CORNELL POULTRY POINTERS

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1999 FRIEND OF THE DEPARTMENT AWARD

Mr. Tyler Etzel was the recipient of this year's Friend of the Department award presented at the 1999 Cornell Poultry Conference on June 23-24 at the Statler Hotel, Cornell University. Tyler finished his education at CALS, Cornell University, and received his B.S. degree in Farm Management in 1978. He immediately joined the family farm. Tyler is the third generation of the Etzel family which has been involved in poultry production since the turn of the century. Together with his father (Tyler Etzel, Sr.), they have done a complete modification of the farm in recent years. Currently they have 140,000 laying hens, growing 14,000 pullets per year and making over 100 ton of poultry feed per week.

Tyler has helped the Department in various ways during the years. He has been a speaker at our Cornell Poultry Conference, been instrumental in talking or corresponding with officials at Cornell University or Albany whenever we've needed his help. He has helped for many years in selecting the topics for the Cornell Poultry Conference and has been a member of the Alumni Board of Directors of CALS.

We wish him and his family prosperity for years to come.

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*MANAGING THE TRANSITION FROM PULLET TO EARLY LAY

With the advent of earlier maturing genetic lines for commercial layer strains, comes the need for understanding what management factors play a role in allowing pullets an opportunity to develop into production layers. The stress of physically moving pullets needs to be considered as a time when steps can be taken to reduce the risk of harm to the bird's reproductive function and help recover to normal eating and drinking habits. Keep in mind, the pullet's environment and social order of cage mates, most likely will be changing drastically. For example, birds must rediscover the location of the water system, feed trough and become accustomed to new lighting and sounds of automated systems.

There have been some factors investigated that can be used by management to help improve the entry into early production:

1. age of transferring pullets
2. considering the drinking water system adaptation
3. change of light source and intensity, and
4. stimulating the appetite beyond normal day length.

1. In an investigation by Babcock with three groups of 112 day-old pullets divided into similar body weight averages that were grown under the same conditions, it was noted that the age the birds were transferred, 16, 18 or 20 weeks, had an effect on the body weight at 20 weeks, early performance, and causes for mortality.

As noted in Table 1A, the pullets that were housed at 16 weeks of age matured a few days earlier and had the highest hen-day percent average for the period, this resulted in more eggs per hen housed. When the mortality was profiled to determine the cause (Chart 1B), those pullets moved the latest had the most casualties from reproductive abnormalities (ruptured yolk, peritonitis, etc.) as well as symptoms of calcium depletion and kidney dysfunction. The number of hens dying with symptoms of calcium demineralization was double in the group transferred at 20 weeks as compared to those moved at 16 weeks. It is recommended to move pullets at least one week prior to the age of first egg production to avoid disruption of the maturing reproductive system and nutrient demands that precede egg formation.

2. In other work by researchers, it was noted that recently moved pullets take time to find the source of water in their new surroundings. This period of time may vary depending on the difference in the style of drinker and its location as compared to the pullet house. Observations done by Duncan and Lee (Chart 2) were made to measure how much time young pullets used the drinking water system in the second 24-hour period after being transferred from the rearing house. Pullets reared on nipples and transferred to laying cages with nipples "inside the cage" spent most of the time drinking water, with only a 19% drop in the amount of time they spent drinking compared to before moving. However, those pullets grown on nipples within the cage and transferred to a laying cage system that had either a "nipple outside of the cage" or a "cup inside of the cage", these were reported to have a 68% drop in the time spent drinking and a 34% drop, respectively. In this regard, production managers need to take precautions to insure that pullets just moved into the lay house are finding the location of water in their new cage. Even when the system of providing water is nearly the same, pullets just relocated will decrease their water consumption (and, of course, feed consumption) most notably in the first 48 hours.

3. On the subject of light intensity, Tucker and Charles had conducted some trials on the effect of changes in transitional light intensity. (Table 3) In this test, four different strains of commercial layers were raised on the same light intensity of 0.5 foot-candles (average between all tiers). Following their transfer at 18 weeks, there was an equal amount of each of the four strains placed on three different light intensities of 0.05 Avg. (.075 high), 0.20 Avg. (0.375 high), and a third level of 1.50 Avg. (2.75 high), as measured in foot-candle units at the feed trough locations. They observed that those pullets transferred to a slightly lower intensity of light as compared to the rearing intensity, actually were the most productive in terms of eggs per hen housed and hen-day rate. Those pullets transferred to a light intensity that was nearly three-fold higher not only had the poorest productivity, but the highest feed consumption, and as a result, the lowest feed efficiency. It was further noted that the activity of hens on the highest light intensity was much greater. And, in fact, those pullets placed on such a large increase in intensity became more nervous and experienced faster feather loss. This was hypothesized to be the cause for a higher mortality rate.

