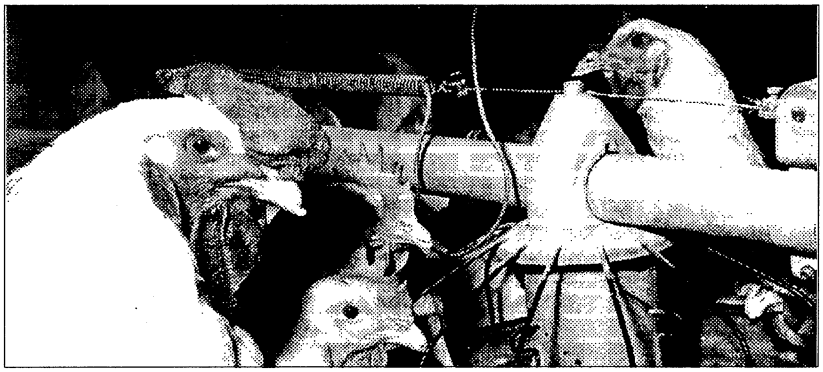

Research Update 1989

POULTRY

FIRST IN POULTRY UPDATE SERIES

This is the first poultry research report published in a new publication series, entitled "Research Update," inaugurated in 1989 by the Alabama Agricultural Experiment Station (AAES). The new series is meant to promote timely reporting of research results dealing with a specific crop or commodity, with distribution to all producers of that particular commodity. In this case, the target audience is all Alabama poultry producers.

Today's highly competitive conditions make it doubly important that agricultural producers have available the latest scientific information. Publication of this new series is meant to help meet that need. Efforts will be made to maintain up-to-date mailing lists of each producer group so all Alabama producers will receive the appropriate report annually.

For more information about poultry production and the latest recommendations, please contact your county Extension Service office.

Low Fat Feeds Reduce Leg Problems in Heavy Broilers

High performance feeds that contain high fat levels support maximum rate of gain. However, such feeds also increase bird losses caused by leg problems.

Omitting added fat from the feed and balancing nutrients at a reduced level have been advocated to relieve these losses. This approach has not been adopted commercially, however, because of the perceived threat of reduced growth, poorer feed conversion, and possible loss in meat yield.

An AAES experiment examined the effects of low fat feed on broiler males reared to 8 weeks of age. The feeds contained corn and soybean meal, adjusted to maintain a proper balance between protein and energy when the fat was removed.

Omitting fat from the starter ration led to a reduction in body weight by 3 weeks of age, along with poorer feed conversion. Examining the bones of the leg with an imaging device indicated that impending leg problems (i.e., tibial dyschondroplasia) were not as apparent with fat omitted from the feed. During the two subsequent 3-week periods, feed conversion continued to be high, as shown by data in the table. However, the difference in body weight between treatments disappeared and the bone structure advantage from omitted fat continued.

All birds were processed, and various aspects of yield were measured. Yield of whole chilled carcasses was not affected by the dietary treatments. Each carcass was deboned utilizing standard commercial cuts. The proportion of parts and meat from the breast and thigh was similar, regardless of fat inclusion or exclusion from the feed.

Overall results indicate that flocks intended for heavy weights

Performance of Broiler Males Given High and Low Fat

Feed fat	0-3 weeks			3-6 weeks			6-8 weeks			Total
	BW[1]	F/G[2]	%TD[3]	BW	F/G	%TD	BW	F/G	%TD	F/G
High.....	1.80	1.69	8.0	5.06	2.15	30.6	6.85	2.65	27.4	2.16
Low	1.67	1.81	1.2	4.77	2.32	12.4	6.86	2.60	17.5	2.28

[1] BW = body weight in pounds.
[2] Pounds of feed per pound of gain.
[3] Percentage tibial dyschondroplasia.

ALABAMA AGRICULTURAL EXPERIMENT STATION AUBURN UNIVERSITY
LOWELL T. FROBISH, DIRECTOR AUBURN UNIVERSITY, ALABAMA

and deboning for breast and thigh meat benefit from omitting fat from the feed. Final weight gain is not affected, while the potential for leg problems is reduced. Unavoidably, feed conversion suffers. However, since added fat is expensive, cost of gain should decrease.

