University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Historical Materials from University of Nebraska-Lincoln Extension

Extension

1989

EC89-259 The Nebraska Poultry Report 1989

Follow this and additional works at: http://digitalcommons.unl.edu/extensionhist

"EC89-259 The Nebraska Poultry Report 1989" (1989). *Historical Materials from University of Nebraska-Lincoln Extension*. 4649.
http://digitalcommons.unl.edu/extensionhist/4649

This Article is brought to you for free and open access by the Extension at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Historical Materials from University of Nebraska-Lincoln Extension by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

AGRI
S
85
E7
C2

University of Nebraska Cooperative Extension Service EC 89-259
University of Nebraska
Institute of Agriculture and Natural Resources

RECEIVED
APR 24 1989
UNIVERSITY OF NEBRASKA
LIBRARIES

The Nebraska Poultry Report

1989

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Leo E. Lucas, Director of Cooperative Extension Service, University of Nebraska, Institute of Agriculture and Natural Resources.

The Cooperative Extension Service provides information and educational programs to all people without regard to race, color, national origin, sex or handicap.

The 1989 Nebraska Poultry Report

Contents

Proper Regulation of Water Fountain Height for Turkeys and Broilers 3
Use of Sunflower Seed in Poultry Diets 4
Surimi-Like Products From Poultry Meat 5
Poultry Industry Gives Solid 4-H Support 6
Acid-Base Status of Blood and CSF in Heat-Stressed Hens 7
Temperature Humidity Index for Laying Hens 9
Evaluation of an Experimental High Protein Corn in Broiler Diets 12
The Effect of Cimaterol Withdrawal on Broiler Composition 13
Gene Transfer in Poultry 15
Value of Chicken Manure Used as Fertilizer 16
Extruded, Roasted and Untreated Full-Fat Soybeans in Poultry Diets 17

Issued February, 1989, 1,000

Contributors

Editor
Mary M. Beck
Associate Professor, Physiology
Animal Science Department

Jeff G. Baier
Graduate Student (M.S.)
Poultry Nutrition
Animal Science Department

Paul L. Bond, Jr.
Research Technician
Graduate Student (Ph.D.)
Poultry Nutrition
Animal Science Department

John A. Brumbaugh
Professor, Genetics
School of Biological Sciences

Chris R. Calkins
Associate Professor, Meats
Animal Science Department

D. M. Danielson
Professor, Swine Nutrition
West Central Research & Extension Center
North Platte, NE

James A. DeShazer
Professor, Agricultural Engineering
Agricultural Engineering Department

Jihad Douglas
Research Technician
Graduate Student (Ph.D.)
Poultry Nutrition
Animal Science Department

Earl W. Gleaves
Professor, Poultry Nutrition
Animal Science Department

Bob Graff
Graff Farms
Beatrice, NE

Bucky Gwartney
Graduate Student (M.S.)
Meats
Animal Science Department

Steven J. Jones
Assistant Professor, Meats
Animal Science Department

Auday A. Maki
Postdoctoral Fellow
Physiology and Biophysics
University of Washington, Seattle

J. A. Rydell
Graduate Student (Ph.D.)
Poultry Nutrition
Animal Science Department

F. John Struwe
Research Technician
Graduate Student (Ph.D.)
Poultry Environmental Management
Animal Science Department

Tom W. Sullivan
Professor, Poultry Nutrition
Poultry Section Leader
Animal Science Department

J. M. Zulovich
Graduate Student (Ph.D.)
Agricultural Engineering Department

Acknowledgments

Appreciation is expressed to the following organizations, agencies, or individuals who have provided support for the Poultry Research Program or for the Poultry Report:
Biokyowa, Inc.
Chesterfield, Missouri
Dawes Laboratories
Chicago, Illinois
Heartland Lysine
Chicago, Illinois
Hill Hatchery
Lincoln, Nebraska
Hoechst-Roussel Agri-Vet Co.
Somerville, New Jersey
Hoffmann-LaRoche, Inc.
Nutley, New Jersey
Hy-Line International
Spencer, Iowa
Iowa Limestone Co.
Des Moines, Iowa
Lonza, Inc.
Fair Lawn, New Jersey
Merck & Co., Inc.
Rahway, New Jersey
Occidental Chemical Co.
Jeffersonville, Indiana
Tyson Foods, Inc.
Springdale, Arkansas
Nebraska Agricultural Research Division
University of Nebraska, Lincoln
University Cooperative Extension Service
University of Nebraska-Lincoln
Nebraska Poultry Industries
Lincoln, Nebraska

Note: Because of budgetary constraints, the POULTRY REPORT is published in alternate years. The next edition will appear in February 1991.

Proper Regulation of Water Fountain Height for Turkeys and Broilers

Paul L. Bond, Jr.
Earl W. Gleaves

Wet litter is becoming recognized as a cause of leg problems, and is definitely a harbor for disease microorganisms. Poor management of water fountains is one of the major causes of wet litter. Many poultry managers are offended when approached about water fountain height regulation because the feeling is that "anyone can do it correctly." However, the definition of "correctly" seems to vary a great deal.

To maintain proper height of waterers for turkeys or broilers is to know that without gravity, poultry cannot swallow. Chickens and turkeys tilt their heads backward after drinking. The tilt of the head allows the water to flow down the esophagus by gravity. Thus, the less bending, tilting, or twisting the bird has to experience in drinking, the less stress is put on the animal.

Rule of Thumb

According to most management guides and poultry text books, adjustment of water fountain height should begin between day 5 to day 10 of the bird's life (i.e. brooding period). As a rule of thumb, the bottom of Plasson (bell-type) fountains or trough fountains should be even with the top of the bird's back (or slightly higher). This practice has two advantages. First, poults or chicks generally drink twice as much water as they eat feed. Water needs to be convenient to the bird, and with the water supply slightly above back height it will constantly be near eye-level. The importance of maintaining proper water:feed ratios is critical to good management. Second, proper height adjustment allows birds to run under fountains when frightened instead of bumping them as they run by. This is especially true of trough-type fountains as they have more surface area to bump. No thought should be given to lowering fountains for "the sake of little ones." Runts will only cost you money at market time and attempting to protect them may be costly to the remainder of the flock.

How can you tell if water fountains are too low? Obviously, if litter material or feces are observed in the water, the fountain is much too low. Likewise, a ring of wet litter around or under the waterer indicates birds are bumping the fountain rather than lowering their heads and going under. Also, when feed is found in the water, this indicates that feed is spilling from the bird's beak as it "bends over" to drink. If birds have to bend over to drink, the water fountain is too low.

Adjust Frequently

It is best if adjustments to water fountain height are done each time you wash and/or disinfect the fountains during the brooding and grow-out periods (you **do** wash the fountains, don't you?). This insures fountain height adjustment at least twice weekly.

Minor alterations to the "rule of thumb" mentioned above must be made according to the type of watering system employed. Generally, trough-type and bell-type fountains should be slightly higher than the bird's back because of the greater amount of surface area subject to bumping, and (since the trough's area is a bit shallow) the relative ease of water spillage from the trough. On the other hand, nipple-type or trigger-type fountains should be **slightly** lower than the bird's back for ease of pressing against the trigger to release water.

In conclusion, proper regulation of fountain height can reduce problems associated with wet litter and can maximize feed efficiency by allowing good water:feed ratios.

Use of Sunflower Seed in Poultry Diets

Jihad H. Douglas
Tom W. Sullivan

Production of sunflower seed with a high oil content is increasing. About 1.34 million tons of sunflower seed were produced in the United States in 1987. Since fats are added to poultry diets as a concentrated source of energy and for other benefits, it is logical to consider high-oil sunflower seed in formulating high-energy, high-protein poultry diets.

Nutrient Composition

Table 1 shows that the protein and amino acid content of different sunflower cultivars differ only slightly. However, there is considerable variation in fiber (14.6 to 25.8%) and ether extract (14.2 to 42.4%). The high ether extract value of unhulled sunflower seed (USFS) compared to yellow corn shows that USFS has the potential of replacing yellow corn as an energy source in poultry diets, but the high fiber content might limit its use, especially in diets for young birds. The metabolizable energy (ME) value of the different cultivars was estimated using the equation of Carpenter and Clegg (1956). Estimation of ME using the equation is not completely dependable because of the high fiber of sunflower seed.

Table 1. Composition of full-fat sunflower seed.[a]

Component	Average composition (%)			
	Kashani[b], 1988 1	Kashani[b], 1988 2	Uwayjan[c], 1983	UNL[d], 1988
Moisture	6.5	7.3	6.81	6.08
Crude protein	16.9	16.3	15.80	15.76
Crude fiber	14.6	25.8	16.73	20.15
Ether extract	42.4	29.0	14.20	22.44
Nitrogen-free extract	16.3	18.4	43.03	32.38
Ash	3.3	2.9	3.43	3.19
Estimated ME (kcal/kg)[e]	5,004	3,929	3,882	3,924
Arginine	1.18	1.39	— —	1.27
Glycine	1.01	.93	— —	.86
Histidine	.35	.40	— —	.36
Isoleucine	.70	.64	— —	.54
Leucine	1.11	.99	— —	.97
Lysine	.56	.50	— —	.54
Methionine	.41	.38	— —	.34
Phenylalanine	.74	.77	— —	.67
Threonine	.68	.62	— —	.55
Tyrosine	.36	.36	— —	.30
Valine	.93	.73	— —	.64

[a]On an as-fed basis.
[b]Kashani and Carlson, 1988. Poultry Sci. 67:445-451.
[c]Uwayjan, Azar and Daghir, 1983. Poultry Sci 62:1247-1253.
[d]Douglas, Sullivan and Bond, 1988. U. of NE (Unpublished Data).
[e]Based on the equation developed by Carpenter and Clegg (1956).

