado Quality Research, Inc., Wellington, Colorado
Duration: January 14, 1998 to March 4, 1998
Protocol Design: Drs. Carey Quarles and Mac Terzich
Investigators: Brent Kim and Dr. Carey Quarles

Summary

This extensive study was conducted under controlled conditions simulating an average commercial poultry production environment to assure data accuracy and statistical significance at Colorado Quality Research, Inc. (an FDA, Good Laboratory Practices (GLP) qualified facility). The objective of this double-blind study was to determine the effects of PLT® - litter treatment on the health and performance of commercial broiler chickens as compared to non-treated litter control pen birds and birds raised in pens with litter treated with two other commercial litter treatments-aluminum sulfate (Alum) and a microbial litter treatment. Research trial JHL-1-96 was a similar trial that determined the efficacy of PLT® treated litter compared to non-treated litter. That trial demonstrated a very significant improvement with the use of PLT® in bird health, performance, and profitability. The findings from this previous study have been published. The findings of the present study are equally favorable for PLT®.

In the present study, a pen trial was conducted with ten replicates to determine the relative ammonia-controlling efficacy of the different litter treatments as compared to each other and non-treated controls. The results of this study show that birds grown in PLT® treated pens had significantly better performance and health parameters when compared to control pen birds or birds from pens treated with the other products. PLT® pens had significantly lower ammonia odor levels throughout the entire grow-out period to controls and other treatments. Birds from PLT® treated pens also had significantly lower foot pad lesions, a higher percentage of grade A carcasses, lower breast blister lesion scores, less airsac lesions, reduced condemnations, and reduced post-vaccination reaction with improved respiratory disease challenge resistance. Litter nitrogen and phosphorus levels were not significantly different between the controls and any of the litter treatment groups. Contrary to suggested claims, Alum treated litter did not have higher nitrogen or phosphorus levels as compared to the control pens' litter or litter from the other treatment pens in this study. Economic benefits from ammonia control with PLT® compared to non-treated controls in this trial included: $112.80/1,000 birds value advantage in weight gain, $239.48/1,000 birds value advantage due to reduced condemnations, $34.32/1,000 birds value advantage for paws due to more birds with Grade A paws, and additional value advantages from a greater percentage of Grade A carcasses and a reduction in breast blisters. As has been shown in previous studies, PLT® more than pays for itself with substantial production cost reductions and increased revenue generation.

Objective

Determine if litter treatments control ammonia odor and if broilers grown on litter treated with Poultry Litter Treatment (PLT®) have improved performance, quality, and profitability when compared with birds grown on untreated litter or litter treated with two other litter treatment products (aluminum sulfate and a microbial litter treatment). Also, to measure the difference in ammonia levels, and litter nitrogen and phosphorus levels, at various intervals prior to and after application of litter treatments.

Note: Aluminum sulfate is a major component in some commercially available litter treatments including the alum litter treatment product used in this study. Alum is

classified as environmentally hazardous by the US EPA and classified by the US Department of Transportation as a Class 9 Hazardous substance. "Research Issues in Aluminum Toxicity" edited by Yokel and Golub, 1997 by Taylor and Francis publishing, Wash. D. C. (202-289-2174) has further details with extensive references regarding toxic effects of aluminum and alum. PLT® and the microbial litter treatments are considered non-hazardous products.

Protocol

General

This study was conducted at Colorado Quality Research, Inc. (CQR) a FDA Good Laboratory Practices (GLP) qualified facility, in concrete floor pens of an environmentally controlled poultry house simulating actual commercial poultry production facilities. All sample collection and evaluation, and other parameters of evaluation in this trial were conducted in a double-blind manner to assure unbiased data accuracy.

Commercial broilers were used for this study with a total of 2,400 male birds, 60 birds per pen in a total of 40 pens with a stocking density of 0.70 sq. ft. per bird with 10 replicates of each treatment. The chicks were all from the same hatchery and breeder source and randomly placed in all pens at 1 day of age and grown to 49 days of age. Ten replicates were done with a total of 600 birds in each treatment. All birds were placed on used wood shaving litter to allow for moderate initial ammonia levels in all pens. The used litter was not top dressed with fresh litter and litter temperature and moisture levels were the same in all pens. Lighting of all the pens was typical for a commercial poultry farm.

