ing procedures, vaccination, processing, and chick transport to the farm.

Disease control begins with determining the immune status of the day-old chick, which should be compatible with the broiler vaccination program. Immunizations must be tailored to fit the needs of the broiler. Considerations should include geographical location and expected exposure to infectious agents.

Highly contagious

Marek's disease (MDV).

Immunization against IBDV is extremely significant, as the immunosuppressive nature of clinical and sub-clinical infections may compromise other vaccination programs. Early exposure to IBDV, particularly in the first 3 weeks, may be devastating. In the presence of IBDV, there seems to be an increase in femoral head necrosis, vitamin E deficiency, air sacculitis, and coccidiosis, among others. Subclinical infections apparently affect most other health programs.

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.

Marginal chick quality, therefore, compounded by early exposure to IBDV and the respiratory viruses (IBV, NDV), can be a deadly combination in the broiler house, especially when there is also a short down-time between flock placements. Such flocks may suffer poor growth and feed efficiency, slow feathering, poor uniformity, femoral head necrosis, and air sacculitis. Because such a combination produces stress, the resulting limited feed consumption and lowered resistance also have the potential of impacting on anticoccidial programs.

Because flocks are pushed to the limits of their growth rate and feed efficiency, house management is critical. Of particular importance are ventilation, water management, litter moisture, air quality, and temperature. Underventilation in cold weather rapidly leads to excessive litter moisture, and the situation is often irreversible in flocks 4 to 5 weeks of age. Open-type drinkers may also compound the problem.

Adequate ventilation, from day of hatch to market, requires substantial energy in the form of heat. Supplemental heat not only controls litter moisture, it also prevents the generation of atmospheric ammonia.

The greatest economic impact in the live phase of broiler production lies within the areas of feed quality and grower management.

Excellent management and quality health programs will not offset a marginal feed. Conversely, an outstanding feed and feed management program may somewhat limit the negative impact of inadequate housing, health programs, or general husbandry practices. However, a top quality feed-in combination with a quality chick, good housing, sound management, and a reasonable health program-is desirable.

Feed conversion is second in value only to yield (carcass) in the overall cost of broiler meat production. Formulations and caloric efficiency of feed are compromised by high moisture grains, poor pelleting, off-grade ingredients, and mycotoxin contamination. Linear formulations are only as good as the ingredient quality, milling procedures, and feed management programs. Of utmost importance is the additional consideration that feed is the delivery system for non-nutritive additives such as anticoccidials, antibiotics, antibacterials, and organic arsenicals.

Current trends in broiler production have developed as a result of a bottom-line demand for an increase in pounds of broiler in a shorter period of time. Such demands result in large flocks, less space per chick, increased growth rate of broilers, and shorter down-time between flocks. The result is extreme pressure on the health programs in poultry production. As flock size and density increase, so do the number and viability of infectious organisms-be they bacterial, viral, fungal, or zooparasitic.

To meet these demands, a cardinal rule of poultry health is often circumvented at the day of flock placement. Mixing broil& progeny from two or more flocks is often necessary to meet the need for increased farm size. Parental immunity to a variety of infectious organisms (particularly viruses) may vary in progeny from different breeder flocks. Vaccination programs, therefore, may not be compatible among mixed-progeny placements.

To further complicate the mixed-progeny placements, there may be differences in day-old broiler size, which is often characteristic of younger versus older breeders. There is often poor uniformity in body weight as well as rolling vaccine reactions, which are manifested by continuous reinfection for an extended period. These are a result of uneven immunity among mixed flocks.

Shortening the down-time between flocks presents a problem with litter management, in that excessive moisture and ammonia become harder to control. Of particular significance is that the viability of coccidial oocysts is probably greater with increased litter moisture, with premature drug withdrawal schemes, and with rapid replacement of flocks, using limited periods for clean-out. The resulting scenario is that excessive litter moisture (35 percent) may affect air quality (particularly when houses are kept tight during cold weather), placing a greater demand on grower skills in house ventilation. Yet increasing the ventilation rate requires more heat to maintain minimal temperatures for young flocks during periods of cooler weather.