Table 2. Effect of dietary level of unhulled sunflower seed on laying hen performance.[a,b]

Sunflower seed %	Egg production %	Feed conversion (kg/doz)	Egg wt. (g)	Egg output (g/hen/day)
0	78.3	2.1	65.5	48.2
19.0	75.0	2.1	65.5	49.0
38.0	72.8	2.1	65.9	47.9

[a]Kashani and Carlson, 1988 Poultry Sci. 67:445-451.
[b]Means of fourteen 28-day periods.

Feeding Trials

Table 2 shows the influence of different levels of USFS on laying hen performance. Feeding USFS as a partial replacement of yellow corn and soybean meal for fourteen 28-day periods did not significantly influence the overall performance of layers. However, egg production rate tended to be lower with each increment of USFS in the diet. Body weight gain of broilers at five weeks of age was decreased ($P<.05$) when USFS constituted either 15 or 25% of the diet (Table 3). The USFS cultivar used by Uwayjan *et al.* (1983) contained about one-third to one-half the oil content as compared to the cultivars evaluated by Kashani and Carlson (1988). This difference in oil content might explain in part the poor performance of broilers from day-old to five weeks of age in the study of Uwayjan *et al.* (1983).

Table 3. Effect of feeding different levels of unhulled sunflower seed on broiler performance.[a]

Sunflower seed %	Body weight at 35 days (g)	Feed/gain 1-35 days
0	1209[a]	1.63[a]
15	1113[b]	1.63[a]
25	975[c]	1.70[b]

[a]Daghir, Raz and Uwayjan, 1980. Poultry Sci. 59:2273-2278.
[a,b,c]Means are different ($P<.05$).

Table 4. Effect of feeding different levels of unhulled sunflower seed on broiler performance, 42 to 56 days of age.[a]

Sunflower seed %	Body weight gain (g)	Feed/gain 42-56 days
0	755	2.69
10	749	2.61
20	764	2.65
30	770	2.78
Linear	NS	NS
Quadratic	NS	NS
Cubic	NS	NS

[a]Each value is the mean of 5 pens per treatment with 50 birds per pen. Douglas, Sullivan and Bond. U. of NE, 1988. (Unpublished data).

Broilers are usually processed and marketed at six to seven weeks of age. However, in recent years some producers are growing broilers to eight or nine weeks of age for processing into boneless white meat fillets, chicken nuggets, and related products. Studies are needed to determine the nutrient requirements and the use of non-conventional feedstuffs for broilers six to eight or nine weeks of age.

Results of feeding different levels of USFS on the performance of broilers six to eight weeks of age are shown in Table 4. Body weight gains and feed conversion of broilers fed USFS up to 30% of the diet were practically identical to control birds fed the corn-soybean meal diet. Differences in the results obtained by Uwayjan *et al.* (1983) and results of this study can be explained largely by the difference in oil content of the cultivars used, and the fact that broilers might be better able to use the high fiber content of sunflower seed at an older age (six to eight weeks) than during the starting period (one to three or five weeks).

Conclusions

Unhulled sunflower seed may constitute at least 30% of the diet of broilers six to eight weeks of age without any adverse effect on performance. The use of USFS in animal feeds is not extensive because of limited production and because of the human consumption of sunflower oil. The use of USFS in animal feeds has great potential in those areas where its production is not large enough to justify oil extraction. Metabolizable energy determinations on different sunflower seed cultivars would facilitate more accurate formulation of diets, especially in the case of poultry. The ME levels specified for various poultry and ME levels in feed ingredients are the primary factors influencing the formulation or final recipe.

Surimi-Like Products From Poultry Meat

G. W. Froning

The poultry processing industry can often learn from existing technologies used by other segments of the food processing industry. An excellent example is the surimi process currently being commercially applied by the fish industry (Lanier, 1986; Lee, 1986). This process involves washing mechanically deboned fish to remove the color producing proteins (hemoglobin and myoglobin) which have a poor bind and impart some undesirable color.

The resultant surimi product has excellent binding properties and is substantially lower in fat. Starch, egg white, and cryoprotectants (protects proteins during freezing) are usually added to improve the general properties of the prepared surimi to further enhance functional properties and storage stability. Surimi is normally extruded into various products, such as chunk-type crab legs and shrimp analogs (Lee, 1986). The prepared products are hard to distinguish from the real thing.

Studies Here

Application of this process to poultry products is now receiving emphasis at Nebraska (Froning and Niemann, 1988) and other laboratories throughout the country. Mechanically deboned poultry meat is now being used in a variety of emulsified products, such as frankfurters, bologna, etc. Unfortunately, mechanically deboned poultry meat lacks the necessary bind and other textural properties for use in other restructured products, such as roasts, patties, and similar applications requiring the appearance of intact muscle. Mechanically deboned poultry meat contains considerable hemoglobin from the bone marrow. This high hemoglobin content imparts poor color characteristics and decreases storage stability.

If mechanically deboned meat is washed three times using a three parts water or dilute salt solution to one part meat, there is a marked improvement in the binding properties

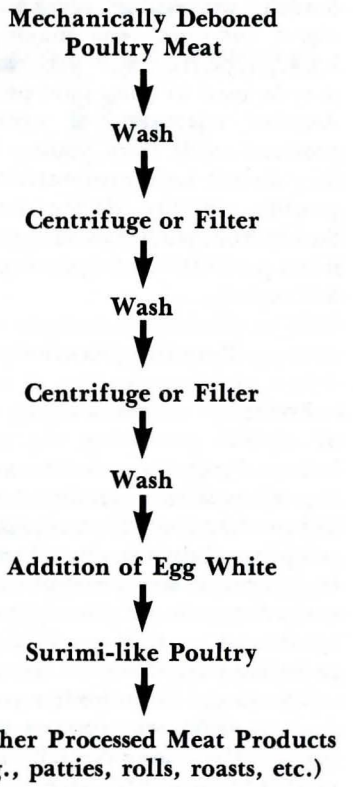


Figure 1. The production of surimi-like from poultry meat.

Table 1. Effect of surimi processing on composition of mechanically deboned chicken meat.

	Moisture %	Fat	Protein
Mechanically deboned chicken meat	68.0	16.2	16.1
Surimi-like product	83.6	1.9	15.5

of the muscle (Figure 1). The undesirable sarcoplasmic proteins are removed and the desirable myofibrillar proteins are concentrated. The resulting surimi-like meat has the appearance of white meat and the textural properties of intact muscle. Since many consumers prefer white meat, there should be excellent market potential. This surimi-like product is higher in moisture and lower in fat than the original mechanically deboned poultry meat (Table 1). Surimi processing reduces yield about one-third: one major drawback. Nevertheless, the washings may be used in other food products. Another advantage of surimi-like products made from poultry is that they do not need cryoprotectants to provide stability during freezing. Surimi from poultry meat apparently is less prone to freezing damage than fish surimi.

Promising Results

Presently, we are studying effects of surimi processing on poultry hearts. Preliminary indications are that it is possible to produce a surimi-like product from heart muscle. The resulting product has excellent binding properties and the appearance of normal muscle. If this approach is feasible, it may be possible to improve less desirable meat sources.

The future of surimi-like products from poultry meat appears promising. For this reason our laboratory is investigating several aspects of the washing process to improve yields and quality of the resultant surimi-like product.

Poultry Industry Gives Solid 4-H Support

F. John Struwe
Earl W. Gleaves

The Nebraska Poultry Industry (NPI) has supported the 4-H poultry program in a consistent and enthusiastic manner. Many activities are available to 4-H'ers who wish to compete for honors, trips, and scholarships in the Nebraska Poultry Youth program.

Each year in November the poultry industry and Ak-Sar-Ben send a poultry judging team to Louisville, Kentucky, to compete in the National 4-H Poultry and Egg Conference. The team representing Nebraska at this contest consists of four individuals who first must win the senior poultry judging contest at the Nebraska State Fair. The State and National Contests include:

Two or three classes of past production laying hens.

Oral reasons for the placing on one or two of the above classes.

Three classes of eggs.
- Shell quality.
- Interior quality.
- Broken out quality.

Three classes of ready to cook carcasses.
- Broilers.
- Turkeys.
- Roasting hens.

One class of poultry cut-up parts.

USDA Standards

All of these categories, except the production classes, are judged using USDA standards to put a grade on the eggs and poultry meat. Not only does the industry support the judging team, but also the 4-H'ers who are competing in the national turkey barbeque and egg cookery demonstration. This year, for the first time, Nebraska is also sending someone to the broiler barbeque contest. These individuals are also selected at the Nebraska State Fair. Each 4-H'er must demonstrate his or her ability to cook turkey, broilers, or eggs, with the final product being judged. These cooking contests are judged on the demonstration and on product flavor, appearance, tenderness, and nutritional value. Not only do the 4-H'ers demonstrate and cook their products at Louisville, they must also give a presentation on the particular product they are cooking. The presentation may include nutritional information, ease of kitchen preparation, or other facts concerning the product.

During the Midwest Poultry Meeting in Minneapolis, a Junior Poultry Conference is held. Each year poultry record book winners from each district in the state are invited to attend. These record books must contain poultry projects to be eligible for competition. The winning record books are also submitted to Midwest in competition for scholarships awarded by Midwest. The number one record book winner from the state is selected to attend 4-H Congress in Chicago each year. Both

trips (Louisville and Minneapolis) include transportation, meals and lodging for the youth, their chaperones, and their coach.

Strong Support

Nebraska's participation shows strong financial support of the 4-H poultry program. In addition to the support of the trips, the industry helps individuals and teams in other ways. Salisbury and Waldbaums have furnished judging jackets in the past. In 1988 Waldbaums again supported the purchases of jackets for the judging team. These jackets are a bright color with lettering across the back that proudly proclaim the youth to be in 4-H and from Nebraska.

Turkey filets for the Nebraska State Fair Contest and the National 4-H Poultry and Egg Conference Turkey Bar-b-que contest are furnished by the Nebraska Turkey Growers. Each year two breast filets are furnished for each individual entry at the state and national contest. This, too, is strong and appreciated support.

