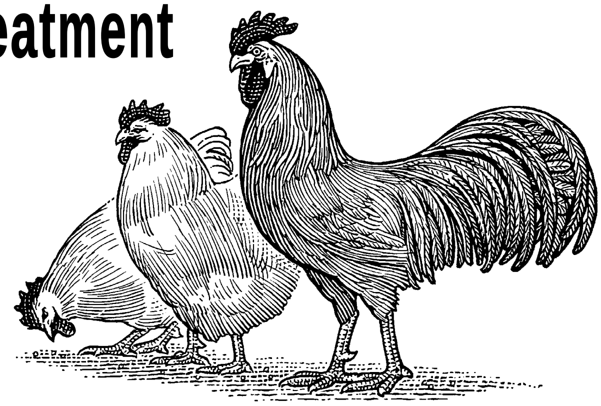
CURRENT CONCEPTS IN WINTER 2001

Broiler Production

Aluminum Sulfate as a Litter Treatment



Ammonia (NH_3) is produced as a gas from poultry manure by the breakdown of uric acid. The gaseous emission of NH_3 can be inhibited if converted to NH_{4+} (ammonium), which can be accomplished by lowering litter pH. Aluminum sulfate, commonly referred to as alum, is an acid that produces hydrogen ions (H^+) when it dissolves, and the hydrogen ions produced by this reaction will attach to ammonia to form ammonium, which further reacts with sulfate ions to form ammonium sulfate—$(NH_4)_2$ SO_4. Ammonium sulfate is a water-soluble fertilizer. Because of these reactions, the amount of ammonia emitted from the litter will be reduced, which will increase the nitrogen (N) content of the litter. Alum addition to the litter will also result in the precipitation of soluble phosphorus and thus reduce phosphorus runoff. The use of alum in broiler-litter management can potentially impact performance and environmental concerns.

Poultry producers have been using alum to improve poultry production and reduce negative effects of litter on the environment. Research has shown that alum applications to poultry-litter control ammonia volatilization and reduce phosphorus runoff from land fertilized with litter. Benefits from using alum as a litter treatment include the following:

- Decreased house ammonia levels
- Reduced energy usage
- Improved bird performance
- Reduced phosphorus and heavy metal runoff from litter application
- Reduced litter moisture due to a drying effect
- Precipitation of soluble phosphorus

For best results, alum should be applied to the litter between flocks, starting after the first flock but before the second flock. Application should be made before each subsequent flock. This will give maximum control of ammonia, when the birds are young and most sensitive to atmospheric ammonia. Higher rates will control ammonia for longer periods as well as tie up additional phosphorus.

A rate of 50 to 200 pounds of alum per 1,000 square feet of floor space is the typical recommendation for the treatment of broiler litter. For most broiler houses, this will equate to one to two tons of alum per house for each grow-out. A lower rate of 50 lbs/1,000 ft^2 will control ammonia during the first few weeks of a grow-out, but has a limited effect on reducing the soluble phosphorus in the litter. At the rate of 200 lbs/1,000 ft^2, ammonia levels and soluble phosphorus levels will be significantly reduced. Rate selection for an individual's operation will be dependent on current management practices and needs based on such factors as ventilation control and litter moisture levels. Higher rates are recommended where high ammonia conditions prevail. Prior to alum application, the broiler house needs to be de-caked or rototilled. Afterward, alum can be broadcast at the chosen level using a decaker or drop spreader. Before birds are placed in the house, alum spills or concentrated areas should be raked into the litter to prevent consumption by the young birds. During application, gloves should be worn to prevent skin irritation and burns. Goggles should be worn for eye protection, and a dust mask should be worn to prevent inhalation of the alum dust.

Research has demonstrated cost savings to the poultry producer from the use of alum. Cost savings can be realized due to a reduction in heating and ventilation costs and improvements in performance. Alum treatment of litter will increase the nitrogen content of the litter, creating a more valuable source of fertilizer. A major environmental benefit of treating litter with alum is the reduction in soluble phosphorus and trace minerals such as copper and zinc. Restrictions on phosphorus application rates will occur in the future, and alum is a useful tool for the poultry producer to ensure the success and longevity of his operation.