E.T. Moran, Jr., S.F. Bilgili, G.R. McDaniel, and J.E. Bartels

Proper Feed and Water Withdrawal Improves Processing Efficiency

It is a common practice to withdraw feed and water from market age broilers prior to processing. This fasting period not only saves feed but, more importantly, allows emptying of the digestive system and facilitates automated evisceration in the processing plant.

Broiler processors occasionally observe a high incidence of gastrointestinal fragility (i.e., easily broken and torn stomachs and intestines) during evisceration. Usually this fragility may be explained by intestinal diseases (such as coccidiosis and enteritis) or mycotoxicosis.

Recent AAES research indicates that duration of feed withdrawal and sex of broilers can also have an impact on gastrointestinal breaking strength. Breaking strength measurements were made on several regions (stomach and gizzard junction, stomach, duodenum, small intestine, and colon) of the digestive system of male and female broilers (49 days of age) that had been subjected to various feed and water withdrawal treatments. The treatments included 0, 6, 12, 18, and 24 hours of feed withdrawal, with and without simultaneous water withdrawal. Tissue moisture levels were also measured during the experiment.

In general, digestive systems full of ingesta (0 hours feed withdrawal) had the lowest shear values, indicating a greater likelihood of tearing during processing. Shear values increased with longer feed withdrawal times. Access to water during feed withdrawal did not affect the fragility. Overall, shear values were higher for males than females.

During feed withdrawal, tissue moisture levels were lower at 6 and 24 hours as compared to 12 and 18 hours. This observation supports the general hypothesis that feed withdrawal more than 12 hours before slaughter often results in more liquid digestive contents and enhances fecal contamination rate in the plant.

These results suggest that properly managed feed and water withdrawal programs can minimize the likelihood of intestinal breakage and fecal contamination during commercial processing of broilers.

S.F. Bilgili

Better Fowl Cholera Vaccine Needed in Alabama

The incidence of fowl cholera in Alabama and in the Southeast has increased in recent years. Many of the flocks with cholera had been previously vaccinated with attenuated vaccine strains of *Pasteurella* sp., a procedure thought to be easy and inexpensive. The contagiousness and resistance of the vaccine strains were evidenced by the development of cholera in birds 8-12 weeks of age, in houses where vaccinated chickens had previously been housed. Conventional techniques of cleaning houses between flocks have not reduced the *Pasteurella* contamination.

AAES studies were made to determine the role of the attenuated vaccine in the dissemination of fowl cholera. Eight-week-old broiler-type chickens were vaccinated in the wing web with a commercially available attenuated live fowl cholera vaccine. Nodules developed in the vaccinated wing web 5 days postvaccination, and by 15 days, 12 percent of the chickens died with symptoms compatible with fowl cholera. Bacteriological isolation of *Pasteurella* sp. confirmed the diagnosis.

Three weeks postvaccination, 50 percent of the chickens were showing signs of sickness, including diarrhea, recumbent position, ruffled feathers, loss of appetite, and weight loss. Some of the vaccinates had enlargement of the wing joint adjacent to the site of vaccination, and cyanosis of the skin on the area over the shoulder joint.

Necropsy examination of sick chickens revealed that 30 percent had lesions characteristic of fowl cholera. The spleens were enlarged and often had white nodules. The livers were enlarged, congested, firm in consistency, and often contained small white spots. Lungs were always enlarged and edematous and had areas of hemorrhages. The kidneys were extremely enlarged and congested and showed multiple whitish focal areas. Chalky material was often found in the kidney area resembling gout. All remaining chickens were necropsied 35 days postvaccination, and *Pasteurella* of the vaccine serotype was isolated from 20 percent.