Ak-Sar-Ben is also active in the 4-H program in ways other than as a partial trip sponsor. The Ak-Sar-Ben broiler show held each year during September encourages 4-H'ers to get involved in growing broilers. The 4-H'er is able to learn many management skills from a project of this type. The top five pens of birds are sold each year to Ak-Sar-Ben sponsors at the Sale of Champions.

Not only are these activities fun and a reward for hard work, they are also educational. For many, this is their first opportunity to travel and meet other 4-H'ers from all parts of the country. The Nebraska 4-H'ers do a good job of representing our state. In the last three years Nebraska has placed 1st, 5th, and 7th in the turkey barbeque. Our judging team has been consistently near the top ten. With placings of 13th, 11th, and 12th during the last three years, they may make the top ten this year. It is important to realize that these contests are very competitive. It is not unusual for as few as 150 points out of a possible 4500 to separate the 10th place team from the 1st place team. The egg cooking demonstration team has placed well also with 5th, 7th, and 6th finishes.

Nebraska Fares Well

In the scholarship competition at Midwest, there has been a winner from Nebraska for each of the last three years. Much of this good showing is due to the efforts of Doyle Free. He works hard at getting the Poultry Record books entered into the competition. His office and poultry extension review the record books that are entered, and send the state winners to Minneapolis.

Each year at the Junior conference in Minneapolis, the delegates give a short talk or demonstration on their poultry projects or activities. These talks are voted on by the other youth members present. Last year, a Nebraska delegate was selected as having the best demonstration. In addition, the delegates are required to visit a booth, interview the people present, and report their findings to the whole group. With this type of representation in these events, one can see that the Nebraska youth work hard and do a good job.

If it were not for industry support, these winning individuals would have to find support elsewhere or not participate at all. These activities give the youngsters an appreciation of the poultry industry and make them aware of opportunities available in this modern fast growing agriculture industry. One-third to one-half of the UNL students with an interest in poultry come through the youth program, some from 4-H, and others from FFA.

The youth involved, the university poultry faculty and staff, and the university administration appreciate this strong industry support. We wish to to thank you, the poultry industry of Nebraska, and Ak-Sar-Ben, for your support of an important program.

Acid-Base Status of Blood and CSF in Heat-Stressed Hens

Mary M. Beck
Auday A. Maki

The respiratory anatomy of birds is complex and its role in thermoregulation is still incompletely understood. High ambient temperatures are thought to cause a shift in the acid-base balance of laying hens during panting in the direction of respiratory alkalosis. This is the basis of the "conventional wisdom" regarding physiological response to heat stress, although there is not complete agreement about the order of events. Development of respiratory alkalosis can be accompanied by electrolyte movement across the cell membrane. Recently, it was confirmed that the low carbon dioxide in blood and respiratory alkalosis that accompany hyperventilation (panting) induced by acute hyperthermia (high body

temperature) are associated with a reduction in blood calcium, but no increase in urinary calcium, leaving open the question of calcium's destination during heat stress. Thermal stress does increase calcium in cerebrospinal fluid (CSF), and, although the CSF would not be of sufficient volume to receive an equivalent decrease in blood calcium, the blood-brain-barrier may become leaky under heat stress, which would allow at least some calcium to cross.

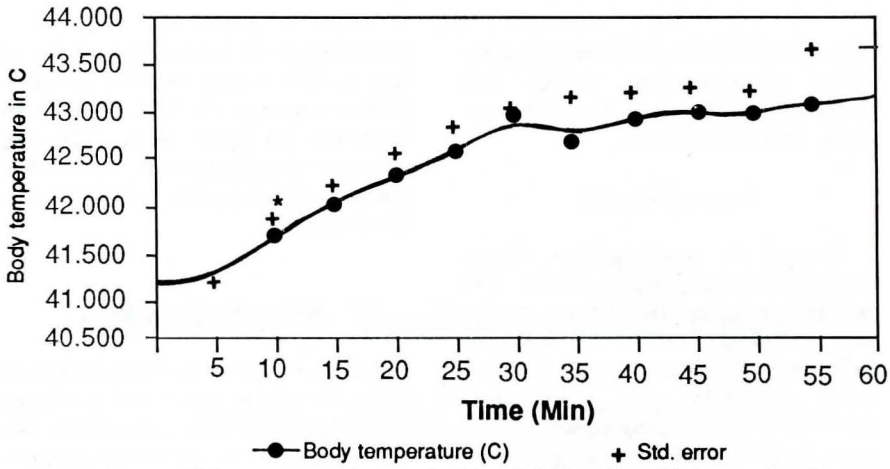
The relationship between the respective chemical compositions of blood and CSF has been studied extensively in mammals. In avian species, however, information concerning systemic and CSF acid-base status during heat stress is not as extensive. Objective of this study was to study and determine the acid-base status of the blood and CSF immediately following onset of thermal stress and to determine the time course of any changes.

The questions asked were:

1. What systemic and CSF changes occur in avian species in response to heat stress?
2. When do changes occur relative to onset of heat stress?

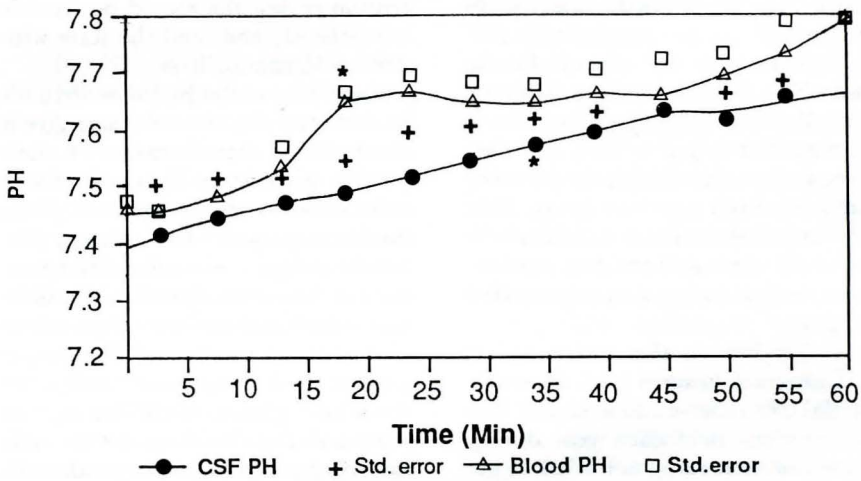
Materials and Methods

HyLine W-36 White Leghorn hens were used at 56 weeks of age. They were caged individually in an environmental chamber held at 25°C (77°F) and fed a standard layer ration (2794 kcal/kg; ME; 15-18% protein) and water *ad libitum*. Heat stress temperature was 39°C (102.2°F). A photoperiod of 16L:8D was used. Cloacal temperature was monitored using a clinical thermometer; an arterial sample was taken at 25°C and every 5 minutes after exposure to 39°C for a total of 60 minutes. Blood samples were analyzed for pH immediately after withdrawal by inserting a small electrode into the syringe. Samples were then analyzed for lactate. CSF pH was measured *in vivo* with a needle electrode inserted into the third ventricle of the brain.



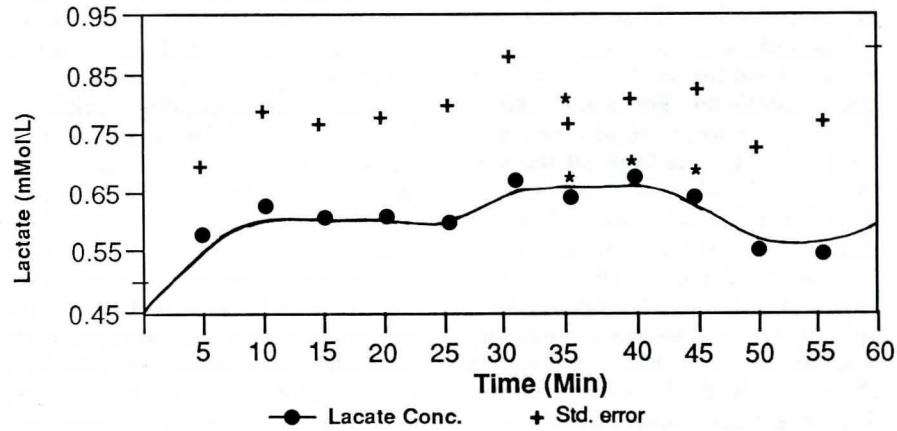
*denotes time at which temperature became significantly higher (P<.05) than at time 0.

Figure 1. Cloacal temperature of laying hens at 25 (time 0) and 39C.



*denotes time at which pH became significantly (P<.05) higher than at time 0.

Figure 2. Arterial and CSF pH in laying hens exposed to 25 (time 0) and 39C.



*denotes time at which lactate level became significantly (P<.05) higher than at time 0.

Figure 3. Arterial lactate in hens exposed to 25 (time 0) and 39C.

Results

Immediately after onset of heat stress, cloacal temperature rose sharply to 42.7 °C (109 °F) where it stabilized (Figure 1). Panting did not begin until about 35 minutes after onset of 39 °C. Arterial pH increased sharply within 10 minutes after onset of 39 °C, reaching 7.65 after 20 minutes, and becoming significantly higher by 30 minutes (Figure 2). CSF pH rose in a nearly linear fashion, but more gradually (Figure 2). Blood lactate increased 5 minutes after onset of 39 °C, after which it stabilized over the next 15 minutes, increasing again 35 minutes after onset of heat stress to a maximum of 0.73 mM/l (Figure 3).

Discussion

This study demonstrates that a representative avian species, the laying hen, displays the same CSF and blood responses to heat as do mammals. The time course of development of alkalosis (Figure 2) can be compared with the time course of lactate (Figure 3) and cloacal temperature (Figure 1) increases. Blood lactate increased instantly on exposure to 39 °C while arterial pH required 10 minutes, suggesting that lactate may have acted as a buffer mechanism to prevent development of alkalosis. At 30 minutes post-exposure, cloacal temperature and pH had stabilized, and arterial lactate had risen again. This later rise in lactate may serve to prevent even greater increases in pH and cloacal temperature by some buffering action. It is much more likely to be caused by low blood carbon dioxide at this point, since panting had begun.