All litter treatments were applied prior to bird placement according to the manufacturer directions at their recommended rates for ammonia control of 50 lbs. PLT®/1,000 sq. ft., 75 lbs. alum/1,000 sq. ft., and 0.10 lbs. microbial litter treatment/1,000 sq. ft. Other housing conditions and ventilation were identical for all treatment groups and controls and were typical for commercial broiler production. Average ambient relative humidity levels during the trial ranged approximately from 30%-80% with an average of 45%-50%.

Ammonia Measurement

Ammonia levels in the air at bird level were measured in each pen at the following intervals:

- The day before chick placement (Day -1)
- The day following litter treatment (before bird placement) Day 0 and at 7, 14, 22, and 48 days of bird age.

Ammonia was measured using a Matheson Toxic Gas Detector, Model 8014KA and Precision Gas detector tubes# 105SC (5-260 ppm).

Litter Nitrogen and Phosphorus

Litter samples (approx. 5 oz.) from 6 different locations in each treatment and control pen were collected. These 6 samples were thoroughly mixed together to produce a composite sample from each of the three treatments and the control groups. These samples were sent by overnight courier to Suwannee Valley REC in Live Oak, Florida for phosphorus and nitrogen analysis using standard laboratory procedures. This is a certified lab that routinely assays litter and soil samples for poultry producers to determine, at critical levels, the proper field application rates of manure for nutrient management programs. Samples were collected at the following intervals:

- The day before chick placement (Day -1)
- The day following litter treatment (before bird placement) Day 0 and at 7, 14, 22, and 48 days of bird age.

Litter pH was determined at CQR before and after treatment using a Fisher Accumet pH meter.

Vaccinations

Birds were vaccinated for Marek's disease at the hatchery. Birds were also vaccinated with Newcastle disease and Infectious Bronchitis viruses using commonly available commercial vaccines at l.5x the normal rate via the drinking water at 14 days of age.

Water and Feed

Water was provided ad libitum throughout the study from an automatic hanging bell drinker in each individual pen. Feed was provided ad libitum throughout the study via 17-inch diameter tube feeders. Chick feeder trays were used for the first 6 days. Starter diet was fed from days 0-15, grower diet from 15-37 days, and finisher diet fed from days 37-49. Diet changes were conducted at the same time for all treatment groups.

Diets used for the trial included 23% starter crumble with Sacox-60 g/t & Flavomycin-2 g/t, 20% grower pellets with Sacox-60 g/t & Flavomycin-2 g/t, and 18% finisher pellets with Flavomycin-2 g/t only. All pens received the same diets throughout the trial.

Clinical Observations

At 7 days following the day 14 vaccination and again at the conclusion of the trial, 6 birds per pen were removed and necropsied to score the thoracic air sacs for lesions. The thoracic air sacs were examined and scored as follows:

0=Clear
I= Cloudy
2= Plaque Formation
3= Severe Plaque Formation

Numerous publications and previous CQR trials have demonstrated that these lesions are indicative of resistance level to Newcastle disease virus and Infectious Bronchitis virus challenge and correlate to post-vaccination reaction and ammonia stress.

Performance and Processing Data

Processing data collected at the end of the study (49 days) included:

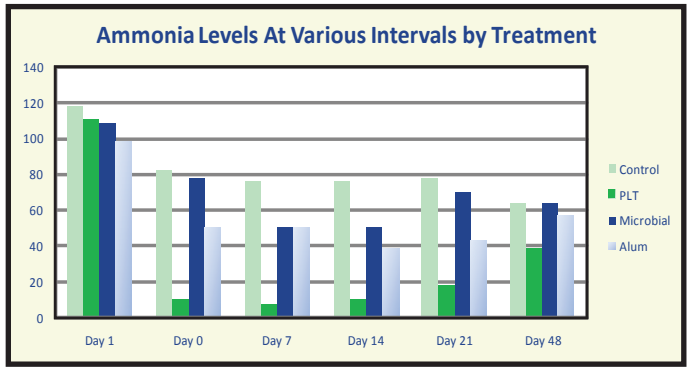
- Individual Bird Weight
- Carcass grade: individual bird evaluation using standard USDA Grades of A, B, C, or Condemned
- Foot pad lesions: individual bird examination and scoring with the following values
  - 0 = normal
  - 1 = pad burn (dermis only)
  - 2 = pad scab (healing)
  - 3 = pad lesion (open sore)
- Breast blister lesions: individual bird examination and scoring with the following values:
  - 0 = no lesion present
  - 1 = small lesion (less than or equal to l/4 inch)
  - 2 = large lesion (greater than 1/4 inch)

Results

All data are represented as an average from all replicates of each treatment group unless otherwise stated.

Ammonia

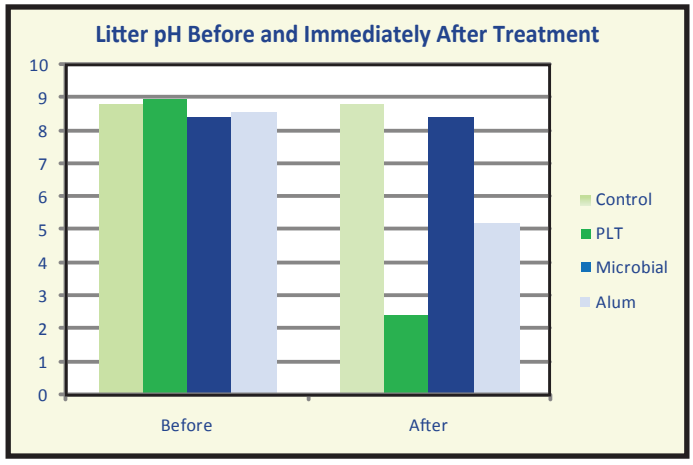
Ammonia Levels At Various Intervals by Treatment



Pens used for all treatments had similar ammonia levels prior to treatment application (day -1). **Pens with litter treated with PLT® had the lowest ammonia** levels immediately following application (day 0) and throughout the entire grow-out (days 7, 14, 21, and 48). The microbial treatment provided the least ammonia control compared to the controls and other litter treatments. PLT® provided the longest lasting ammonia control.

Litter pH

Litter pH Before and Immediately After Treatment



Litter pH was lowest in the PLT® treated pens after treatment.

Litter Nitrogen & Phosphorus

Data represented as Nitrogen (N) mg/kg litter and Phosphorus (P) mg/kg litter. Assays conducted by Suwannee Valley REC, Live Oak, Florida.

Treatment	Day-1 N/P	Day 0 N/P	Day 7 N/P	Day 14 N/P	Day 21 N/P	Day 48 N/P
Control	22500 13700	20000 13150	27000 13550	27000 13400	23000 11300	29000 12600
PLT®	20500 13200	19000 11000	30000 14000	29000 12450	26000 9950	30500 13550
Microbial	26000 13300	25000 12550	29000 15200	28000 12250	25500 11500	30500 12650
Alum	20500 11800	17500 9800	28500 12900	27000 11550	29000 11550	33000 12800

Litter phosphorus levels appear to remain steady in the control pens throughout the grow-out. In the treatment pens, there appears to be little difference in litter phosphorus levels compared to the controls through the grow-out The PLT® pens appears to have the highest numerical value at the end of the grow-out at day 48. The alum or microbial treated litter pens do not have higher phosphorus levels compared to the controls or the other treatments.

Airsac Lesions and Respiratory Tract Integrity

Thoracic airsac lesions were evaluated as a measurement of respiratory tract integrity and disease resistance following ammonia exposure and vaccination. Previous published studies have shown that the greater the ammonia exposure, the greater the respiratory tract damage and therefore the lower the bird's resistance and thus the greater the airsac lesion score. Higher airsac lesion scores relate to more respiratory tract damage and poorer ability of the bird to resist respiratory disease challenges.