Producers should recognize that light intensity and the source of light (incandescent vs. fluorescent) has an effect on the physiological response of the hen through the light receptor-endocrine gland link. An attempt should be made to keep both the intensity and source of light the same in the switch from grow to laying facility. Additionally, as seen in this recent work, genetic selection has given us strains of layers today that do not need high amounts of light intensity in order to produce eggs.

The amount of light necessary for egg production seems to be much less, and a relative change to a higher intensity at the time of sexual maturity does not seem to be required. However, care should be taken as some strains have been pointed out to be more light sensitive than others, meaning a difference in the minimum threshold of light intensity needed.

4. As mentioned in discussions on early water consumption after transfer to the layer house, feed consumption as a result of lower water consumption may also lag behind previous levels. Another complication as pointed out by Dr. Summers (Table 4), is the fact that appetite is normally depressed at the time of laying the first egg as the hen goes through changing hormone levels. This physiological response is not preventable. Add to this the complications of recovering from a vaccination reaction, heat stress or a sudden increase in unpalatable feed ingredients (limestone) and it can be explained as to why the appetite takes time to recover - not to mention the shock of moving stress.

In an attempt to manage the young layer through this period, middle-of-the-night (MNF) feeding has been discovered as one technique that can help stimulate consumption (Chart 5). Its success has already been proven by Dr. Harms at Florida to improve shell quality during high temperature stress, especially in older layers. This is based on the need for calcium mobilization during the time of egg shell formation which occurs through the night. By providing feed in the night time, the digestive system can become another source of calcium in addition to the bone structure source. In the case of young layers, calcium absorption is very efficient. However, under stress, appetite may be depressed and MNF can be used during early production to help compensate for otherwise deficient nutrients and improve consumption of water. Used in the proper way, MNF can be a management tool that can be added or removed as conditions and production parameters change, without affecting the overall perceived day length.

As a final consideration, pullet growers need to realize that the time constraint of proper growth and the ability to have the hen produce the first egg at an earlier age are becoming more in conflict with each other. Tissues such as major organs, bone muscle and feathers are developed at different rates. However, the earlier maturity in today's commercial lines has brought on reproductive development (ovaries and oviduct) at a time when other tissues, especially the skeleton, may still be completing their formation. This puts protein metabolism in a higher demand than was the case with later maturing layers. As well, calcium and phosphorus need to be increased to supply the finalization of medullary bone deposition at the same time the rapidly maturing pullet is getting ready to form its first egg shell. This places more emphasis on the need for careful diet selection in the final portion of the growing period. Flock managers need to review these needs with their nutritional advisors and feed companies to provide the proper ration to satisfy the multiple demands of growth and reproduction (Chart 6). In most cases, the general advice is to eliminate low protein "developer" type rations and moderate calcium level "prelay" rations and utilize layer diets at an earlier age.

[*Talk presented by Mr. Jim Geary, ISA-Babcock Breeders, Inc., Ithaca, NY.]

NOTE: SEE SEPERATE ENCLOSED INFORMATION FROM SLIDES THAT WERE PRESENTED.

GET READY FOR CONCENTRATED ANIMAL FEEDING OPERATION PERMITS

You all know that EPA is turning its attention toward the non-point arena. Using their figures one-fourth of the water pollution in the country is from animal waste. *E. coli* and pfisteria concerns are making headlines. EPA is actively working to get states to prevent this pollution. DEC in New York has CAFO permits available as a general permit. To be included under this permit in NY a farm needs to:

- Send in a Notice of Intent before January 1, 2000.
- Complete a certified plan within 18 months if the farm has more than 1,000 animal units, or within 24 months for farms that have between 300 and 1,000 animal units.
- Implement the plan by January 1, 2005.

