CURRENT CONCEPTS IN FALL 1995

Broiler Production

New Test Could Result In Safer Poultry Products

A food safety regulation proposed Feb. 13 by the USDA Food Safety and Inspection Service (FSIS) calls for a number of mandates for meat and poultry processors, one of which is that all carcasses processed must be given at least one antimicrobial treatment. An AAES research project has developed a new test that can be used to identify effective treatments to meet the industry and USDA goal of reducing pathogens on meat and poultry products.

FSIS officials proposed the Pathogen Reduction: Hazard Analysis Critical Control Point System, which has been dubbed the "Mega Reg." The antimicrobial treatments it outlines may include chlorine, trisodium phosphate, hot water or organic acids. An AAES research effort has confronted the bacterial contamination problem by investigating the attachment of Salmonella to poultry skin. These studies led to the development of a novel method for providing relatively quick and accurate evaluations of acid-based and other treatments that show potential for use in poultry processing.

Bacterial contamination of poultry during processing is unavoidable. Chickens naturally carry a wide variety of bacteria into the processing plant. Some of these bacteria are transferred to the surface of the chicken during processing. Most of the bacteria do not cause disease but do decrease the shelf-life of poultry. However, bacterial pathogens such as Salmonella, Campylobacter jejuni and Listeria monocytogenes can be transmitted to humans who eat improperly handled poultry. Certain processing steps (carcass washing and immersion chilling effectively reduce, but do not completely eliminate, bacterial contamination of poultry skin. Data collected in AAES studies indicated that 47% of broilers obtained from retail sources were contaminated with C.jejuni, and a survey of freshly processed broilers showed that 17% were contaminated with Salmonella, albeit at low numbers.

Many novel antimicrobial treatments for broiler carcasses have been tested and reported in the past, but few, if any, have been adopted by the industry.

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AU Notes

The Southeastern Poultry and Egg Association has recognized Auburn University as one of six key institutions involved in providing people with undergraduate and graduate training for the poultry industry. These institutions have been provided funds by the Southeastern Poultry and Egg Association specifically to promote the recruitment of quality undergraduates into their poultry programs. Auburn's Poultry Department has chosen to use these funds in several ways to increase the number and quality of students we graduate.

In July, the Poultry Science Department hosted 25 high school science and ag business teachers from across the state for a 2-day program designed to demonstrate the importance of poultry to Alabama's economy. Participants were schooled on poultry programs at Auburn and updated on the wide range of job opportunities available in the poultry area. It is hoped that by arming key contacts at Alabama schools with this information, a greater percentage of students looking for a challenging career in science or agribusiness will consider the poultry industry and Auburn's Poultry Science Program. In other words, we are busy "putting the word on the street"

In addition to the summer program, monies are being put into updated brochures to be distributed to potential students, and into internships at the State Diagnostic Laboratory for pre-vet students interested in poultry.

Dr. Robert Norton has joined the Poultry Science Department faculty as an assistant professor in microbiology. He joins Drs. Connor and Hinton in researching this broad and important discipline. Dr. Norton's area of specialization is enteric or gut bacteria, and his recent research includes efforts to determine the effects of microbes in the feed on gut health.

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Positive results in the laboratory have seldom been translated into favorable results in the processing plant This discrepancy is likely due to a lack of standardized testing methods, as well as to the natural process by which bacteria attach to the poultry skin.

Most traditional laboratory tests examine the numbers of bacteria in the water used for poultry processing chill and scald baths. However, bacteria imbedded in follicles of the chicken skin are much better able to survive most disinfectant treatments. The "skin attachment model" (SAM), which resulted from the AAES project, allows for testing of antimicrobial agents against skin-attached bacteria. SAM allows researchers to target specific pathogens without interference from background microbes. It also allows for increased recovery of sublethally injured cells, which helps to avoid "false-negative" test results. Favorable SAM results are more likely to translate into success in subsequent processing plant experiments.

SAM has been used to quantify the effectiveness of generally-recognized-as-safe (GRAS) organic acids against Salmonella that are attached to poultry skin. Acetic, citric, lactic, malic, and tartaric acids have been evaluated at concentrations of 0.5-6% when applied in simulated chiller, dip and scalder conditions. In general, anti-Salmonella activity increased progressively as concentration increased, and it was greatest in chiller and scalder conditions.