Average Thoracic Airsac Lesion Scores

The following lesion scores were collected from individual birds in each pen of each treatment and an average is reported. Lesion scoring is based on a 0 to 3 scoring with more severe lesion at the higher score: 0 = clear, 1 = cloudy, 2 =plaque formation, 3 = severe plaque formation.

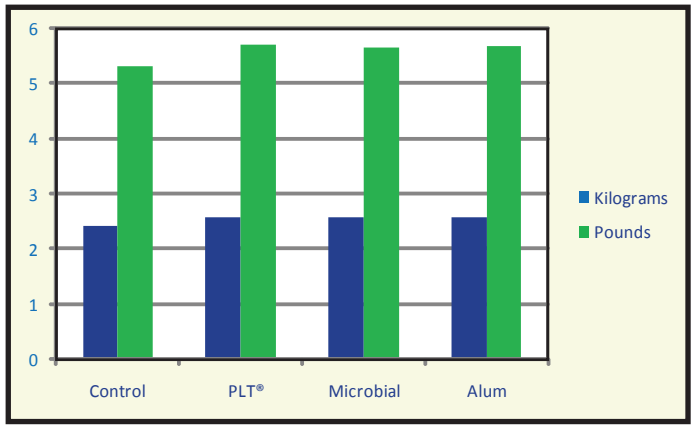
Airsac Lesion Scores

	Day 20	Day 48
Control	0.65	1.09
PLT®	0.18	0.28
Microbial	0.57	0.71
Alum	0.35	0.73

Birds in the PLT® treated pens had the lowest airsac lesion scores at both day 20 and day 48 of the study. Both other litter treatments had high lesion scores. Only the PLT® pen birds had very significantly lower lesion scores compared to the controls. Airsac lesion scores of the PLT® birds reflect the low ammonia levels in the PLT® pens.

Average Bird Weight

Each bird in all treatment groups was weighed at the end of the trial and the following data represent average bird weights for each treatment group.

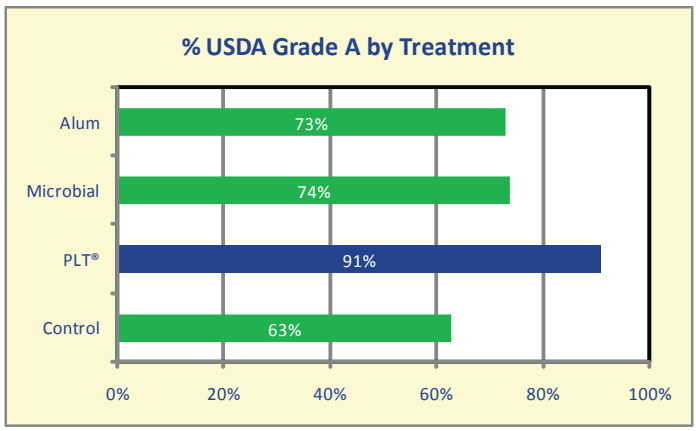


Average Bird Weight at 48 Days (Data represent average weights of 600 birds in each treatment)

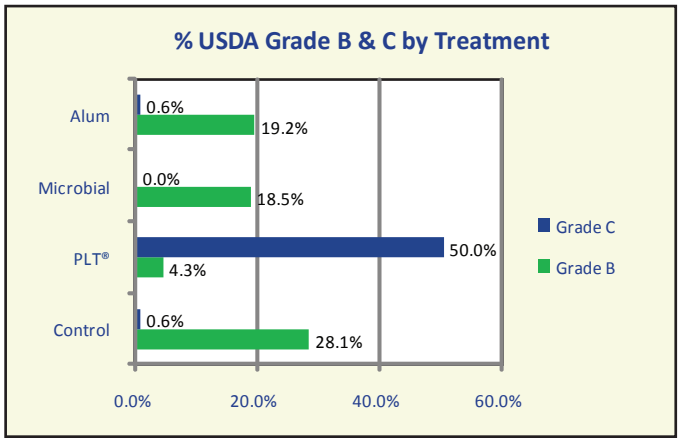
Birds in the PLT® pens had the best weights compared to the controls and the other treatments. Birds in the PLT® pens were an average 171 grams heavier than birds in the control pens. The extra weight in the PLT® pen birds is due to a reduction in brooding stress (less ammonia at time of bird placement) thus allowing the birds to better reach their maximum genetic potential. The birds used energy consumed in the form of feed to add muscle (weight) instead of using the energy to fight stress.