Over-ventilation to lower house temperatures, by contrast, may lead to dry litter, dustiness, and airborne matter containing infectious organisms. Viruses, for example, thrive in such conditions, and their contagious nature is ideal for rapid and continuous flock exposure.

It is important to note the cumulative nature of stress on the broiler, in the form of wet litter, atmospheric ammonia, dust, temperature extremes. infectious organisms, and limited feed and water space. The threat is both cumulative and continual for all confinement-reared broiler flocks.

Also noteworthy is the fact that health programs designed to prevent or control specific diseases have been developed independently. When incorporated into a flock situation, success will be a reflection of concurrent health and management practices. Interpretation of health programs is a challenge which must utilize a combination of experience, basic biological principles, and economic constraints.

The typical broad approach currently in use in poultry health applies the biological principles and the economic constraints, quantifying broiler performance over time, and identifying subtle variations from the standard. This approach precludes one-disease, one-diagnosis viewpoint.

Certain so-called cardinal rules in disease prevention and control have been, and will continue to be, violated in broiler production. These include sanitation, pure flock placements, new litter per flock, extended periods between flocks, and flock density limitations. Their significance continues to be monitored via the bottom-line.

Should future economics dictate dramatic changes in poultry health and management practices, they will no doubt be implemented. For the present, however, the bottom-line approach will prevail, and health programs will continue to bear the brunt of management decisions that are geared toward least-cost production and profitable product.

Historically, broiler production evolved into a profitable agri-business through selective implementation of technology, determined on the basis of need.

Solutions to problems, particularly infectious diseases, have often been found and implemented before all the relevant factors have been elucidated. Thus, the complex manipulation of health programs and management practices in broiler production is dynamic. It reflects the application of known principles, the avoidance of extremes, and the assessment of trends in host performance.

It can be said, then, that the economics of poultry health and live production are measured by the biological response of the broilers to management practices or infectious disease agents. The "bottom-line*' in broiler production is simply a balance between the management practices of large-scale continuous rearing and health programs which generate immediate profitability without compromising future performance.

The rapid evolution of the industry from small back-yard flocks to large-scale confinement-rearing facilities has revolutionized our concepts of poultry diseases, their prevention, diagnosis, and treatment.

The concept of poultry health is now a measure of cost to produce a unit of live broiler at market age. Because our concepts of flock health and performance have changed dramatically, high mortality, poor growth, poor feed efficiency, excessive downgrades, and condemnations are no longer acceptable. The "bottom-line" is now a reflection of optimal growth rate, feed, and caloric efficiency, combined with minimal condemnation percentages.

Technological advances in health programs have been dramatic, successful, and profitable. They include surveillance, diagnosis, serology, vaccination, and feed additives. However, these advances-regardless of their level of sophistication-have been implemented only with the economic confines of the industry.

If cost were not a consideration, there are very few, if any, infectious diseases in broilers that could not be eradicated. For those few diseases which have warranted intensive control (avian influenza, exotic Newcastle disease, Mycoplasma gallisepticum), the commitment has been forthcoming. For endemic and opportunistic bacteria, viruses, and parasites, however, there is little to gain, biologically, and certainly less economically. In fact, considering the current broiler performance figures in the Southeastern United States, it seems doubtful that a 4.0-pound broiler at 42 days of age, with a feed efficiency of 1.85 or less, and a calorie utilization under 2,700 could be improved substantially enough to warrant eradication of all the infections that are endemic in broiler operations.

The standards or guidelines in broiler production have evolved through experience in all phases of the industry, with reasonable application of cardinal rules of poultry health. Both health and production, therefore, must operate within established economic guidelines, while still providing the acceptable "basics" in husbandry and disease control which will not jeopardize the long-term objective of profitable and wholesome product. •

This information was prepared by M. K. Eckman, *Extension Poultry Scientist,* for the Novus International Symposium, Lisbon, Portugal, October 1992.