It appears, therefore, that lactate may play a very important role in protecting the bird against hyperthermy, initially by rising directly in response to heat to delay onset of alkalosis, and later by rising again to limit its severity. The much greater CSF lactate response to heat stress temperatures may be evidence of less effective buffering in the brain or, alternatively, greater sensitivity to thermal stress.

Temperature Humidity Index for Laying Hens

J. M. Zulovich
J. A. DeShazer

High temperature and humidity effects on poultry have concerned poultrymen, but little knowledge exists explaining the production effect of this combination. Nebraska has one of the few laboratories capable of evaluating effects of high temperature and humidity upon the physiological responses of poultry. A temperature-humidity index has been developed at Nebraska in the Bioenergetics Laboratory in Agricultural Engineering which combines air temperature and humidity into

Table 1. Normal year flock information

Age (Weeks)	Week of production	Egg production (%)	Feed consumption (lb/100 hens)
18	0	0.0	15.27
22	4	62.5	19.09
26	8	93.1	23.99
30	12	90.1	24.54
34	16	88.7	25.24
38	20	86.3	25.43
42	24	84.0	24.48
46	28	81.7	24.34
50	32	79.4	24.18
54	36	77.1	24.02
58	40	74.8	23.81
62	44	72.5	23.56
66	48	70.2	23.29
70	52	68.1	23.07

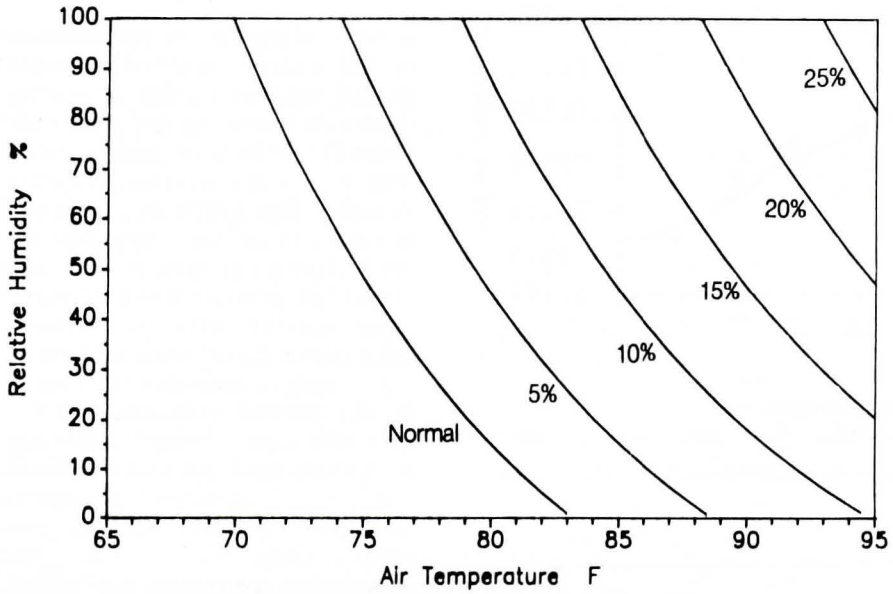


Figure 1. Expected feed consumption decline due to prolonged heat exposure.

one value. These index values can be substituted into previously developed environmental relationships between air temperature and production. Using index values and production relationships, production declines due to combined high temperatures and humidities can be estimated.

Materials and Methods

The temperature-humidity index (THI_h) was developed from a physiological database obtained during the summer of 1987. Ten environmental temperature-humidity combinations were based on five dry bulb temperatures of 86.0, 89.6, 93.2, 96.8 and 100.4°F; and two relative humidity levels of 50 and 90%. The duration of the heat stress period was five hours or until body temperature reached 112.1°F. Sixty White Leghorn laying hens from 61 to 74 weeks of age were used.

Rates of sensible and latent heat loss, respiratory rate, and rectal temperature were measured once every five minutes during heat stress exposure. Statistical and engineering parameters such as average values and rate of change were extracted from these measurements to provide 22 physiological variables. These physiological variables were then correlated to calculated index values.

A temperature-humidity index value was calculated using the following equation:

$$THI_h = a\,T_{db} + (1-a)\,T_{wb}$$

where:

T_{db} = Dry bulb temperature of heat stress environment, °F

T_{wb} = Wet bulb temperature of heat stress environment, °F

and a = Weighting factor for the index.

Index values calculated from "a" values ranging from 0.1 to 0.9 were correlated with the physiological variables. Correlations of the index values and the physiological variables were grouped according to state of egg formation, egg production level, and egg size produced.

Results and Application

Only the hens forming an egg while the energetic measurements were taken were used to develop the index. This is the common physiological state for producing laying hens. The two other grouping factors, egg production level and egg size produced, did not influence, as anticipated, the selection of the optimum weighting factor for the THI_h. Therefore, the index does not need to be adjusted for egg production level or egg size.

The optimum "a" value was 0.6; thus, the weighting factors for the dry bulb and wet bulb temperatures were 0.60 and 0.40, respectively.

Thus, THI_h in equation form is:

$$THI = 0.60\,T_{db} + 0.40\,T_{wb}$$

where: T_{db} = Dry bulb temperature, °F,

and T_{wb} = Wet bulb temperature, °F.

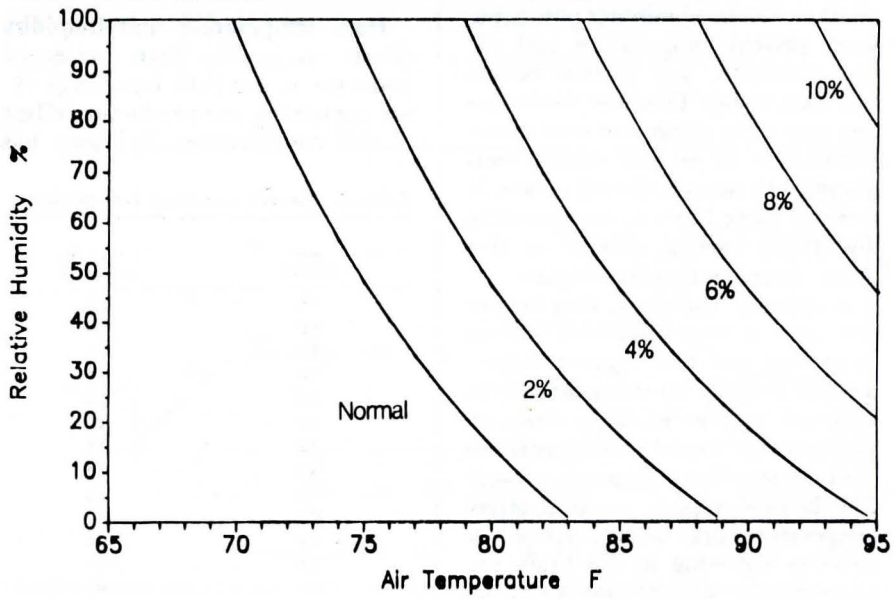


Figure 2. Expected egg production decline due to prolonged heat exposure.

The THI_h was substituted for air temperature in a laying hen production model initially developed at the University of Nebraska. The presented equations, charts, and table can be used to determine the most economical operating temperature and humidity for a laying facility based only on feed consumption and egg production.

Cost = fdcost fdcons (1-fddec/100)

where: Cost = feed cost per 100 hens
fdcost = feed cost/lb feed at 1300 kcal ME/lb of feed
fdcons = normal feed consumption (lb/day-100 hens)
fddec = percent feed consumption decline (%)

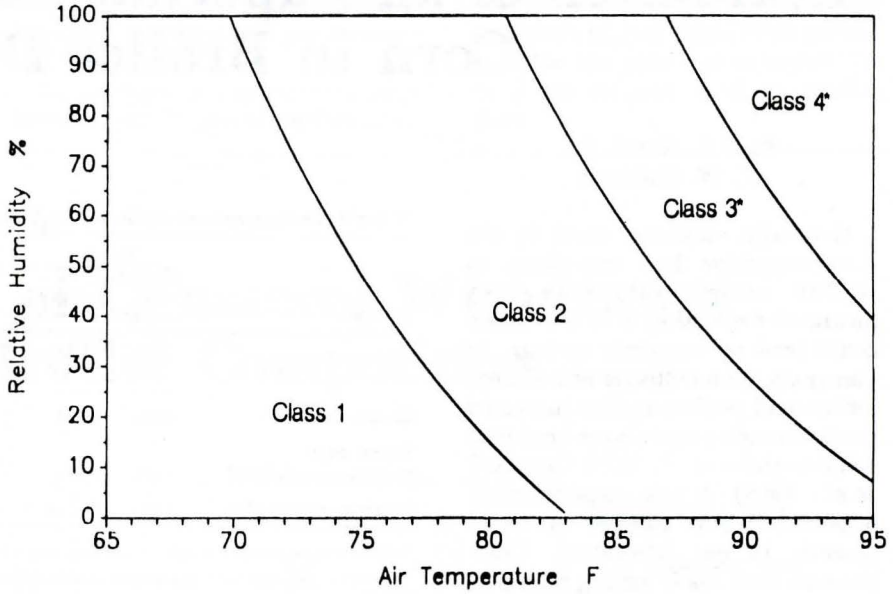
Income = eggprod (1-eggdec/100) eggprice/12 (1-break/100)

where: Income = egg income from 100 hens
eggprod = normal egg production level (%)
eggdec = percent egg production decline (%)
eggprice = egg price for size produced ($/dozen)
break = percent egg breakage (%)

Net Return = Income Cost

where: Net Return = income after feed cost from 100 hens

The user of this economic method must provide the feed cost and the egg price for each egg class. Table 1 provides an example of normal feed consumption and egg production levels at a given age. You can find this information in the "Management Guide" for a given breed or variety. The value for feed consumption decline (fddec) is obtained from Figure 1. The egg production decline (eggdec) and egg breakage percentage (break) are obtained from Figures 2 and 3, respectively. The egg class produced is influenced by the production week of the hens. A series of figures is necessary for determining egg class produced. A sample figure (Figure 4) shows the egg class produced by 30-week-old hens in the 12th week of production.