Data from these experiments established the bactericidal activity of the tested acids (see table). At 0.5% and 1% some activity was noted, but concentrations of 2% or more were required to kill more than 100 Salmonella bacteria on each skin sample. About 25% of the chickens sold at supermarkets have Salmonella but usually less than 100 cells per chicken. Therefore, any treatment that kills more than 100 cells per piece of skin is considered highly effective. However, at concentrations of 2% or more, cost and skin discoloration become obstacles to the commercial applicability of organic acids as sanitizers for ready-to-cook poultry. Therefore, means of enhancing the effectiveness of low levels of organic acids need to be found to circumvent cost and quality problems.

The organic acids also were tested against Salmonella bacteria freely suspended in water. In contrast to SAM results, most acid treatments rapidly killed more than a million free-floating Salmonella bacteria. This difference clearly demonstrates that Salmonella attached to or embedded in broiler skin are resistant to or protected from the lethal effects of organic acids. Therefore, any means of improving the effectiveness of organic acids should attack this protective effect. It is likely that the high lipid content and topography of chicken skin are the primary protective factors. Thus, the use of "transdermal" agents may increase the number of bacteria killed by enhancing delivery of the acids to attached or embedded pathogens.

Much of the information on transdermal delivery of antimicrobials is found in the pharmaceutical area. However, many pharmaceutical transdermal agents are emulsifiers, which allow for mixing of lipid and water phases. Emulsifiers are widely used in food applications.

Current AAES efforts are focused on improving the effectiveness of low organic acid concentrations. By determining efficacy and factors that affect bactericidal activity, it is likely that treatments can be further adapted for processing plant and field experiments.

This information was prepared by D. E. Conner and K. C. Tamblyn of Auburn's Poultry Science Department and is reprinted from Highlights of Agricultural Research, Vol 42(l) p. 15.

Percent Reduction In The Number Of Live Salmonella Bacteria After GRAS Organic Acids Applied In Three Simulations.

Acid	Application[1]					
	Chiller		Dip		Scalder	
	Loose	Firm	Loose	Firm	Loose	Firm
Acetic	37	60	0	0	95	98
Citric	75	88	0	0	92	97
Lactic	92	84	37	50	98	99
Malic	98	98	0	0	92	96
Tartaric	60	84	0	0	80	98

[1]In the chiller treatment, samples were submersed in water at 0°C for 60 minutes; dip, 23°C for 15 seconds; and scalder, 50°C for 2 minutes. The "Loose" columns represent the numbers of cells recovered from rinse water following acid treatments. The "Firm" columns represent numbers of cells recovered from shin after acid treatment and rinse. This table shows the average batericidal activity of the acids across all concentrations.

Current Concepts In Broiler Production is a publication of the Alabama Cooperative Extension Service with the cooperation of the Department of Poultry Science at Auburn University. This publication is designed to provide new and emerging concepts and information to those involved in broiler and breeder production.

Information on management, feeding, and disease will be compiled from research underway at Auburn University, as well as from other sources. New technologies and practices will be highlighted as they become available.

Fermentation Of Poultry Carcasses

Disposal of poultry by-products has been identified by the poultry industry as a high priority. Poultry producers must plan and manage their operations in a way that is safe for the environment. Poultry wastes including dead birds can cause problems in the environment and can create hazards to human and animal health, if improperly managed. It is the responsibility of poultry producers to ensure that by-products from their birds are being utilized in accordance with voluntary compliances based on best management practices.

Poultry carcasses resulting from death by natural occurrences must be disposed of daily by environmentally and biologically safe methods. Past carcass disposal practices generally have been considered biologically, environmentally or economically unacceptable. Improper disposal often promotes groundwater contamination as well as the spread of infectious diseases. Such methods include dumping into open pits, waterways or abandoned wells and feeding carcasses to livestock. In contrast, burial pits, incineration, composting and rendering are currently acceptable and legal methods of carcass disposal.

Burial in a pit is the most common method employed by poultry producers, but is becoming less desirable because pits fill quickly and carcasses are slow to decompose. Residue remaining in pits after years of use or in soils with high groundwater tables may reduce surface and groundwater quality and pose a serious problem. In Arkansas, legislation has been enacted to prohibit use of burial pits.

Incineration is also a widespread method of disposal that has been adopted by the poultry producers. No disease can escape the incineration process. However, incineration is slow and expensive and generates nuisance complaints, mainly due to odors. Incinerators also produce particulate air pollution.

Composting has emerged as an alternative that provides an environmentally and biologically safe method of converting daily mortality losses into humus-like material useful as a soil amendment. Testing and adoption of composting as a method for the disposal of poultry carcasses began in Alabama in 1989. Subsequently, methods for composting poultry carcasses have been approved by the State Veterinarian's Office and Alabama poultry farmers have constructed more than 800 carcass composting facilities. Composting is a desirable environmental and economic option and has gained widespread acceptance among many poultry producing states.