Mixer Testing Is Important To Broiler Production

Recent work from Kansas State University (Behnke and McCoy 1992) illustrates the importance of properly mixed feeds on broiler performance. Broilers were fed a low-density starter feed to 28 days to provide a mild nutrient stress on the birds. Starter feed mixing times were selected to provide poor (40.5 percent CV), intermediate (12.1 percent CV), and adequate (9.7 percent CV) mixes. Broiler performance was impaired in birds fed the poorly mixed feed compared to results from the intermediate or adequate diets. Mortality was elevated in birds fed poorly mixed feed in addition to decreases in growth and feed efficiency.

Using a broiler growth model, Ivey and Harlow *(1992)* predict an improvement of 3.7 points in body weight, 8.8 points in feed conversion, and a decreased cost of 0.7 cents per pound of live weight between birds fed feeds with poor variability in protein and energy (24 percent CV) versus birds fed more uniform feeds (6 percent CV).

Variation in feed nutrients can be attributed to a number of causes, including;

1. Feed ingredient variability.
2. Feed mixing variability.
3. Improper weighing of ingredients.
4. Sampling error.
5. Lab analytical variation.

I would like, at some point in the future, to discuss items 1, 4, and 5 on this list, however, a reminder of the importance of evaluating mixer performance may also be useful.

Current GMPs for the production of medicated feeds dictate that "all equipment shall possess the capability to produce a medicated feed of intended potency, safety and purity." One way to help insure this is to check the accuracy of your mix once or twice per year. This is best accomplished by collecting 10 evenly spaced samples from the same batch of feed during feed discharge through the surge bin. Good sampling is crucial to obtaining accurate results. These samples are not to be composited, but should be kept separate for analysis.

One or more tracer compounds are then identified for analysis to judge mixer performance. Many nutrients and additives have been used as tracers, however, accurate results are obtained most frequently if the tracer substance comes from only a few ingredient sources. Protein, fat, and even, to some extent, the macrominerals calcium and phosphorus are poor choices for mixer study tracers since each is supplied by a variety of ingredients having their own variability within lots. Therefore, variability can be-much lower for these nutrients than for micronutrients.

Sodium, salt, trace minerals, or synthetic amino acids provide better results as they are added at low levels and represent the most difficult nutrients to mix uniformly. Certain vitamins, drugs, or commercially prepared tracer substances have also been used successfully.

All samples should be analyzed for one or more tracers, and coefficients of variation should be generated according to the following formula:

$$CV = S/M \times 100 \text{ where } S = \sqrt{S^2}$$

$$S^2 = \frac{\Sigma X^2 - (\Sigma X)^2/N}{N-1}$$

X = a single analytical value
M = mean (average&of all X's
N = the number of values (samples)
S^2 = the variance of the samples
S = the standard deviation of the samples
CV= coefficient of variation

An excellent example of how to use these formulas can be found in Jones (1992, p. 91) 1992 *Feed Additive Compendium.* Coefficients of variation below 10 percent are considered adequate and CVs of 4 to 8 percent are possible.

Should a mixer show CVs over 10 percent, several areas need to be evaluated, including mix time, over filling, wear on equipment, and liquid addition systems. Mix times can be evaluated by increasing 1 minute and running another mixer test.

Take Home Message:

Mixer tests should be completed once or twice a year. Coefficients of variation should be under 10 percent or broiler performance may be compromised. Ž

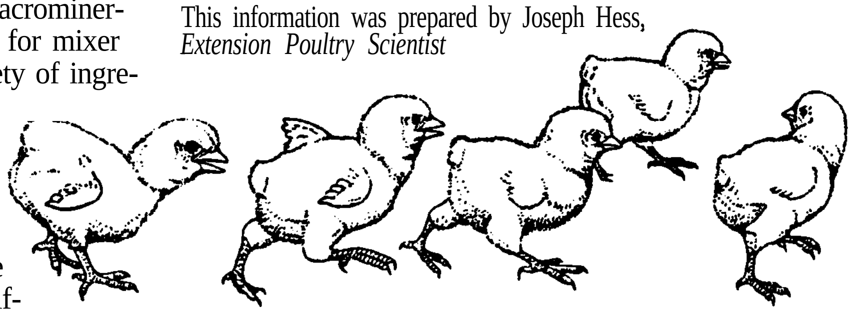
References

Behnke, K., and R McCoy. 1992. Non-uniformity in feed. *Feed Management* 43(9): 16-18.