Carcass Grade

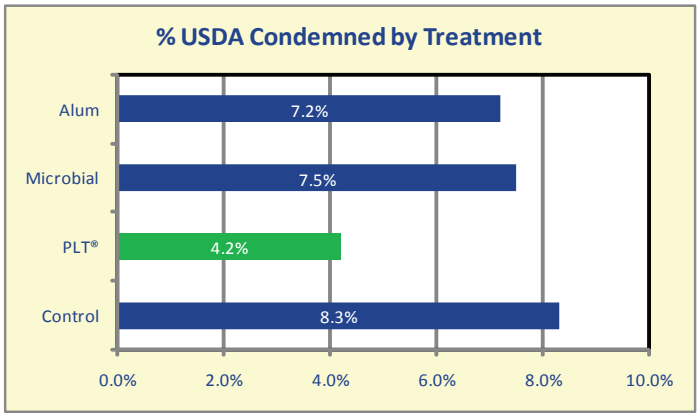
% USDA Grade A by Treatment



% USDA Grade B & C by Treatment



% USDA Condemned by Treatment



More birds in the PLT® treated pens were Grade A, 30% more than the control pen birds and 20% more than both other treatment pen birds. Because so many PLT® treated pen birds were Grade A, there were fewer Grade B and C PLT® birds. Both other litter treatments had an equal number of birds with Grade B. Only the PLT® treated pens bad significantly less condemned birds, pens containing both other treatments had similar rates of condemnation as the control pens.

Foot Pad Lesions

% Foot Pad Lesion Scores by Treatment

Score*	0	1	2	3
Control	10%	11%	40%	39%
PLT®	68%	18%	14%	1%
Microbial	36%	23%	25%	16%
Alum	48%	32%	17%	3%

*Scores: 0 =normal, 1 =pad burn (dermis only), 2 =pad scab (healing),3 =pad lesion (open sore)

Lesions were observed at a higher rate in the Alum and Microbial litter treatment groups compared to the PLT® treated pens.

Birds in the PLT® treated pens had significantly lower incidence of foot pad lesions and those with foot pad lesions in the PLT® pens had much lower scores than any other group. Note that the control pen birds have high scores of 2 and 3 relating to more severe foot pad lesions. Only 10.3% of the control birds had no foot pad lesions as compared with 67.5% of the PLT® birds with no foot pad lesion.

The PLT® birds had the lowest percentage of incidence of lesion scores 1, 2, and 3 than any of the other treatment groups. The reason for the high percentage of PLT® birds with no lesions and lower overall lesion scores is the lower ammonia levels and lower litter pH values in the PLT® pens compared to all other treatment group pens.

Breast Blisters

% Breast Blisters by Treatment

Score*	0	1	2
Control	77.4%	5.0%	17.6%
PLT®	96.8%	2.6%	6.0%
Microbial	86.3%	4.4%	9.3%
Alum	88.6%	4.7%	6.7%

*Scores:0 = no lesion, 1 = small lesion < 1/4 inch, 2 = large lesion > 1/4 inch

A significant percentage of PLT® birds had no breast blisters compared to the controls and the other treatments. Also noteworthy is the high percentage of birds with severe breast blisters in the Alum and Microbial treatment groups. The reason for the lack of lesions in the PLT® birds is because of the significant reduction of

ammonia and litter pH in the PLT® pens compared with the control and other treatment pens.