The data obtained in these studies show that the vaccine strains of attenuated *Pasteurella* have retained a degree of virulence that can result in field problems. In order to induce immunity, the vaccine strain must have a minimum level of virulence to reproduce within the chicken and to maintain the necessary invasiveness to make contact with the immunological system. During the process of reproduction and invasiveness, it is apparent that some of the bacteria revert to a higher degree of virulence and this results in infection of chickens.

These results clearly explain the spread of cholera following vaccination with attenuated vaccines, and especially the outbreaks that occur during stressful periods such as the beginning of the laying cycle.

Because the vaccine strain serotype is also isolated from very young chicks, it appears that the vaccine strain is hardier than conventional strains of *Pasteurella*.

It is apparent that new and better vaccine formulations are needed by the poultry industry. The emulsified vaccines induce a good antibody response but they can also induce unacceptable side reactions such as arthritis.

E.C. Mora

Matching Vaccine to Virus Subtype Important in Controlling IBDV

Despite advances in vaccine development and antibody determination, infectious bursal disease virus (IBDV) incidence and associated disease problems still occur. Infection with IBDV in young chickens produces atrophy of the bursae of Fabricius and immunodepression. Immunodepressive IBDV infections appear with increased frequency and severity despite improved sanitation and hygiene and repeated IBDV vaccination. Immunodepression decreases vaccine efficacy and increases susceptibility of chickens to other infectious agents. One cause of increased IBD may be the varied subtypes of the virus that causes the disease.

The objective of this AAES study was to determine how three IBD vaccines protect broilers against infection with serological subtypes of IBDV. This study was the first to examine the efficacy of new live IBDV subtype vaccines against standard and variant serologic IBDV isolates, thus generating information for more effective control of IBD. Specific pathogen-free (SPF) broilers were used in the study.

The efficacy of live vaccines against IBDV subtypes was determined using 16 groups of 20 broilers per group. The design consisted of three vaccine groups and a nonvaccinated (NV) group, each of which was challenged with one of three IBDV isolates. In addition, there was a non IBDV challenge group for each of the three vaccinated groups.

The challenge isolates were the Delmarva variant E, a standard serotype 1 (APHIS), and an untyped virulent isolate from Mississippi. The vaccines were a cloned standard (CS) vaccine (Clone Vac-D78), a cloned variant (CV) vaccine (Bursa Vac IV), and a noncloned standard (NCS) vaccine (Bursine II). Vaccination was at 10 days, challenge at 24 days, and necropsy examination at 31 days. A protection score (percent) was calculated for each group based on the percent of birds with normal size bursae of Fabricius. Results showed an average percent protection score against all three challenge viruses for the CS vaccine of 63, the CV vaccine of 68, and the NCS vaccine of 75.

Results indicated efficacy differences among the three vaccines against the three challenge viruses. Although the NCS vaccine provided the highest overall protection against the three IBDV, differences were small when compared to the other two vaccines. However, significant differences were evident in protection scores of each of the three vaccines against individual challenge viruses. Therefore, it is important to determine the predominant IBDV subtype in the field before selecting the vaccine to use. Results reported herein provide a rationale for selecting efficacious vaccine programs in breeders and broilers once the dominant IBDV subtype in an area, complex, or farm is established.

J.J. Giambrone

Early Detection of TD Cuts Broiler-Breeder Losses

Tibial dyschondroplasia (TD) is a common skeletal abnormality in rapidly growing broilers and turkeys. Though not fatal, TD causes lameness and interferes with birds getting food and water. The end result is reduced efficiency or even death due to starvation and/or dehydration. TD costs poultry producers millions of dollars annually in replacement birds and much more in poor performance of surviving birds.

The incidence of TD was studied in broiler breeders reared under two nutritional-management regimens at the AAES:

- **Regimen 1.** From 0 to 8 weeks of age, both males and females were fed free choice a broiler diet similar to the one used by basic breeders (23 percent protein, 3,200 ME/kg). At 8 weeks the birds were changed to a developer diet of 18 percent protein and 2,900 ME/kg and placed on a restricted feeding program for the duration of the experiment. The amount of feed fed from 8 to 20 weeks of age was determined by the weight the birds needed to achieve breeder recommended body weight by 20 weeks of age.
- **Regimen 2.** The same number of birds as in regimen 1 were fed the same developer diet free choice from 0 to 3 weeks. Then, regulated amounts of feed were supplied from 3 to 20 weeks.