*These two classes are theoretical, generated from equations, but in reality are not seen as a consequence of temperature.

Figure 4. Egg class produced at 30 weeks of age.

In the following example, using this economic method, the maximum temperature can be calculated for maximum net return in a laying house at 50% relative humidity. The feed cost is $0.06/lb and egg prices are $0.57 and $0.53 for Class 1 and Class 2, respectively. By obtaining the remaining information for the equations from the appropriate figures, the following incomes and costs are calculated. The incomes are $4.28, $4.28, $4.27 and $3.95 per 100 hens at 73, 74, 75 and 76°F, respectively, and the corresponding costs are $1.47, $1.47, $1.47, and $1.46 per 100 hens. Thus, the resulting net returns are $2.81, $2.81, $2.80 and $2.49. Therefore, the maximum temperature is 74°F. The reason for the sudden drop in net return from 75 to 76°F is that the hens are laying eggs in Class 2 instead of Class 1.

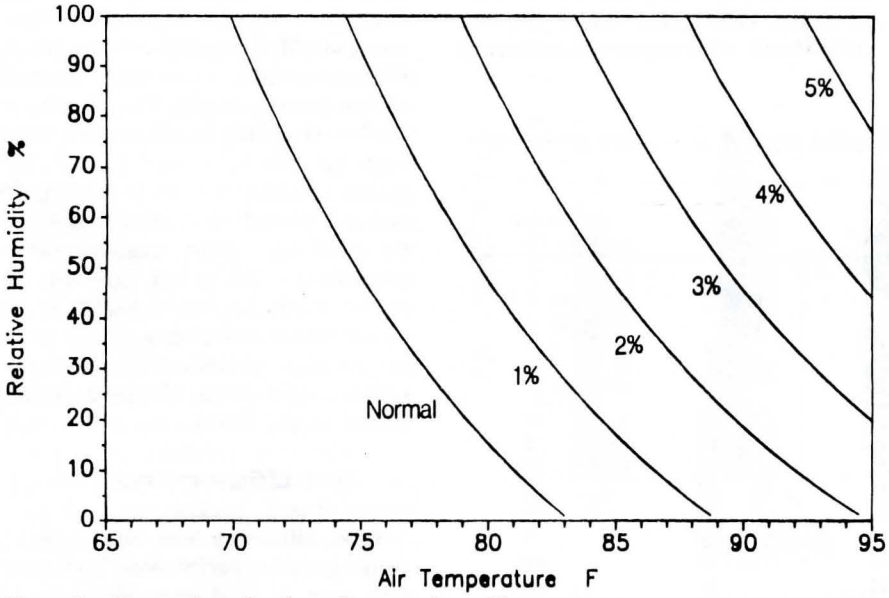


Figure 3. Expected egg breakage due to prolonged heat exposure.

Evaluation of an Experimental High Protein Corn in Broiler Diets

Paul L. Bond, Jr.
T. W. Sullivan

Generally, soybean meal is the most expensive feed ingredient in poultry rations. Therefore, any means of decreasing it in the ration could lead to economic savings. In past years, corn cultivars with altered amino acid profiles and/or increased levels of crude protein have been tested (Fernandez *et al.*, 1974; Cromwell *et al.*, 1968). A new, experimental, high protein corn cultivar was tested recently in our laboratory. Comparisons were made among high protein corn, "generic" corn, and grain sorghum of a known cultivar (NC+271) and composition. Corn that is truly higher in crude protein and amino acid content could end the need for soybean meal in poultry diets.

Experimental diets were formulated using the nutrient composition values shown in Table 1. The high protein corn contained higher levels of the amino acids lysine, methionine, and cystine as compared to the other grain sources.

Two Trials

Two feeding trials were conducted. The first used grains in diets considered low in protein for starting chicks (18.4% protein). The rationale for this was that if the experimental corn was truly higher in protein, chicks would gain more weight. In trial two, recommended (NRC, 1984) protein levels (22% in the starter, 19% in the grower) were used, and the birds were fed to 42 days of age. In each trial, body weight gain and feed efficiency were used as response criteria. Differences in shank color were noted in trial two. Shank color was measured using a *Roche* color fan.

Table 2. Performance of chicks fed high protein corn, generic corn, and grain sorghum.

Treatment	Trial 1		Trial 2				
	Body wt gain (grams)[a]	Feed/gain ratio	Body wt gain (grams)[b]		Feed/gain ratio		Shank color
	Day 21	Day 21	Day 21	Day 42	Day 21	Day 42	Day 42
Generic corn	585a	1.68b	571a	1633a	1.64b	2.00b	7.3c
Exper. high protein corn (#3166)	627b	1.57a	590a	1750b	1.57a	1.96a	6.5b
Sorghum (NC+271)	588a	1.61ab	596a	1680a	1.54a	1.94a	1.0a

[a]Each value is the average of 5 replicate pens containing 6 Vantress X Arbor Acre chicks per pen.

[b]Each value is the average of 5 replicate pens of males and 5 replicate pens of females containing 6 Vantress X Arbor Acre chicks per pen.

[a,b,c]Values within the same column which are followed by different subscripts are statistically different ($P < .05$).

Results of feeding trials one and two are shown in Table 2. In the first trial, chicks receiving the experimental high protein corn diet gained about 40 grams (about .10 pound) more weight than chicks fed diets with the other grain sources. Therefore, this cultivar of corn can be called high protein since the protein level is great enough to end the need for soybean meal and chicks still grow at a fast rate. However, in trial two, there were no significant differences in 21-day weight gains (these diets contained recommend instead of low protein levels). Conversely, at 42 days the birds fed diets containing high protein corn had gained 117 grams and 70 grams more (about .25 and .15 pound) than birds fed generic corn and grain sorghum diets, respectively. This late growth response might be due to higher levels of the sulfur-containing amino acids in the high protein corn. Such responses have been observed before (Bond *et al.*, 1985).

Feed Efficiency Improved

Feed efficiency was improved by feeding the experimental high protein corn in trial one. However, in

Table 1. Approximate nutrient composition of grains involved in the high protein corn evaluation study

Component	Yellow corn	Exper. high protein corn (#3166)	Grain sorghum (NC+ 271)
Metabolizable energy			
KCal/lb	1530	1530	1480
KCal/kg	3370	3370	3260
Fat, %	3.8	3.8	3.0
Linoleic acid, %	1.9	1.9	1.1
Crude Protein, %	8.9	11.2	10.8
Lysine, %	.24	.32	.22
Methionine, %	.18	.22	.16
Cystine, %	.20	.24	.20
Tryptophan, %	.07	.07	.07
Threonine, %	.39	.37	.30
Isoleucine, %	.30	.36	.35
Phosphorus (Avail.), %	.08	.08	.09
Calcium, %	.01	.01	.02

trial two, feed efficiency of chicks fed grain sorghum was equal to that of birds fed high protein corn. Shank color was lowest for birds receiving the grain sorghum diet. Generic corn produced shanks more deeply pigmented than did the high protein corn. However, skin pigmentation in broilers is usually not of great economic importance.

In summary, an experimental high protein corn improved performance of broiler chicks receiving both low and recommended or standard protein levels in their diets. High protein corn has the potential to reduce the need for soybean meal in poultry diets.

The Effect of Cimaterol Withdrawal on Broiler Composition

B. Gwartney
S. J. Jones
C. R. Calkins

Introduction

Poultry consumption has increased over the past several years as consumers have realized its potential nutritional benefits. Skinless poultry meat is low in fat and cholesterol, high in digestible protein, and provides a wide range of nutrients. These factors, along with an outstanding promotion effort and low cost per serving, have boosted the poultry industry's image to the consuming public. However, producers still face the problem of excessive abdominal fat found in the tail region of poultry. Producers are continuously making strides in cost efficiency and product improvement. New methods of producing leaner, more desirable poultry are being developed and used at a rapid pace.

Cimaterol, a Beta-agonist, reduces fat and increases protein in broiler chickens and can be added directly to the feed as an additive with very little additional production cost. This is important because the producer would minimize handling of the birds, reducing further management practices, and keeping costs down. The addition of cimaterol (1 ppm) in the diet reduces fat content and increases protein. This is important to the producer who wants to market a leaner, more desirable product to the consumer.

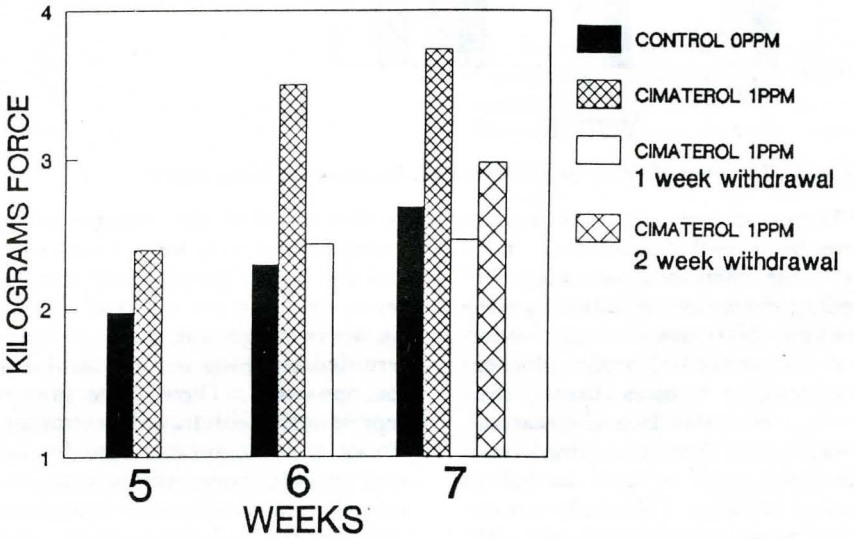


Figure 1. The effect of cimaterol withdrawal on shear force values of breast muscle.