Economic Evaluation

An assessment of the value of using PLT® vs. controls

Average Weight

	Average Weight	Wt./1000 Birds
Controls	5.326	5,326
PLT®	5.702	5,702
Microbial	5.671	5,671
Alum	5.687	5,687

Bottom Line Economics

PLT® birds had a weight advantage of 376 lbs. over the controls per 1000 birds. At an average cost per pound of 99 cents a pound (Feedstuffs, July 15, 2013), **the extra live weight produced by using PLT® results in an additional $372.24 per 1,000 birds**. With the average delivered cost of PLT® subtracted from this, the advantage per 1,000 birds is $363.49 (average delivered cost of PLT® is about $.00825/bird for entire house application prior to bird placement). PLT® birds had a $6.00/1,000 advantage over alum treatment birds and a $12.04/1,000 advantage over the microbial treatment birds.

USDA Condemnations

PLT® birds had 50% fewer condemns than the controls and 43% fewer condemnable lesions than the other treatments. At the average weight of 5.702 lbs. per PLT® bird listed previously, **the PLT® birds had 239.48 lbs. more salable weight** than the controls due to the reduction of condemnations in the PLT® birds. At 99 cents a pound (Feedstuffs, July 15, 2013) this amounts to a PLT® advantage of $237.07/1,000 birds. When the average delivered cost of PLT® is subtracted the PLT® advantage is $228.76/1,000 birds due to reduced condemnations and more salable weight. Only the PLT® birds had significantly fewer condemns compared to the control. The other treatments had similar numbers of condemns compared to the controls and therefore have no significant economic advantage.

Foot Pad (Paws) Lesions

Paw Economics per 1,000 birds*

	% Grade A	$ Value	Advantage vs. Control
Control	10.3	$6.18	
PLT®	67.5	$40.50	$34.32
Microbial	35.6	$21.36	$15.18
Alum	47.8	$28.68	$22.50

*1000 broilers= 187.5 lbs. paws, calculated as 1.5oz./paw (3.0 oz./ bird) for average broiler

Bottom Line Economics

Grade A paws (lesion score of 0) have a value of 32 cents per pound. In this trial, the PLT® birds had 67.5% Grade A paws. The control birds had 10.3% Grade A paws. The value for paws from 1,000 PLT® birds is $40.50 and from 1,000 control birds $6.18. The PLT® birds had an average increase in paws value per 1,000 birds compared to the controls of $34.32. This is a very significant difference in the value of grade A paws compared to the controls and a significant difference in value compared to the other treatments.

Birds grown on PLT® treated litter have a very significant value of paws of $40.50/1,000 birds, a value advantage of $ 34.32/1,000 birds vs. birds grown on non-treated litter (controls).This amount is equal to $32.25/1,000 birds when the cost of PLT® is deducted.

Conclusions

In this study, PLT® controlled ammonia better and longer than other litter treatments and non-treated controls. Due to these factors, birds grown in the PLT® treated pens had significantly better performance and profitability compared to controls and other litter treatments. Economically, PLT® generated increased revenue due to increased weight gain, decreased foot pad lesions, improved carcass grade, and reduced breast blisters and condemnations. PLT® was found to be the most cost-effective and longest lasting ammonia controlling litter treatment.

Ammonia

PLT® virtually eliminated ammonia immediately upon application. Only the PLT® pens had significantly less ammonia than the control pens through the entire trial at all sampling times. Even at the end of the trial, at day 48, the PLT® pens had significantly less ammonia than the control pens or pens treated with both other litter treatments.

The significant immediate and long-term control of ammonia in PLT® treated pens provides a less stressful environment for chicks at the time of placement. The other litter treatments did not provide this ideal brooding environment due to the high ammonia levels at the time of bird placement.

Litter pH

Litter in the PLT® treated pens had significantly lower pH value (acidic) than the other litter treatments and controls.