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AU Notes

With the passage of Amendment 1 on November 7, the final piece of the puzzle is in place for the funding of the Poultry Science Building. Monies will also be made available for the State Diagnostic Lab, Vet School projects, Forestry, and the Animal Science Department. Thanks to all who supported this initiative. With luck, bids will go out in March for the building, and we will be scratching dirt by late spring or early summer. We have not seen a timetable on building or repairs for the Diagnostic Lab or other projects.

Betaine as a Feed Ingredient for Broilers

Practical feed formulation for commercial broilers dictates that feeds be developed to optimize live performance and product yield in the most economical manner possible. This is accomplished partly by a judicious use of feed ingredients to maximize nutritional and other benefits to the bird and the operation as a whole. Broiler feeds are, by nature, relatively nutrient dense to foster the growth efficiency that broiler companies have come to demand. Due to this, feed ingredients that offer nutrient density in several nutrient categories, or have other unique field benefits, are prized by those charged with formulating broiler feeds. Betaine, as a feed ingredient, is an excellent example of this concept.

Betaine the feed ingredient has received considerable attention regarding inclusion in animal feeds, particularly in recent years. The broiler industry in the U.S. has evaluated the inclusion of betaine in broiler feeds, and many operations have incorporated betaine into their feeding regimens. In addition, benefits to human health have opened markets for this product within the human nutrition area.

Betaine the nutrient has been well characterized with regards to its role as a methyl donor. Betaine, choline, and methionine provide methyl groups for the methylation of homocystine. In practice, choline must be converted to betaine for the methyl group to be available for this important biochemical pathway. In addition, betaine has systemic and cellular properties that make it attractive as a nutritional supplement for poultry.

An important function of betaine within plant tissues is cellular osmotic protection. The osmolyte properties of betaine protect plant cells from stress due to freezing, drought, or salinity. Those same properties can potentially benefit poultry nutrition and the protection of cells within the bird from various stresses and insults. Areas of interest for the poultryman include protection of the digestive tract during parasitic infection, modulation of intestinal contents and gut integrity to reduce carcass contamination, improvements in live performance due to improved intestinal health, improvements in meat yields due to enhanced moisture uptake during processing, and reduced weep loss.

Betaine as an Osmolyte

The methyl donor qualities of betaine allow poultry nutritionists to use betaine in an efficient manner in broiler feeds as an ingredient in least-cost formulations. This is an important advantage to the nutritionist. The osmolyte functions of this feed ingredient, however, bring added value with regards to live performance and processing results.

Maintaining bird health is a constant balancing act in broiler live production. One important aspect of disease control is maintaining intestinal health. Broiler companies individually spend hundreds of thousands of dollars per year controlling coccidiosis and related bacterial diseases of the gut. Recent research from a number of labs indicates that dietary betaine helps reduce the severity of the coccidiosis challenge. Work at Auburn indicates that broilers given a known dose of *E. acervulina* and fed betaine showed better gains, improved fecal scores, and improved gross lesions as compared to birds given coccidia without betaine. In our work, no improvements were seen if a coccidiostat (Narasin) was included in the feed, although other researchers have reported improvements with other coccidiostats. More importantly, betaine is giving some measure of support to intestinal cells to reduce the impact of coccidiosis. This biological activity of betaine may well work synergistically with most coccidiosis control programs. Additionally, many bacterial diseases of the gut, such as necrotic enteritis, are triggered by cellular damage due to coccidiosis. Better protection of intestinal cells may help in reducing these related bacterial problems.