Ivey, F. J., and H. B. Harlow. 1992. Improvements in broiler production through the use of a growth model. Novus International Symposium, Lisbon, Portugal, October 1992.

Jones, F. T. 1992. Mixing feeds and mixer test procedures for batch mixers. *1992 Feed Additive Compendium,* pp. 91-93.

This information was prepared by Joseph Hess, *Extension Poultry Scientist*



Incidence Of Tibial Dyschondroplasia And Performance Of Broilers Under Two Lighting Programs

Tibial dyschondroplasia (TD) is a common leg abnormality that occurs in rapidly growing broilers. It is known that reduction of growth because of feed restriction results in a decrease in leg abnormalities. However, feed restriction results in lower body weights, which is not an attractive solution to leg problems for the commercial broiler producer. Several intermittent lighting regimes, when compared to continuous lighting, have been effective in reducing leg abnormalities. In addition, intermittent light has reduced mortality while maintaining equal or slightly better performance than continuous light. An experiment was conducted to determine if intermittent light could result in a reduction of TD without reducing body weights. Two lighting programs were tested: (1) continuous light (Ct), 23 hours of light and 1 hour of dark, and (2) intermittent light (It), 1 hour of light followed by 3 hours of dark repeated six times in a 24-hour period. A total of 1,010 broiler chicks of both sexes were used for three lines of broilers: (1) a high (H), (2) a low (L) incidence of TD at 7 weeks of age, and a control (C) or nonselected line. The 350 C, 300 H, and 360 L line chicks were from generation two of a selection experiment for a high or a low incidence of TD at 7 weeks of age. The presence or absence of TD and body weights were determined at 4 and 7 weeks of age. Low intensity x-ray imaging was used for TD diagnosis (Lixiscope). Tibial dyschondroplasia was recorded as 0 for normal broilers or 1 for broilers with an abnormal mass of cartilage accumulation in the proximal tibiotarsus. Body weight gain and feed efficiency were calculated for 0 to 4 and for 4 to 7 weeks of age. Birds were fed *ad libitum* a starter broiler diet from 0 to 3 weeks (23.1 percent CP and 3,194 kcal/ME/kg), and a grower diet from 3 to 7 weeks of age (20.1 percent CP and 3,197 kcal/ME/kg). Data were analyzed using the GLM procedure of SAS Institute. Data for TD were analyzed within each age using a statistical model that included the main effects of treatment, pen within treatment, line, and sex, and their interactions. Differences in body weight and gain, and feed efficiency were tested using the pen means. The percentage incidence of TD at 4 weeks of age was 15, 30, and 5 percent for the C, H, and L, lines, respectively. At 7 weeks, incidence of TD was 34 percent, 47 percent, and 11 percent for the C, H, and L lines, respectively. At 4 weeks, incidence was 21.4 percent and 12.0 percent, and at 7 weeks was 36.6 percent and 25.0 percent for males and females, respectively.

Incidence of TD was reduced by It light only in birds from the C line. The response of the H and L lines was the same in Ct or It light at 4 or 7 weeks. In contrast, the average response of the selected lines within each treatment was significantly different at 4 and 7 weeks of age from that of the C line. The average incidence of TD of the H and the L lines was 17.6 percent and 15.7 percent at 4 weeks and 29.8 percent and 29 percent at 7 weeks in the Ct and It lighting programs respectively. In the C line, incidence of TD was 22.6 percent and 7.7 at 4 weeks and 38.8 percent and 28.7 percent at 7 weeks in the Ct and It lighting programs, respectively. In this experiment, intermittent light was only able to reduce the incidence of TD in the C line. The body weight of the H and L lines were similar at 4 and 7 weeks of age. However, the H and L lines were heavier than the C line. At 4 weeks, body weights were 1,031, 1,046, and 1,050 g, and at 7 weeks were 2,294, 2,338 and 2,351 g, for the C, H, L lines, respectively. The effect of TD on body weights was studied in birds from the H and the C line. Tibia1 dyschondroplasia had an effect on body weights at 4 and 7 weeks and the effect was the same across lighting programs and sexes. At 4 weeks of age, broilers with TD were 32 g heavier than broilers without TD. At 7 weeks of age, broilers with TD were 47 g lighter than those without TD. It is possible that the effect of TD on body weights depends on the age of the broiler and the severity of the TD lesions.