TD was determined on the legs of the broiler breeders at 4, 7, 11, and 15 weeks of age using a Lixiscope (imaging device). The percentage incidence for male birds in regimen 1 at these ages was 14, 20, 9, and 0 percent, respectively. Only 2 percent of the females at 7 weeks of age developed TD. None of the birds in regimen 2 developed TD. Peak incidence of TD occurred at 7 weeks of age; at 15 weeks of age none of the birds showed symptoms of the disease.

Though TD cannot be prevented by any known nutrients and reduced growth rate due to reduced feeding is not acceptable, the AAES study demonstrates that the disease can be detected early by using a Lixiscope. This will allow basic breeders to cull affected birds and reduce the incidence of TD by choosing only unaffected birds for their breeding programs.

J. Wong-Valle, G.R. McDaniel, and J.E. Bartels

Dried Whey in Withdrawal Feed Ineffective Against Broiler *Salmonellae*

The percentage of broilers harboring *Salmonellae* has been shown to greatly increase during live haul. This rapid cross-contamination can largely be attributed to fasting prior to catching, close contact in transit, and consumption of contaminated cecal droppings.

Since access to feed may influence retention of consumed *Salmonellae*, initial research examined the significance of feed intake, before and after cooping, on the *Salmonellae* problem. Results indicated that feeding and fasting would influence the numbers of cells in the ceca at the expected time of processing. However, the differences were small and threats to carcass cross-contamination would continue to be substantial.

Reducing the extent of *Salmonellae* shedding prior to cooping would reduce subsequent contamination. Lactose in the feed is known to alter the cecal microbial population, increase the organic acid level of the contents, and reduce the pH. These changes are unfavorable to *Salmonellae* and can cause meaningful reductions in their concentrations. Dried whey is high in lactose, but its use is limited because of its cost and the adverse effects on performance. However, use of low concentrations of whey in the withdrawal feed was a possible option.

A study at the AAES evaluated the addition of dried whey to withdrawal feed and its ability to reduce cecal *Salmonellae* after an oral dose of organisms. A probiotic providing an array of microbes compatible with the ceca was included to augment fermentation.

Live performance was not affected by either of the feed additives or a combination of the two. The ceca were significantly affected (increased weight and expansion from entrapped gas) whenever whey had been incorporated in the feed, indicating that conditions unfavorable to *Salmonellae* had been induced. However, recovery of *Salmonellae* was similar, regardless of treatment.

Based on these results, dried whey in withdrawal feed is considered ineffective in *Salmonellae* control because little relief from cross-contamination can be expected. The increased cecal size created by whey is undesirable because of the increased likelihood of gut breakage during evisceration.

E.T. Moran, Jr. and S.F. Bilgili

Cell Surface Molecules Affect Productivity of Chickens

As in all animals, cell surface molecules of chickens produced by the major histocompatibility complex (MHC) act as self-identification agents by which the species recognizes foreign substances. This molecular recognition is the essential step by which the cells of individuals generate immunity against foreign invaders.

Recent work on commercial broilers aided by well-studied lines of chickens maintained in the Auburn Avian Immunogenetic Model (AAIM) reveals three new facts about the MHC genes:

1. Mutation is unusually high in one of the world's fastest growing broiler breeder lines and the structure of the MHC genes of chickens is more complex than previously shown. Selection for rapid growth apparently accelerates mutation.

2. Rapid growth modifies the effect of MHC genes on the incidence of signs and symptoms of Marek's disease (MD); therefore, the effect of a certain MHC gene on a Leghorn x broiler cross is not the same as that in a purebred broiler line, see table. Thus, the MHC genes do not act independently of other genes in the species.

3. MHC genes causing high susceptibility to the growth of the tumors of MD, in contrast to those causing resistance, produce faster body growth in broilers.