Should you participate? I expect from a regulatory perspective both EPA and DEC will go slow. They are not likely to go after any one under 1,000 animal units unless there is a discharge until after 2009. That is when they expect all livestock farms to have a Comprehensive Nutrient Management Plan (CNMP). Yet there are upcoming issues:

EPA will make changes to the poultry and swine CAFO regulations in 2001. They will likely drop any references to liquid systems and waterer overflows that now confuse the issue on poultry. They may make some changes to their animal unit calculation. They will likely make specific requirements for documentation on where and how the manure is spread.

Total Maximum Daily Load (TMDL) ratings for nonpoint nutrients and bacteria will come out in 2003. If the existing loads in some watersheds exceed the limits states may be forced to accelerate enforcement of nonpoint programs on agriculture to lower the loads.

Soon the Coastal Zone Management Reauthorization Act (CZMRA) has to be reviewed for compliance. States may think they've got it covered. NY hopes voluntary implementation of AEM will meet it. EPA may not think progress is good enough and insist on an acceleration.

After evaluating the specific watershed situation and the potential pollution concerns they have, farms will have to decide whether to get a permit or not. Farms that have more than 300 animal units and the potential to discharge should get the permit. Those farms with fewer animal units should start to take steps now to eliminate pollution. Smart farmers will begin to plan for these requirements.

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AGRICULTURE'S EFFORTS MUST BE FOCUSED ON BUILDING IMAGE

(Animal rights terrorism mounts in U. S.)

[The following *OPINION* article was taken from Feedstuffs, Vol. 71, No. 42, October 11, 1999, page 8.]

Even though animal rights has been an issue that both production agriculture and the biomedical industry have faced for some time, the battle now appears headed in a very disconcerting and alarming direction.

Until recently, the activities of animal rights activists in the U. S. have, for the most part, been limited to protests at industry conventions and department stores, with an occasional on-farm "freeing"of animals. Since the beginning of this year, however, the tactics of the animal rights movement in the U. S. have taken on a new intensity, in some cases to the extent of being terroristic and / or criminal in nature.

In one of the more recent attacks on agriculture, a $1.5 million Wisconsin feed mill warehousing mink feed was destroyed while several simultaneous raids were carried out on nearby fur farms. The actions were severe enough to prompt Wisconsin's lieutenant governor to tell the media that the state's agricultural future has been threatened by these acts.

Agriculture has not been the only target for animal rights activists. Fast food restaurants are also feeling the heat. Threats have been made against these establishments ranging from arson to less violent targeted campaigns, the most recent of which is aimed at one of the largest users of beef in the world, McDonald's. In this campaign, animal rights activists are pressuring McDonald's to offer a veggie burger at its U. S. operations, buy chickens raised in at least 1.5 sq. ft. of living space, stop selling eggs from "factory farmed hens," require improved standards for transportation and slaughter from suppliers, stop using genetically altered birds that suffer from leg deformities and stop buying pigs from farms that keep sows in intensive confinement. The activists admit their overall objective is to get McDonald's to stop selling meat altogether.

The human medical community has been another favorite target of activists. In one such case earlier this year, black-hooded vandals raided University of Minnesota laboratories and classrooms causing $2 million in damage. A videotape of that raid showed the vandals stuffing lab rats, mice and other animals into what appeared to be air-tight plastic containers with little or no regard to their health and welfare, leaving to question the real motive of that attack.

Additionally, there have been cases where fur producers and biomedical researchers have received razor blades in their mail.

Steve Kopperud of the Animal Industry Foundation (AIF), a national foundation operating with the goal of educating the consuming public about modern farming and ranching, is curious about how much longer the animal rights movement will condone terrorism. Kopperud said in a recent AIF mailing that, "We've been lucky these criminals have not killed or hurt someone."

AIF recently called on the media and entertainment industry to join in denouncing animal rights terrorism, saying such a move would undoubtedly be in Hollywood's best interest as mainstream America - the folks who watch television, purchase magazines and newspapers, buy the CDS, the movie tickets - won't tolerate terrorism in any form. AIF also told studies and product sponsors they would be wise to wake up to the interests of mainstream America.

"If you don't condemn this violence, your silence is tantamount to condoning it. This isn't trendy anymore - it's grown ugly and increasingly dangerous," Kopperud said in a message directed at Hollywood.

The same message is relevant to U. S. animal agriculture. Animal rights is an issue that is increasingly going to influence how animal agriculture operates. It is an issue that is not going to go away and one that cannot be ignored.