There were no differences in body weight or gain at 4 or 7 weeks

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Joe Hess
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between the lighting programs. The body weights at 7 weeks for birds in Ct and It light were 2,307 and 2,316 grams. Broilers under It light had a better feed efficiency between 0 and 4 weeks than broilers exposed to Ct light, (1.668 and 1.714, respectively). Feed efficiency was similar from 4 to 7 weeks in the two lighting programs.

The results of this experiment indicated that It light caused a decrease in incidence of TD in the C line but not in the H and L TD lines of broilers. Body weight and gain were similar in both lighting programs. •

This information was prepared by J. Wong-Valle, G. R. McDaniel, D. L Kuhlers and J. E. Bartels for *AAES Highlights of Agricultural Research*, Fall, 1992.

Research Shorts

Recent poultry research of interest to poultry managers.

Broilers And Breeders

1. Grieve, D. B., G. I. Boerboom, and S. K. Muir. 1992. Newcastle protection in birds exhibiting various degrees of tongue staining after consumption of a vaccine solution containing a blue dye. Journal of Applied Poultry Research 4(1): 415-18.

A blue dye was incorporated into vaccines administered through the water to correlate tongue staining with vaccination coverage. Degree of staining indicated the amount of Newcastle vaccine consumption and the level of resistance to challenge.

2. Harlow, H. B., and F. J. Ivey. 1993. Consequences of variation on profitability in commercial broiler production. Abstracts of the 1993 Southern Poultry Science Society Meeting.

Variation in the different phases of production typically costs 5 cents per bird, more in some complexes. Using knowledge of sources of variation to evaluate management problems is discussed.

3. Jones, F. T. 1993. A comparison of methods to assess the bacterial population in the broiler house environment. Abstracts of the Southern Poultry Science Society Meeting.

Cellulose sponges more accurately sampled bacterial populations than Petrifilm, RODAC plates, or cotton tipped swabs.

4. McGeachin, R B., L. J. Srinivasan, and C. A. Bailey. 1992. Comparison of the effectiveness of two antioxidants in broiler type feed. *Journal of Applied Poultry Research* 4(1):355-59.

Feeds may show peroxide formation by 7 days in hot weather conditions. Two commercially available antioxidants demonstrated feed fat stabilization.

5. Moran, E. T., and M. C. Todd. 1993. Effect of submarginal phosphorus and livehaul on broilers reared to heavy weight: Live performance, mortality, and carcass quality. Abstracts of the 1993 Southern Poultry Science Society Meeting.

Available phosphorus levels were reduced by 10 percent in starter grower and withdrawal feeds. Carcass bruising increased after livehaul in birds fed low phosphorus levels.

Comment: Possible thigh bruising problems must be weighed against any reductions in feed cost.

6. Sander, J. E., and R. D. Schwartz 1993. Efficacy of drinking water suspensions of fenbendazole against Ascaridia galli in broilers. Abstracts of the 1993 Southern Poultry Science Society Meeting.

Fenbendazole was more than 99.5 percent effective against nematodes at 60.6 ppm.

7. Shane, S. M. 1992. Microbial monitoring of hatcheries using the Biotest Centrifugal Air Sampler. Abstracts of the 1993 Southern Poultry Science Society Meeting.

An air sampler was compared to exposure plates in measuring bacteria and mold levels. The air sampler proved more sensitive than plates in measuring mold levels.

8. Todd, M. C., and E. T. Moran. 1993. Effect of continuous submarginal phosphorus and livehaul on broilers reared to heavy weight: Dimensions, mineralization, and strength of tibia and femur. Abstracts of the 1993 Southern Poultry Science Society Meeting.

This work indicates that the femur is more sensitive to low phosphorus than the tibia, while most research has looked at effects on the tibia. •

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