Betaine and Processing

In the United States, cutup and deboned meat dominate broiler markets. For this reason, factors affecting meat yields have an inordinately large impact on profit. Research completed at Auburn indicates that betaine in the feed or water can impact water uptake and weep loss of whole carcass and deboned meat. Improvements in moisture retention may be an important tool in improving yield of deboned meat and insuring juiciness and textural quality in the final product. In addition, betaine supplementation may reduce live shrink or moisture lost by birds during the feed withdrawal period prior to processing. Ongoing research at Auburn is designed to further explore the use of dietary betaine in maintaining tissue moisture and product quality. Weep loss, moisture-holding capacity and cooking losses are of particular interest in the current trial.

Contamination of carcasses by intestinal content is an important issue in the U.S. broiler industry as companies implement HACCP programs and microbiologically based monitoring programs. Betaine's effects on intestinal quality may help avoid intestinal tearing during mechanized evisceration. Field research indicates that there may be measurable differences in the force required to tear small intestinal tissue when birds are fed betaine.

Conclusion

Betaine can function as a methyl donor, allowing it to be included in feed formulations in an economical way. In addition, the osmolytic functions of betaine offer a myriad of potential benefits in cellular protection and moisture retention. These benefits may aid poultry companies in areas of major concern regarding bird health or product quality.

Joe Hess of the Auburn University Poultry Science Department provided this information.

Fertility, Hatchability, and Point Spread: Breakout Analysis

Hatchability in the United States Broiler Industry continues to average in the neighborhood of 82.5 percent. Although true fertility remains as the greatest loss category, embryonic mortality patterns often create concern with regard to incubation requirements as genetic selection in yielding strain crosses evolve. Some data suggest that the requirements of the embryo are changing as we select for performance in the broiler progeny. A recent review of the impact of incubation on embryonic mortality with yield genetics is well worth reading (Hill, 2000. Multistage incubation and yield genetics, Poultry Digest, 59(5): 14-20). Hill contends that multistage incubation targets the average ovic embryo, and variation in incubation requirements increases in embryos from older and younger flocks with selection increases in yield genetics. Additionally, as the number of nonviable eggs (i.e., infertile, early dead) increases as a percentage of eggs set, the impact on the difference in machine temperature and temperature required for incubation may play a significant role. Obviously, the industry will continue to target yield genetics and struggle with fertility in parent flocks. This poses several questions for the future in the breeder phase of live production: (1) Will it be practical to chase incubation requirements on the basis of variation in embryos from different breeder flocks? (2) Will it be necessary to remove nonviable eggs during the incubation process to negate their impact on machine operation? (3) Would higher and more consistent fertility limit the negative impact of variation in incubation requirements, and can such fertility levels be obtained? Answers to these questions will require some extensive research efforts. Will such answers lend themselves to practical implementation at the commercial level? Time will tell.

Information in the following tables reflects fertility, hatchability, and point-spread figures from the analysis of 298 egg breakouts of yielding-type breeders. Figures are divided into breeder flock ages as follows: 30 weeks or younger, 31 to 39 weeks, 40 to 49 weeks, and 50 weeks and older. Candling was conducted at 10 or 12 days of incubation; any embryonic mortality to that time was designated as early dead. The remaining losses in incubation were calculated by subtracting actual hatch from true fertility less the early dead. Point spread, of course, is the difference between true fertility and actual hatch. The (N) value represents the number of breakouts for flocks in each age range. The key to abbreviations in the following tables is as follows: TF = true fertility; ED = early dead; AH = actual hatch; PS = point spread; HF = hatch of fertiles; and MD/LD/P/C = the total of mid-dead, late dead, pips, and culls.

Mike Eckman of the Auburn University Poultry Science Department provided this information.