Litter Nitrogen & Phosphorus

Litter analysis revealed no significant difference in nitrogen or phosphorus levels in any of the treatment groups when compared with the control groups. The PLT® pens had the highest numerical levels of nitrogen and phosphorus at the end of the trial. In this study, there appears to be no difference in litter phosphorus binding capabilities among the different treatments when compared to controls.

Airsac Lesions

PLT® pen birds were the only birds with significantly lower airsac lesion scores compared with the controls. PLT® provided a less stressful, lower ammonia, environment than other litter treatments and non-treated environments. The birds in the PLT® pens had greater resistance to respiratory disease challenge and less respiratory tract damage following challenge leading to less vaccination reaction, improved bird health and performance, and improved production profitability.

Average Weight

Birds grown in the PLT® pens had better weight gain compared to birds in the other treatment pens and the control pens. In this study birds grown in PLT® treated pens had an average of 171 grams more weight than birds in the control pens. Improvement in weight gain in PLT® birds resulted in $372.24/1,000 birds in increased revenue with PLT®.

Carcass Grade

Birds from the PLT® treated pens bad a significantly higher percentage of Grade A carcasses, Almost 20 % more birds were Grade A in the PLT® treated groups compared to the alum or microbial treatments and almost 30% more than the control pen birds.

Because more birds in the PLT® pens were Grade A, there were significantly less birds with Grades B or C in the PLT® treated pens when compared with the control pens or the other litter treatment pens. Birds in the alum and microbial treated pens had the same incidence of birds with Grades B and C as the control.

Condemnations

Only birds in the PLT® treated pens had a significantly lower condemnation rate compared with the control pen birds. The condemnation rate of the PLT® birds was about half of the control birds or either of the other litter treatment pen birds. Increased revenue generation due to reduced condemnations in the PLT® birds resulted in $237.07/1,000 birds from a greater amount of salable weight.

Foot Pad Lesions

A very significantly higher percentage of PLT® pen birds had no foot pad lesions compared to the controls due to greater ammonia control in the PLT® pens. A significant percentage of birds from the PLT® pens had no foot pad lesions compared to both of the other treatments. Birds from the alum treated pens had more severe lesions compared to the PLT® birds. Birds from the microbial treatment pens had more severe lesions compared to the PLT® birds and also very significantly higher lesion scores of 3 representing open sores on the foot pad. A greater percentage of Grade A paws on the PLT® birds resulted in $40.50/1,000 birds in greater revenue generation by using PLT®.

Breast Blisters

Almost 97 percent of the PLT® birds had no breast blisters due to better ammonia control as compared with only 86 and 89 percent respectively for the microbial and alum treated pen birds. Both of the other treatments had a significantly higher percentage of birds with small lesions compared to PLT® birds and a very significantly higher percentage of birds with large lesions compared to PLT® birds.

Economics

The economic advantage of growing broilers on PLT® treated litter, as demonstrated in this study, was very significant. In this study the benefits of using PLT® to grow broilers and reduce ammonia were many times greater than the cost of PLT®. The average delivered cost of PLT® in the US is about $8.25/1,000 birds when PLT®

is applied to the entire house prior to bird placement. The benefits demonstrated in this trial includes $372.24/1,000 in increased weight gain, $237.07/1,000 in more salable meat due to less condemnations, and $40.50 increased value in paws. Also, significantly more PLT® birds had Grade A carcass quality and a significant reduction in breast blisters adding to the economic value of using PLT® to grow broilers. In addition to these economic advantages of PLT®, previous studies have demonstrated significant production cost savings of using PLT® including fuel savings up to 40% due to ammonia reduction.

There were no known circumstances that may have affected the data quality or integrity during this study. The report and data herein are accurate in that they represent the actual results of the study, and were collected in a manner which did not misrepresent the true effects of the test articles. A signed release statement is on file from the investigators and is available upon written request.

Test articles were used in a manner consistent with each manufacturer written publicly available instructions and were applied in a manner consistent with typical poultry industry standards. This study was conducted under conditions typical for commercial poultry production. The protocol and daily procedures during the trial were evaluated and monitored critically to equally evaluate all products and parameters.

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