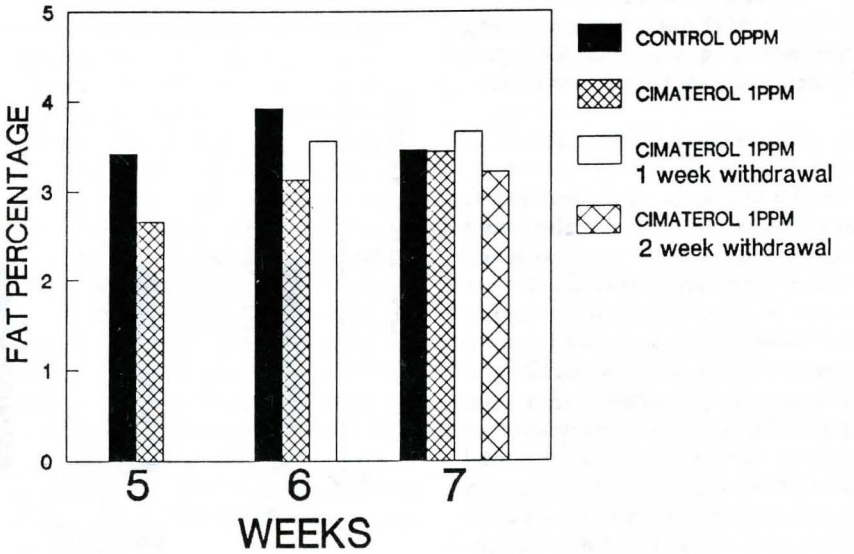


Figure 2. The effect of cimaterol withdrawal on fat content of leg muscles.

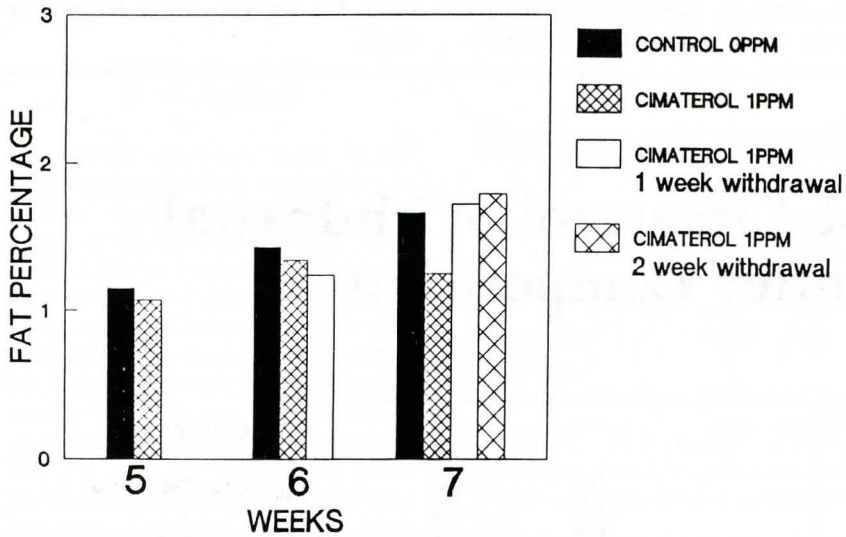


Figure 3. The effect of cimaterol withdrawal on fat content of breast muscle.

These changes in composition have been well documented; however, the increased advantages of feeding cimaterol are offset by some resulting decreases in meat tenderness. Cimaterol-fed broiler chickens have tougher muscles (breast) than broilers fed a diet free of cimaterol. This problem should be considered if cimaterol is to be used in today's broiler industry. This study was designed to see whether different withdrawal periods from cimaterol might alleviate the decreased tenderness problem without compromising other advantages of increased protein and decreased fat deposition.

Materials and Methods

Broiler chickens were obtained at three weeks of age, weighed and wingbanded, and randomly assigned to one of nine treatments. Birds were housed in growing batteries under continuous light and were given water and feed *ad libitum*. Broiler chickens were fed either 0 or 1 ppm cimaterol in the diet starting at three weeks of age and were fed to final ages of five, six, or seven weeks with groups of cimaterol-fed and control-fed (0 ppm cimaterol) birds slaughtered at each of these three periods. At five weeks of age, two groups of cimaterol-fed birds were fed the control diet (withdrawal), until slaughter at six and seven weeks of age. At six weeks of age, one group of cimaterol-fed birds was fed a control diet for one week. These three groups represent the withdrawal treatments. Breast and leg muscles used for fat and protein composition were removed immediately after slaughter, quick frozen in liquid nitrogen, and stored frozen until further analysis. Breast muscles sheared to determine tenderness were left on the carcass for two hours after slaughter allowing rigor to occur. The breasts were then removed and placed in a 4°C cooler for 24 hours to let any aging or tenderization occur and frozen for later shear force determination on an Instron Universal Testing Machine using a Warner-Bratzler shear attachment.

Results and Discussion

Cimaterol-fed birds had lower fat and higher protein contents in the breast and leg muscles when compared to the control counterparts resulting in a leaner, more nutritious product containing less cholesterol (Figures 2,3,4,5). Cimaterol-fed birds also had higher shear force values in the breast muscle, an indication of increased toughness possibly due to decreased degradative enzyme activity and/or an increase in cell size (Figure 1). Degradative enzymes are responsible for partial tenderization due to protein degradation in the muscle postmortem and decreased amounts of these enzymes could result in increased toughness. An increase in cell size (hypertrophy) could also be responsible for the observed decrease in tenderness where increases in cell size result in

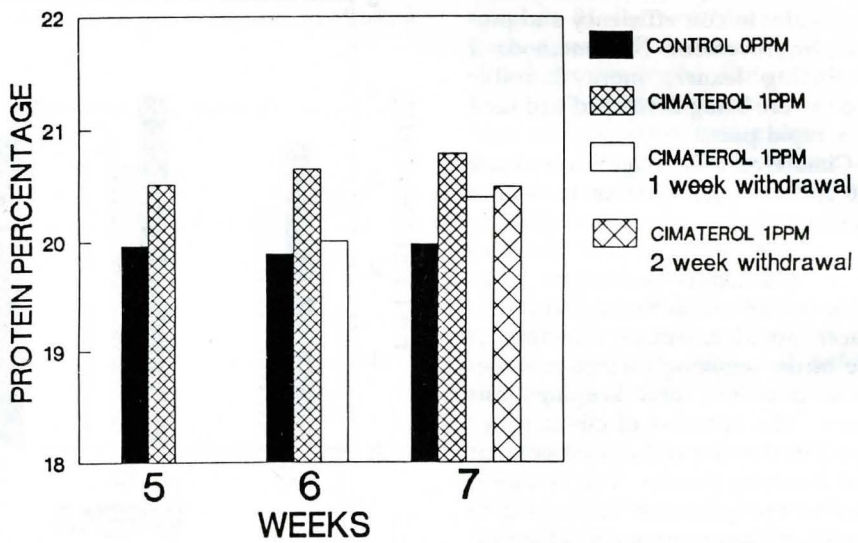


Figure 4. The effect of cimaterol withdrawal on protein content of leg muscles.

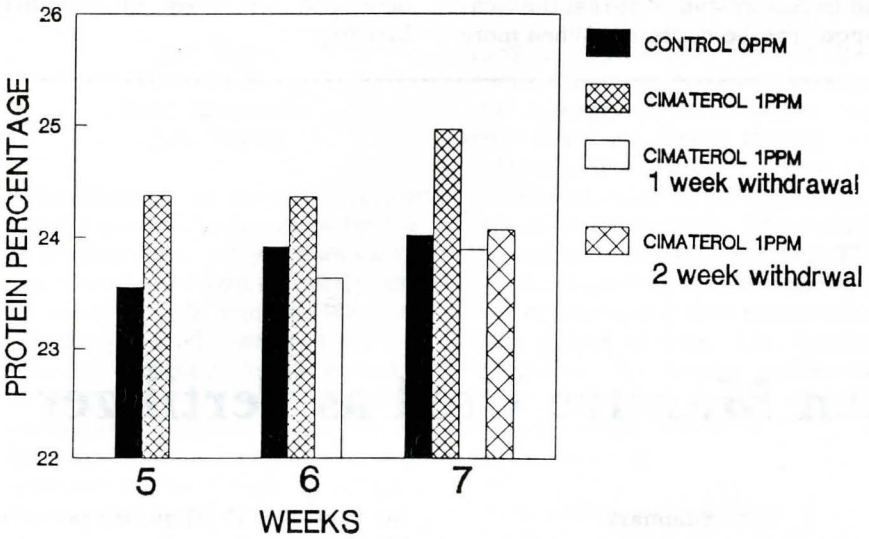


Figure 5. The effect of cimaterol withdrawal on protein content of breast muscle.

an increased "packing" of the muscle fibers, thus increased shear force values. Withdrawal from cimaterol to the control diet, however, resulted in a reversing of these trends and brought the cimaterol-induced shear force values back to near control levels (Figure 1).

Leg muscles revealed the greatest sensitivity to cimaterol for fat deposition, with five and six week cimaterol birds having significantly lower fat contents (Figure 2). This sensitivity could be due to two factors: one, that leg muscle contains a high proportion of red fibers which in turn contain higher degrees of inter and intrafiber fat (seam fat and marbling respectively), and two, because of the above, leg muscle contains more fat to be affected by cimaterol. Withdrawal treatments, however, resulted in increased fatness similar to the control counterparts. No major differences were observed in the fat content of the breast muscle, but cimaterol fed birds did have numerically lower fat percentages than controls at all ages (Figure 3).