Rendering can be used as a method to convert poultry carcasses into a valued feed ingredient. Removing poultry carcasses from the farm is acceptable for the environment; however, the spread of diseases during routine pickup and transportation of poultry carcasses to a rendering facility may present a substantial threat to farm biosecurity. Farm-to-farm pickup on a daily basis or short-term freezing on the farm offer potential for allowing the movement of carcasses to a processing facility; however, both methods are expensive. Moreover, disease causing-organisms are not killed.

Fermentation of carcasses offers a means of on-farm preservation for subsequent recovery and recycling into a feedstuff. Dr. Dobbins from the University of Georgia first proposed lactic acid fermentation of carcasses as a biosecure method for recycling carcasses in 1984. Since then, research on this subject has been conducted in the states of Georgia, Alabama, Maryland, North Carolina and Pennsylvania.

Initial investigations into the fermentation of poultry carcasses began at Auburn University in 1990. Fermentation of poultry carcasses requires the grinding of carcasses into small particles. During grinding a fermentable carbohydrate such as sugar, whey, molasses or corn is added and mixed with the carcasses. The mixture is fed into an enclosed tank.

During fermentation, sugars in the carbohydrate source are converted into organic acids, i.e. lactic acid, by gut bacteria which lowers pH to below 5.0 and preserves the carcasses within 3 to 5 days. Disease-causing organisms associated with the carcasses are killed or inhibited during the fermentation process due to the decrease in pH. Since fermented material can be stored and will remain in a stable state for several months, it can be accumulated until there is a sufficient amount to war rant the cost of transportation to a rendering facility.

In March 1992, an experimental fermentation facility was constructed on a commercial broiler farm housing 68,000 birds in four houses to demonstrate the feasibility of on-farm fermentation of poultry carcasses. The on-farm fermentation facility was designed by faculty of the Agricultural Engineering Department. The system was designed to accommodate the processing of normal daily mortality and includes a grinder unit and tanks for the fermentation process. The equipment is housed in a 12-foot x 20-foot shed structure with a raised platform to accommodate grinding equipment. The facility has a concrete floor and is equipped with single phase 220 volt electricity and water.

A grinding unit was specifically constructed to be user friendly and to fulfill the requirement for the simultaneous addition of a carbohydrate source during the grinding of carcasses. After testing several possible carbohydrate sources including sugar, whey, molasses and corn the cheapest and most readily available additive was ground corn. Therefore, the grinding system was designed to add ground yellow corn at

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a minimum level of 20% (weight:weight) in combination with carcasses.

On a daily basis, broiler carcasses are put through the grinder with ground corn added at the 20% level. The mixture of ground carcasses and carbohydrate source is directly fed into an enclosed tank where fermentation takes place as the sugars in the corn are converted into lac tic acid by bacteria. The pH level is lowered to below 5.0 within 7 to 10 days, thereby preserving the mixture.

After each use, the grinder is washed out using a water hose with a minimal amount of water which can be rinsed into the holding tank with the ground mixture. Once a month, the grinder is disassembled and thoroughly cleaned. Typically, fermented carcasses can be picked up and transported to the rendering plant at the end of a growout cycle, which overcomes cost barriers associated with frequent carcass pickup from the farm.

According to an economic evaluation of fermentation conducted in the Department of Agricultural Economics and Rural Sociology, the initial investment costs for fermentation may be relatively high. The total costs for the building, grinder and tanking equipment were estimated at $8,200 per installation. A value of 2 cents per pound was placed on the fermented product based on rendering company payments. Overall the net cost of disposal using fermentation was calculated to be 4.5 cents per pound. In comparison, incineration and composting costs were cited at 8.9 cents and 4.8 cents per pound, respectively.

When a given technology meets biological and environmental criteria then managerial and economic considerations should be paramount in selecting an appropriate disposal method. Each method of disposal has tradeoffs in terms of resource requirements including initial investment, operating costs, labor, managerial expertise and size of operation. Proven and potential technologies should be closely examined to ensure biological, environmental and economic compatibility. Implementation of new technologies will involve coordination and cooperation between the farmer and the integrated company.

Fermentation of poultry mortalities is being explored in an effort to develop an economically, microbiologically and environmentally sound method for stabilizing carcasses, allowing them to be stored safely on-farm and subsequently transported to a rendering facility at the end of a growing cycle. Unlike routine pickup of ‘fresh” mortalities, fermentation storage of dead poultry reduces transportation costs by 90% and eliminates the potential for transmission of pathogenic microorganisms.