The AAES results show that MHC genes modulate and are modulated by the expression of other genes, identifying apparent reciprocating feedback loops with large effects on production efficiency. The germ plasm resources in AAIM enable similar exploration of productivity through basic biological science into the future.

L.W. Johnson

Effect of MHC Gene on MD Incidence and Broiler Growth[1]

MHC gene[2]	MD incidence		7-week body weight
	Broiler	Leghorn cross	
	Pct.	*Pct.*	*Lb.*
R MD	71	34	4.11
S MD	73	90	4.40

[1] Sexes pooled.
[2] R MD = resistant to MD and S MD = susceptible to MD as previously proved in purebred Leghorns.

Large Particle Limestone Improves Calcium Solubilization by Laying Hens

It has been hypothesized for several years that laying hens solubilize a higher percentage of ingested calcium from large particle limestone (LPL) than from small particle limestone (SPL). However, there was no scientific evidence to support this hypothesis until AAES experiments comparing the percentage of LPL and SPL calcium solubilized by laying hens proved this theory was true.

Solubilization of calcium from limestone is important because only the solubilized form is available for absorption in the digestive system of the hen. Increased solubilization of limestone by the hen means increased availability of calcium for the hen to absorb and to subsequently use in egg shell formation.

During the studies, 3.75 g (grams) of SPL and LPL were intubated to two groups of laying hens. Solubilization and retention of calcium by hens were measured between two consecutive ovipositions (24-26 hours). The LPL used in the study was 2-5 mm (millimeters) in diameter (pullet size) and SPL was 0.5-0.8 mm in diameter (fine granular).

More calcium was solubilized and retained in the body of the hen from LPL than from SPL, as shown in the table. The hens consuming LPL solubilized approximately 0.5-0.8 g more than the hens consuming SPL. These results indicate that it is beneficial to substitute a large particle calcium supplement, such as pullet-size limestone or oyster shell, for a part of the fine granular limestone used in the diet. Using large particle supplements in the laying hen diet decreases calcium solubilization from limestone and increases its availability for absorption by the hen.

K.S. Rao and D.A. Roland, Sr.

Effect of Dietary Limestone Particle Size on Calcium (Ca) Solubilization in Laying Hens

Ca available, grams	Particle size	Ca solubilized by the hen		Ca retained by the hen	
		Grams[1]	*Pct.*	*Grams*	*Pct.*
Trial 1					
3.46	Large	2.75	79	2.54	73
3.75	Small	2.18	58	1.94	52
Difference		.57		.60	
Trial 2					
3.33	Large	2.79	84	2.26	68
3.75	Small	2.03	54	1.94	52
Difference		.76		.32	

[1] 1 ounce = 28 grams.

Delaying Change from Pullet Feed to Higher Calcium Layer Feed Reduces Performance of Hens

Many egg producers have delayed the transition from pullet to layer feed or have fed diets containing an intermediate level of calcium until the average production of the flock was 5 percent. The justification for this method of feeding was that if layer calcium levels are fed too early, the higher calcium levels will significantly reduce feed consumption and adversely affect egg production. No data have been found which indicate that increasing feed intake by feeding inadequate calcium will have any overall benefit on hen performance. However, there are data to indicate that incorrect timing of the transition from pullet to layer feed and feeding incorrect calcium levels will adversely affect hen performance.

Results of AAES experiments indicated that delaying the transition from pullet to layer feed until pullets had laid just 7 eggs increased feed consumption. The overconsumption had no beneficial effect on egg size, but the calcium deficiency did reduce egg specific gravity and bone strength. It was concluded that feeding early maturing pullets layer calcium levels did not reduce feed intake but that early maturing pullets fed inadequate calcium overconsumed in an attempt to obtain more calcium.

When the transition from pullet to layer feed was delayed until production was approximately 10-15 percent, pullets consumed an average of 5 percent more feed and were 5 percent heavier at the end of the production cycle than pullets fed layer calcium levels starting at 2 weeks prior to the first egg. The increased feed consumption had no beneficial influence on egg production or egg size but did significantly reduce feed efficiency.