Protein content in the breast and leg muscles was increased at all ages in cimaterol-fed birds compared to the control birds. Withdrawal from cimaterol to the control diet reduced protein content in the breast and leg muscles to near control levels (Figure 4). This is important since withdrawal, in some instances, reduced the protein levels in breast muscle to below that of control birds, negating all the advantage of increased protein due to cimaterol (Figure 5).

In conclusion, withdrawal from cimaterol results in a reversal of the positive (decreased fat, increased protein) as well as the negative (increased shear force values) effects. Therefore, withdrawal from cimaterol is helpful in reducing the toughness effect; however, it is compromised by increased fatness and decreased protein. The question remains, do the decreases in fat and increased protein levels outweigh the increased toughness observed? This question is being further studied by investigating possible mechanisms that might be involved in the tenderness problem.

Gene Transfer in Poultry

John A. Brumbaugh

The ability to transfer genes into various lines and breeds of chickens should benefit the poultry industry. Transfer of disease resistance and/or immunity, production traits, autosexing markers, and even vitamins or pharmaceuticals useful to the consumer could conceivably be permanently transferred. The transfer is accomplished so that the introduced trait is passed on as a genetic trait through the eggs and sperm. Some work with disease resistance has already been accomplished by Dr. Lyman Crittenden and his collaborators at the Regional Poultry Research Facility at East Lansing, MI. They have been able to transfer resistance to Avian Leukosis Virus (ALV) type A into a previously susceptible White Leghorn line. The testing of disease resistance is very slow work, however, and difficult to quantify.

In the UNL School of Biological Sciences, my students and I have been developing a simple system for testing gene transfer in chickens. We have developed a strain of ALV which contains a mouse gene that produces pigmented hair. The first step is to transfer the mouse gene into chick cells growing in a Petri dish using the virus as the transferring agent. The cells are from snow white (albino) chickens. Cells with the mouse gene present should become darkly pigmented. If the test with cells is successful, then the gene will be transferred into freshly laid eggs

of the snow white genotype. Pigmented chicks will be raised to maturity and bred. If the mouse gene has been transferred into the sperm, or eggs, then the dark pigmentations should be transmitted to the next generation. One would then have transgenic chickens expressing a mouse gene. This test system can be conveniently monitored because no sophisticated test or equipment is required to see the effects of the transferred gene, just the observation of darkly pigmented feathers. Such a test system would allow the frequency and transmission of transferred genes to be readily studied so that the technique can be perfected. When more important genes are to be transferred, "tried and true" methods can be used. It is possible that the transfer of pigment genes could lead to the development of a strain of autosexing White Leghorns that would retain the production traits developed by years of intensive breeding.

Value of Chicken Manure Used as Fertilizer

Bob Graff
E.W. Gleaves

This research, conducted at Graff Farms, Beatrice, NE., was a five-year study to determine the value of chicken manure when applied to Gage county farm land. The application rate was about one 300-bushel spreader load per acre. The manure came from a high-rise cage layer building on the Graff Farm.

Test Design Notes

1. To ensure accuracy, yield information for both plots (Check and M Check) was measured in 1983 before manure application. The Check plot had a yield advantage of 1.47 bu. per acre. This value was added to the manure yield advantage for each of the five test years.
2. Manure was added only one time and that was before the 1984 planting season. No additional manure was added during the five year period.
3. Anhydrous ammonia was applied at the rate of 105 pounds of N per acre each year on both the Check and Manure plots. No other fertilizer was added.
4. Row length was 1,280 ft.

Summary

1. Costs include:
   a. Manure spreader
   b. Power to pull spreader
   c. Skid loader
   d. Labor-loading 300 bu. spreader (10 min), spreading (10 min)
   e. Value of manure if purchased (Graff uses 20 cents per hen)
2. Total yield advantage for the five years was 75.96 bushels per acre (Table 1).
3. It would be interesting to see the results of manure application each year or every other year. Also, it appears that cage layer manure at the rate used in this study should be applied to cropland (milo, corn) at 3-or 4-year intervals to maximize yields.

Table 1. Graff's results.

Year and treatment	Row width	No. rows	Acres	Wet wt.	Moist.	Test wt.	Adj. yield	Yield advan.	Cumm advan.
				lbs.	%	lb/bu	bu/acre		
1983									
Check	36	10	.88	4580	17.7	— —	88.97	1.47	— —
M. Check	36	10	.88	4520	18.0	— —	87.50	— —	— —
1984									
Check	36	10	.88	4780	18.7	56	91.65	— —	— —
Manure	36	10	.88	5700	18.6	57	109.44	19.26	19.26
1985									
Check	36	10	.88	3980	14.0	— —	80.72	— —	— —
Manure	36	10	.88	4860	13.9	— —	98.72	19.47	38.73
1986									
Check	34	10	.83	5200	15.4	— —	110.02	— —	— —
Manure	34	10	.83	6080	15.4	— —	128.63	20.08	58.81
1987									
Check	34	10	.83	5100	20.1	57	101.92	— —	— —
Manure	34	10	.83	5300	17.0	57	110.08	9.63	68.44
1988									
Check	34	10	.83	3500	13.5	60	75.71	— —	— —
Manure	34	10	.83	3780	13.5	61	81.76	7.52	75.96

Extruded, Roasted and Untreated Full-Fat Soybeans in Poultry Diets

Jeff Baier
T.W. Sullivan
D.M. Danielson
J.A. Rydell

Unextracted or full-fat soybeans present potential advantages for use in poultry diets. They are an excellent source of protein (37-42%), and of metabolizable energy (ME) because of their oil content (17-22%). The ME content of full-fat soybeans (1650 kcal/lb) is much higher than extracted soybean meal (1140 kcal/lb). The unextracted meal is a granular material high in oil (fat) that can be handled with more ease than fat in the feed mixing operation. Fat within the matrix of the feed particle, rather than applied to the surface, allows feeds with a higher fat content to be made into satisfactory pellets. The quality of this vegetable fat is higher than that obtained from most sources of added fat (Stilborn *et al.*, 1987).

Different methods of processing full-fat soybeans exist. The primary purpose of processing is to reduce or eliminate the growth depressing effects of trypsin inhibitors (natural components of soybeans). Processing methods generally fall into two categories. These methods are extrusion and roasting. In the extrusion process, beans are forced through the holes of a die. Trypsin inhibitors are inactivated either by the heat of friction or by applied heat. The extruded product requires no grinding. The process of roasting involves the exposure of beans to a heat source for a short period of time. This heating inactivates the trypsin inhibitors. However, the beans must then be ground, rolled, or flaked before mixing and feeding.

Two Experiments

Two experiments were recently conducted in the Animal Science Department to evaluate full-fat soybeans in broiler diets. These experiments were designed to determine the effect of feeding extruded, roasted, and raw full-fat soybeans on growth, feed efficiency, body tissues, and livability of starting and growing broilers. Four diets were formulated in each experiment. Composition of major ingredients in the diets is shown in Table 1. The primary protein supplement in these diets was either extracted soybean meal or extruded, roasted, or raw full-fat soybeans (ground). Each of the full-fat soybean meals constituted 41.5% and 31.2% of the starter and grower diets, respectively. Grain sorghum of a known cultivar was the grain source in these diets.

Results of Experiment I are shown in Table 2. Birds receiving the soybean meal (47.5%) treatment had the greatest gains ($P<.05$) and the most favorable feed/gain ratio. Birds receiving the extruded soybeans had greater gains ($P<.05$) and a better feed/gain ratio than birds receiving roasted or untreated soybeans. Birds receiving the untreated soybeans had the lowest gains ($P<.05$) and the poorest feed/gain ratio ($P<.05$). It was evident from these results that extrusion and roasting improved the nutritional value of soybeans for starting broilers. However, birds receiving soybean meal had greater gains ($P<.05$) and better feed/gain ratios than birds receiving either extruded or roasted soybeans.

The four soybean products evaluated in Experiment II were assayed for trypsin inhibitors by Dr. John Rupnow, Department of Food Science and Technology, UNL. Levels of trypsin inhibitor found in soybean meal, extruded roasted, and untreated soybeans were, respectively, 4.20, 0.88, 0.30, and 14.90 mg per gram. Results of Experiment II are shown in Table 3. The body weight gain response of birds at 21 days was very similar to that observed in Experiment I. Birds receiving the soybean meal had the greatest gain ($P<.05$) followed by those receiving extruded, roasted, or untreated soybeans. The same trend was evident in feed/gain ratios at 21 days. However, after 21 days, broilers either adapted or were in some way better able to use the extruded and roasted full-fat soybeans.

Table 1. Composition of the major ingredients used in experimental diets.[a]

Component	Soybean meal (47.5%)	Full-fat soybeans	Sorghum grain (milo)
Metabolizable energy, kcal/lb	1140	1650	1480
Fat (ether extract), %	1.0	17.5	2.5
Crude protein, %	47.5	37.0	9.0
Lysine, %	3.20	2.40	.22
Methionine, %	.72	.54	.15
Cystine, %	.74	.54	.20
Tryptophan, %	.64	.55	.07
Threonine	2.00	1.50	.31
Isoleucine	2.60	2.00	.38
Phosphorus, total, %	.65	.58	.27
Phosphorus, avail., %	.22	.20	.09
Calcium, %	.20	.25	.05
Linoleic acid, %[b]	.40	9.00	1.10

[a]Feedstuffs Analysis Table (1985).

[b]Linoleic acid content of other ingredients: yellow corn, 1.9%; dehy alfalfa (17%), .40%; stabilized animal tallow, 2.5%; stabilized lard, 12.0%; meat and bone meal, .30%; fish meal, .10%.

Table 2. Influence of extruded, roasted or untreated, full-fat soybeans and extracted soybean meal on performance of broilers to 21 days, experiment I.