The Alabama poultry industry is fully aware that the on-farm management of wastes, primarily manure and dead birds, is a continuous and growing challenge. Large volumes of on-farm wastes being produced, coupled with the intensification of environmental awareness, have pressured poultry producers and scientists into examining alternatives for the biologically and environmentally sound disposal of carcasses. Fermentation can meet the requirements for a suitable remedy for proper disposal of on-farm mortalities.

This information was provided by J.P. Blake, Extension Poultry Scientist and Associate Professor, and D.E. Conner, Associate Professor, Department of Poultry Science, and J.O. Donald, Extension Agricultural Engineer and Professor, Department of Agricultural Engineering, Auburn University.

Hot Weather Effects On Feed In Feed Bins: Pellet Durability

Hot weather has many negative effects on feed and ingredient quality. Feed storage time, feed and ingredient quality must be monitored closely in order to optimize bird performance during this difficult time of the year. Stability of vitamins and fats are compromised in the hot, humid conditions prevalent inside feed bins in hot weather. In addition, mold and toxin production are enhanced by the conditions prevalent at this time. This study was initiated to determine whether repeated heating and cooling was contributing to a deterioration in feed texture (pellet quality).

There are many advantages to feeding formulated feeds in pelleted form; including prevention of ingredient segregation, salmonella reduction, and increased nutrient availability. Most contribute to better feed conversions and better animal performance. Also, increased ingredient density increases handling and storage efficiencies. Producing a quality pellet is expensive, and the process varies considerably from one null to another.

The effect of repetitive temperature cycles and age on durability of pellets has not been determined. The temperature of feed inside of storage bins on farm sites will vary during the daily 24-hour cycle. Van Wicklen (1991), in tests involving the possibility of using reflective coatings to reduce feed temperatures, reports that temperatures immediately inside the bin wall may vary by 15°C (27°F) over a 24-hour period in Georgia, with temperatures ranging from 20°C to 35°C (68°F to 95°F). Reflective coating paints tested were effective in lowering feed temperatures. Results of tests in California, Ernst (1993), indicated that feed bin internal temperatures can be reduced by use of reflective coatings.

Experimental Procedure

Feed from a commercial mill was taken from the drop chute that would normally go directly into a feed truck, a sample that would approximate the quality of feed as it would arrive at a poultry grower facility. Initial mixing of ingredients for pellets included 1% fat. Production of pellets used in these tests involved raising mixed ingredients to 180°F using steam and holding the mixture in the conditioner for 3 minutes. Pellets were produced using a 4.37 mm (.172-inch) diameter die opening. The process then added 2.85% fat sprayed on at the die. Average age of pellets at the start of each test procedure was 72 hours. The initial feed sample as obtained from the mill was screened using a Tyler #5 screen, with an opening of 4.0 mm (.157 inch) to give a 1OO% pellet base gross sample. The original sample contained 57.41% full size pellets as determined using the °5 screen. Sixteen 1.1-pound individual samples were taken at random from the gross sample for each temperature-durability test and 16 similar samples were taken for control comparisons. Samples were contained in closed plastic containers equipped with snap lock lids which resulted in essentially no moisture loss during tests. Temperature-durability samples were placed in a 39” X 39” X 96” chamber where temperature could be controlled to 2.5°F. Temperature in the chamber and of temperature-durability samples was initially at 77ºF and was raised over a 4-hour period until temperature of the center of samples reached the desired magnitude. Temperature was then held close to this temperature for 4 hours to simulate the effect of the sun and ambient temperature on a feed storage bin. After the desired length of time at elevated temperature, chamber temperature was reduced and test samples allowed to return to 77°F. Control samples were kept at 77°F.

Pellet Durability When Subjected To Temperatures Likely In Feed Bins.

	Temperature (°F)									
Day	77		86		95		104		113	
	Cool[1]	Hot[2]	Cool	Hot	Cool	Hot	Cool	Hot	Cool	Hot
1	72.3	75.4	76.5	72.6	74.0	76.3	77.0	75.7	76.0	77.9
2	75.2	75.5	74.6	72.7	74.8	72.5	77.4	75.8	79.1	74.7
3	74.5	76.2	72.6	74.4	74.0	73.8	78.7	74.3	78.2	75.9
4	73.9	72.8	75.5	74.7	75.1	72.8	80.1	75.6	80.1	76.4
Avg	74.0	74.9	74.7	73.6	74.5	73.9	78.3	75.3	78.4	76.2

1 Samples cooled before pellet durability measurement
2 Samples measured for pellet durability while hot
Samples at 104°F and 113°F taken from a second batch of feed.