The study illustrated the importance of properly timing the transition from pullet to layer feed. Delay in providing the correct quantity of calcium to early maturing pullets will increase feed consumption, body weight, and liver fat, and will reduce egg shell quality, bone strength, and feed efficiency. The increase in feed intake will not increase egg size but will increase feed cost. Hens should receive the correct calcium level approximately 10 to 14 days prior to the first egg and not after the first egg.

D. A. Roland, Sr.

Effects of Pre-production Levels of Calcium Feeding on Performance of Hens for 12 Months

Calcium level fed, pct.		Feed consumption/ hen/day	Body weight
Pullets[1]	Hens[2]		
		Grams	*Lb.*
1.0	3.75	115	4.0
1.7	3.75	113	4.1
3.7	3.75	110	3.8

[1] Fed until 15 percent production reached.
[2] Fed for 12 months after 15 percent production reached.

Mature and Immature Pullets Compared at Sexual Maturity

Age at sexual maturity (production of first egg) is influenced by genetic background and environment. Stimulation of hormone events required for egg production may have threshold requirements of age, body weight, and/or composition (e.g., fat and protein). To determine these requirements, differences between immature and mature broiler breeder pullets were examined in AAES research.

Pullets were raised on litter floors under standard management procedures and placed in cages at 18 weeks of age. The lighting schedule was: 23 hours light (L), 1 hour dark (D) at 1-day-old; 8 hours L, 16 hours D thereafter to 17 weeks; 9 hours L, 15 hours D from 18 to 19 weeks; and 15 hours L, 9 hours D from 20 weeks to end of experiment.

Body and Organ Weights at Sexual Maturity

Variable	Result, by pullet maturity	
	Immature	Mature
Body weight, lb.	5.3	6.1
Abdominal fat pad, grams[1]	52.1	80.2
Liver, grams	56.7	83.9
Ovary, grams	1.5	45.4
Oviduct, grams	6.8	98.9
Carcass with fat pad		
Fat, pct.	15.1	17.1
Protein, pct.	17.0	16.5
Liver		
Fat, pct.	20.6	19.0
Protein, pct.	17.1	15.9

[1] 1 ounce = 28 grams.

At production of the first egg, weights were taken of the egg, body, liver, ovary, oviduct, and abdominal fat pad from mature pullets. Fat and protein contents of the carcass (including fat pad) and liver were determined. Similar measurements were made in paired immature pullets which lacked rapidly growing follicles.

Average age at production of first egg was 178 days. As shown by data in the table, live body weight and weights of the liver, ovary, and oviduct were greater in mature than immature pullets. However, differences in body weight between immature and mature pullets were accounted for by weights of the reproductive organs (e.g., egg, ovary, and oviduct) of the mature birds. There were no differences in carcass fat or protein between immature and mature pullets. Livers of immature pullets had a greater percentage of fat than those of mature pullets.

With sexual maturity delayed by restrictive photoschedules in this research, results did not identify any strict thresholds for body weight and composition for production of the first egg.

J.A. Renden

Support Poultry Research

Funds appropriated by the Alabama legislature provide the major financial support for Alabama Agricultural Experiment Station research. Hatch funds from the U.S. Government also represent an important funding source. Since these funds are limited, however, many areas of research would go unsupported except for financial support from various granting agencies, commodity groups, and other friends of the Experiment Station. Contributions of these supporters to the AAES programs of research are acknowledged with gratitude.

Among these supporters of AAES research, the following are thanked for their contributions to 1988-89 research in poultry science:

- **Agri-Bio Corp.**
- **Alabama Poultry & Egg Assoc.**
- **American Cyanamid Co.**
- **Ethyl Corp.**
- **Hoechst-Roussel (Agri-Vet Div.)**
- **Hoffman-LaRoche**
- **Ross Breeders, Inc.**
- **Southeastern Poultry & Egg Assoc.**
- **UpJohn Co.**
- **USDA/ARS**

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June 1989 6M

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