Treatment[a,b]	Response at 21 days		
	Body wt. gain (grams)	Feed/gain	Livability (%)
Soybean meal (47.5%)	568d	1.51a	29/30a
Extruded soybeans	530c	1.53a	29/30a
Roasted soybeans	451b	1.68a	30/30a
Untreated soybeans	267a	2.50b	29/30a

[a]All soybeans were of the same commercial cultivar. **Dry extrusion** was done with an Instra-Pro EXTRUDER, Model 200R, Instra-Pro Div., Triple "F", Inc., Des Moines, IA. **Roasting** was done with a Gas ROAST-A-TRON, Mix Mill, Inc., Bluffton, IN 11751; operating temperature for soybeans was 113 to 130°C (235 to 265°F).
bFive pens of six Vantress x Arbor Acre (f.s.) chicks were randomly assigned to each treatment at 1-day old.
a,b,c,d Average values (for five pens of 6 chicks) within the same column which are followed by different subscripts are statistically different (P<.05).

There were no significant differences (P<.05) among the weight gains at 42 days of birds receiving soybean meal, extruded soybeans, or roasted soybeans. However, weight gains of birds receiving roasted soybeans were numerically less at 42 days than gains of birds receiving soybean meal and extruded soybeans. Birds fed the untreated soybeans had the lowest (P<.05) weight gains, as expected. The feed/gain data at 42 days followed a trend very similar to the weight gains.

Pancreas weights (Table 3) corresponded closely to the level of trypsin inhibitor found in the four soybean products evaluated in this experiment. Average weights were higher (P<.05) for birds receiving the untreated soybeans than for those of birds receiving the other three dietary treatments. It would appear that chicks are able to tolerate moderate levels (.88 to 4.2 mg/grams) of trypsin inhibitor in soybean products. The average weight of pancreas tissue from birds fed untreated soybeans was about two times greater than weights for birds receiving the other treatments.

In summary, results from two experiments with broilers indicate that diets containing extruded and roasted soybeans are well used. The evidence seems to show that older birds (21 to 42 days of age) are better able to use full-fat soybeans than are starting birds. Perhaps the proteolytic enzymes necessary for protein digestion are more plentiful in older birds than in the starting chick. Lower levels of extruded or roasted soybeans should perhaps be used in broiler starting diets. It is possible that adult birds (layers and breeders) can use moderate levels of untreated full-fat soybeans in their diets.

Discussion

Cost is a major consideration in the decision to use extruded or roasted soybeans instead of soybean meal in poultry diets. The cost of soybean meal is usually determined by the price that can be obtained for the oil and the price of raw soybeans per bushel. The price of extruded soybeans or roasted soybeans is determined by the price of raw soybeans per bushel, the cost of purchasing the processing equipment, or the cost of having the beans processed plus the cost of transport. Processing costs tend to decrease as the volume of soybeans processed increases, making ownership of the processing equipment more feasible. Dr. Jerry Sell of Iowa State University has recently developed a formula to determine the value of extruded soybeans:

Value of extruded soybeans ¢/lb = [Price 47% SBM X 0.8085] + 1.07 [Price of A-V fat X 0.175]

Where:

0.8085 = protein content of extruded soybeans ÷ protein content of 47% soybean meal

1.07 = factor to adjust for the higher metabolizable energy content of soy oil when compared with animal vegetable blend of fat.

0.175 = the difference between the fat content of extruded soybeans and soybean meal, expressed in decimal form.

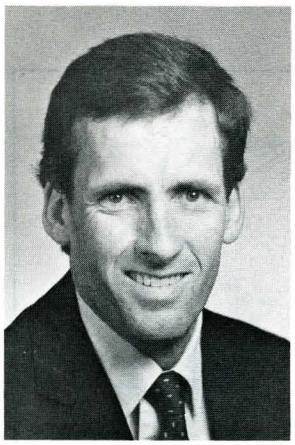
A-V = animal vegetable blend

The processing of extruded soybeans or roasted beans may be one way to build high nutrient density rations in areas of grain surplus. Building rations locally or on the farm with premixes allows farmers to cut transportation costs, but doesn't allow for the easy addition of fats or oils. The use of extruded or roasted full-fat soybeans allows the farmer to make high nutrient density rations under most conditions. Full-fat soybeans, either extruded or roasted and ground, will most likely find greater use in poultry rations in the future.

Table 3. Influence of extruded, roasted or untreated, full-fat soybeans and soybean meal on performance of broilers to 21 and 42 days, experiment II.

Treatment[a,b]	Body wt. gain (grams)		Accum. feed/gain		Pancreas wt. (grams)[c]	
	21 days	42 days	21 days	42 days	21 days	42 days
Soybean meal (47.5%)	570d	1648b	1.43b	1.70b	2.11b	3.88b
Extruded soybeans	538c	1654b	1.39b	1.64b	1.75b	3.55b
Roasted soybeans	504b	1532b	1.47b	1.71b	2.01b	3.31b
Untreated soybeans	331a	1249a	1.94a	1.90a	4.09a	7.87a

[a]Feedstuffs Analysis Table (1985).
[b]Four pens of six female and four pens of six male chicks (48 total) of Vantress x Arbor Acre (f.s.) strain were randomly assigned to each treatment at 1-day old.
[c]Two birds from each experimental pen (16 per treatment) were sacrificed at 21 and 42 days to obtain pancreas and intestinal tissues.
a,b,c,d - Average values within the same column which are followed by different subscripts are statistically different (P<.05).



Steven J. Jones

In the two years since the last POULTRY REPORT, two Animal Science faculty have received national recognition in research from the Poultry Science Association. The following citations were made to Dr. Steven J. Jones (1987) and Dr. Glenn W. Froning (1988) at the respective annual meetings of the Association.

Glen Froning

The Poultry Science Research Award for 1987 was presented to Steven J. Jones. The award of $500 and a scroll is presented to a member of the PSA who in the preceding year was sole or senior author of outstanding research published in *Poultry Science*. The recipient must not have reached 40 years of age at the end of the year in which the research was published.

Jones was selected for this award in recognition of two outstanding papers published in *Poultry Science* during 1986 dealing with fractional rates of muscle protein turnover in broilers. These studies were:

Jones, S.J., M.D. Judge, and E.D. Aberle, 1986. Muscle protein turnover in sex-linked dwarf and normal broiler chickens. *Poultry Sci.* 65:2082-2089.

Jones, S.J., E.D. Aberle, and M.D. Judge, 1986. Estimation of the fractional breakdown rates of myofibrillar proteins in chickens from quantitation of 3-methylhistidine excretion. *Poultry Sci.* 65:2142-2147.

Jones was born May 21, 1953, in Salt Lake City, Utah. He earned a B.S. in foods and nutrition at the University of Utah in 1978 and an M.S. in animal science at the University of Arizona in 1980. In 1984, he completed a Ph.D. in animal science at Purdue University under the direction of Elton D. Aberle. His dissertation was entitled "Muscle Protein Turnover in Chickens Varying in Muscle Mass and Growth Potential." At the Reciprocal Meats Conference in 1984, he was a recipient of a Graduate Student Award. Jones joined the staff of the Department of Animal Science at the University of Nebraska in 1984 as an Assistant Professor, a position he currently holds.

The 1988 recipient of the American Egg Board Research Award is Glenn Froning. The title of his award-winning paper is "Effect of ultrafiltration and reverse osmosis on the composition and functional properties of egg white." The article appeared in *Poultry Science* 66:1168-1173 (1987). Presently, Froning is a Professor in the Department of Food Science and Technology at the University of Nebraska, with both teaching and research appointments.

Froning's research interests have included mechanical deboning of poultry meat, emulsification properties of poultry meat and eggs, color stability of poultry meat, extraction of lipid components and cholesterol from eggs, improved functionality of egg proteins, and ultrafiltration of egg white. He is author or co-author of more than 95 scientific publications and popular articles on poultry meat and eggs.

Froning was born in Gray Summit, Missouri. He obtained a B.S. degree in poultry science at the University of Missouri in 1953, an M.S. degree in poultry products at the University of Missouri in 1957, and a Ph.D. in food science (poultry products) at the University of Minnesota in 1961. He served in the U.S. Army as a 1st Lieutenant from 1954 to 1956. Froning was Assistant Professor in the Department of Food Science, Rutgers University, from 1961 to 1963 and served as Assistant Professor in the Department of Poultry Science, University of Connecticut, from 1963 to 1966. He has been on the staff of the University of Nebraska since 1966, and has served as Professor and Chairman of the Poultry and Wildlife Science Department from 1972 to 1977 and Professor of Animal Science from 1977 to 1984.

Froning is a member of Alpha Zeta, Gamma Sigma Delta, Gamma Alpha, Sigma Xi, Phi Tau Sigma, PSA, Institute of Food Technologists, American Chemical Society, and American Association for the Advancement of Science. Froning received the 1972 National Turkey Federation Research Award and the Nebraska Poultry Industries Poultryman of the Year Award in 1981. He is also a member of numerous university, college, departmental, and professional society committees. He is a past president of Gamma Sigma Delta on the University of Nebraska campus. He has served as Secretary-Treasurer, member of the Executive Committee of PSA, Section Editor of Marketing and Products, and currently is an associate editor of *Poultry Science*. He is also a past member of the program committee of the Institute of Food Technologists.

Find Your Future

in

ANIMAL SCIENCE

at the

UNIVERSITY OF NEBRASKA

CURRICULUM OPTIONS

Undergraduate programs for Animal Science majors and for other students in the College of Agriculture help develop the student's capability to cope with problems of Nebraska's livestock industry. Because of the size of this livestock industry—65% or more of Nebraska's agricultural income—all agriculturists who work in Nebraska must understand livestock production. Many options are available in the undergraduate Animal Science program. These include:

1. Production—Beef, Sheep, Swine, Poultry, Dairy
2. Range Production
3. Science
4. Business
5. Meats
6. Communications and Education options available through College Core