Table 1. Average All Flocks (N = 298)

TF - 94.96
ED - 5.20
AH - 81.54
HF - 85.86
PS - 13.42
MD/LD/P/C - 8.22

Table 2. All Flocks 30 Weeks and Younger (N = 20)

TF - 93.88
ED - 6.27
AH - 77.96
HF - 83.0
PS - 15.92
MD/LD/P/C - 9.65

Table 3. All Flocks 31 to 39 Weeks (N = 73)

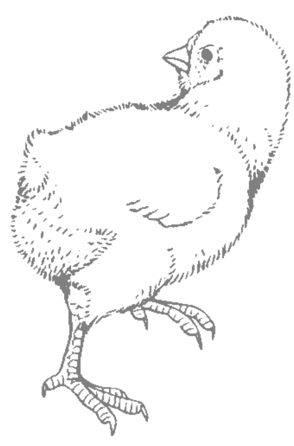
TF - 96.56
ED - 5.10
AH - 84.05
HF - 87.04
PS - 12.51
MD/LD/P/C - 7.41

Table 4. All Flocks 40 to 49 Weeks (N = 95)

TF - 96.46
ED - 4.23
AH - 84.57
HF - 87.76
PS - 11.89
MD/LD/P/C - 7.66

Table 5. All Flocks 50 Weeks and Older (N = 110)

TF - 92.95
ED - 5.20
AH - 79.58
HF - 85.61
PS - 13.37
MD/LD/P/C - 8.17



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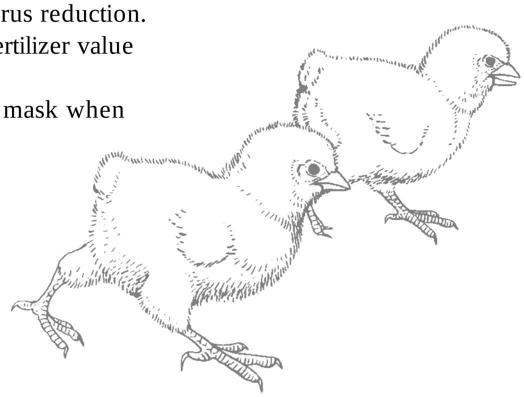
Using alum-treated litter as a fertilizer has no effect on aluminum uptake by plants. Aluminum is one of the most common elements found in soil and can be found in ranges from one to ten percent of the soil. Alum-treated litter will not significantly increase soil aluminum content.

Summary

- Using alum as a litter amendment can effectively reduce in-house ammonia volatilization and improve performance.
- Between 50 and 200 lbs/1,000 ft^2 of alum will provide ammonia control and soluble phosphorus reduction.
- Alum does not negatively impact the fertilizer value of litter.
- Wear protective gloves, goggles, and a mask when applying alum.

This information was provided by John P. Blake and Joseph B. Hess of the Auburn University Poultry Science Department and is reprinted from the Alabama Cooperative Extension System Timely Information Sheet of the same name.



Research Shorts

Recent Research of Interest to Poultry Managers

1. M.H. Henry, R.D. Wyatt and O.J. Fletcher, 2000. The toxicity of purified fumonisin B_1 in broiler chickens. Poultry Science 79:1378-1384.

This trial found few economic effects of pure fumonisin on broiler health and growth. Previous trials used a culture material that may contain a number of toxins and metabolites. This trial shows that effects of contaminated grain on birds are probably from one of the other components of the growth of these molds.

2. May, J.D., B.D. Lott and J.D. Simmons, 2000. The effect of air velocity on broiler performance and feed and water consumption. Poultry Science 79:1396-1400.

This trial points out the benefits of air movement (in this case, around 400 ft^2/min.) on broiler performance (body weight and feed conversion). Birds on high airflow from 21 to 49 days of age ate more feed and drank less water than birds on a conventional airflow system.

3. Johnston, S.L. and L.L. Southern, 2000. The effect of varying mix uniformity (simulated) of phytase on growth performance, mineral retention, and bone mineralization in chicks. Poultry Science 79:1485-1490.

In this experiment, the authors switched feeds daily to vary the amount of phytase in the mix. Growth and feed conversion were not affected, while bone strength was only reduced with the highest swings in phytase level.

4. Fetrow, J., E-education lets ag sector target midcareer need. Feedstuffs, 72(44):22-23.

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