Four samples in temperature-durability tests were removed from the chamber each day and these along with four samples from the control group wire subjected to durability described in the ASAE standard. After completing the durability test, samples were then screened using the next smaller screen opening (Tyler “5) than that of the original pellet diameter as required by the ASAE standard. The process was continued for four consecutive days to simulate feed remaining in a bulk feed bin for 4 days after delivery before being consumed by birds. A second feed sample was obtained from the same mill a week later and was screened as previously described. This sample contained 54.80% full size pellets. Samples were prepared as previously described. Samples for the 104°F and 113°F tests were taken from this common pool.

An additional series of tests was conducted on samples that were prepared as above and were still at an elevated temperature when tested. These samples were taken from the second mill sample. Four samples were placed in the temperature chamber at staggered times each day and heated to the prescribed level. Once the sample core temperature reached the desired level, the sample was removed and subjected to pellet durability tests while still in the elevated temperature condition.

Results

As the accompanying table shows, pellet durability was remarkably constant across samples held at four temperatures designed to recreate conditions within feed bins. Percent pellet figures were high after heating at all temperatures and were not affected in those feeds subjected to multiple days of cycling temperatures.

Even those samples tested hot did not show a major reduction in pellet durability, although per cent pellets after the durability test were reduced slightly in most cases. These results were not different statistically.

It would be interesting to look at fat stability, vitamin stability and mycotoxin proliferation on samples exposed to cycling temperatures of these types. Quality reductions in these ares may be significant despite no obvious differences in feed texture.

Conclusion

Pellet durability was not compromised by repeated exposure to cycling high temperatures as might be expected to be found in feed bins in hot weather.

This information was prepared by J. L. Koon and C. A. Flood, Associate Professors, Department of Agricultural Engineering, and J. B. Hess, Assistant Professor, Department of Poultry Science, and is excerpted from a paper given at the American Society of Agricultural Engineers 1994 Winter Meeting.

Research Shorts

Recent Research Of Interest To Poultry Managers

1. Skewes, P. A. and J. D. Harmon. Ammonia Quick Test and Ammonia Dosimeter Tubes for Determining Ammonia Levels in Broiler Facilities. Journal of Applied Poultry Research Vol. 4(2) pp. 148.

The Ammonia Quick Test and Passive Dosimeter Tubes were compared to the more expensive, and presumably more accurate, Low Range Detector Tube. The Quick Test was shown to be accurate only between 20-25 ppm ammonia, while the Passive Dosimeter Tube was accurate over a higher range of ammonia levels. Our sense of smell begins detecting ammonia at levels higher than that suggested for best poultry health (below 25 ppm).

2. Effect of Vitamin Supplementation on Broiler Performance and Carcass Characteristics. Keeping Current, KC 9405, BASF Fine Chemicals, Mount Olive, NJ.

Vitamin concentrations common in broiler production were compared under stress conditions. Higher supplementation levels improved weight gain, feed conversion, mortality, processing yield, breast meat yield and skin scratches under moderate to severe stress conditions (old litter, high density, E. coli and cocci challenge and high fat peroxides).

3. Robinson, F. E., N. A. Robinson, R. T. Hardin and J. L. Wilson. The Effects of 20-Week Body Weight and Feed Allocation During Early Lay on Female Broiler Breeders. Journal of Applied Poultry Research Vol. 4(2) pp. 203.

Breeders varying in 20-week weights were fed one of three allotment programs in early lay. Light hens did not respond to increased feed with increased production, but put on fat and had production problems due to obesity. Larger hens used increased feed allotments for egg production and were more productive in terms of egg and chick numbers. Overfeeding in the prelay period can influence production negatively.

4. Giambrone, J. J., L. Lanquing and F. J. Hoerr. Improved Diagnostic Tool Developed for Major Poultry Disease. Highlights of Agricultural Research, Vol. 42(l) pp. 10.

Auburn research has developed a relatively rapid test to confirm the presence of viral tenosynovitis in suspect lameness cases. The test will be evaluated by the State Diagnostic Lab for use in identifying Viral Tenosynovitis.

5. Moran, E. T.. Low Phosphorus meets Broiler Carcass Quality. Feed Mix, Special Issue on Phosphates, pp.21.

Removing phosphates from the withdrawal feed to improve feed costs led to femur breakage and blood splash. Although meat yields were not reduced, the accompanying reduction in product quality and the increase in labor required to debone these products would overcome any feed price advantages.

We would like to compile an updated list of individuals interested in receiving *Current Concepts In Broiler Production* on a regular basis. If others in your organization would like to receive this publication, please fill out this form and return it to:

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