In addressing the complex issue of animal rights, agriculture must recognize that it is consumers that must be the focal point, not animal right activists. Agriculture's efforts must be focused on strengthening its consumer image. Perhaps the best way of accomplishing that objective would be for agriculture to become more open about why animals are raised the way they are and more forthcoming on the value of concentrated production from both a food safety and economic perspective.

Now is the time for agriculture to begin a self-evaluation of its production practices and to prepare itself to address the big question that is sure to come soon from consumers. By taking the necessary steps now, agriculture can surely better its image at a time when animal rights activists are embarking on tactics that are spurring consumer outrage.

COST OF ANIMAL WELFARE SHOULD BE IMPORTANT CONCERN

[The following article by Dr. Charles Beard was taken from Feedstuffs, Vol. 71, No. 42, October 11, 1999, page 8.]

Should broilers have more floor space? Should table egg layers have larger cages with roost poles? Should layers not be beak-trimmed or induced to molt?

If you polled the poultry-consuming public and asked these questions, my guess is that the majority would say yes. They would take that position without giving it much thought other than it would appear to be better for the animal's welfare from a consumer's perspective.

As the debate over animal welfare issues begins to intensity, there is another side to the equation that must be considered along with the benefits of improved animal conditions. The issue is cost. It is fairly obvious that the industry is currently operating with production efficiency as its main concern. Efficiency dictates cage and floor density, for example.

If it were more cost effective to lower broiler density, the industry would soon do it because competition would dictate it.

It is doubtful that any of the animal welfare activists have given much consideration to what the implementation of their program would cost the consumer. For example, if we provided one-third more floor space for broilers, we would need an additional new broiler house for every two that are currently in place. That would be a significant increase in cost to the independent grower who furnishes the house, electricity, gas and shavings. Labor costs would also increase by a third at clean-out and for those multi-daily walk-throughs and mortality pick-ups. I've only used broiler density as a single example.

What if regulations were implemented on the catch / live-haul process or the transportation / dumping and shackling of birds that could also increase labor and equipment costs?

The table egg layer industry has pressure on it to abolish the practice of induced molting. This practice, which involves 75-80% of commercial flocks in the U. S., allows the hen to go another one, two or even three laying cycles instead of being slaughtered after her first period of lay. Induced molting, therefore, obviously extends the life of the hen, and according to molting experts, accounts for approximately 15% of the profit in the egg industry.

If the industry couldn't induce molt, it would need to increase the pullet supply to replace spent hens slaughtered after the first laying cycle. Some estimate 47% more pullets than are currently produced would be necessary. That means 47% more pullet houses, 47% more breeder flocks / hatcheries and 47% more male chicks to be killed in the hatchery.

Even with the obvious benefits of induced molting extending the life of layers and avoiding the requirement of killing more male chicks in the hatchery, this issue is on the "front burner" of animal welfare activists. The added cost to egg production built into the loss of induced molting will be passed on to the consumer in the price of eggs and foods that contain eggs.

The layer cage density issue will be similar in concept to the broiler density scenario. If you provide 30% more space, you will need 30% more cages and 30% more houses to match the current level of production. Even worse, there is mounting pressure for the U. S. industry to follow the lead of European countries, which have a cage-free egg flock on their agenda for the future. It is doubtful that a non-cage industry could even meet the egg supply demands, regardless of the considerable increased cost. It would result in more labor, be more land and facility intensive with other disease and management complications adding to egg production costs.

The “free-range” push would be a disaster from the standpoint of parasites, predators, disease, weather and flock management in general. Those who advocate this approach haven’t been around as long as those of us who have worked with backyard free-range operations.

The bottom line is that industry will eventually have to produce poultry products in the way its customers demand they be produced. Their demands will be heard either through their political or purchasing power or through a combination of both. Consumers need to know up front that the costs are going to be passed on. The basic principles of economics will dictate that. If the more affluent who are looking for what they perceive as noble animal causes are successful in lobbying an urban-oriented Congress, it will be unfortunate. These changes could result in much higher costs for fundamental family staples like poultry meat and eggs.

While it may not be a big deal for the affluent to pay twice as much for meat and eggs, it could result in some poor children going hungry.

That is something we should all think about.

Before animal welfare changes are implemented, we need to extend the “ripple in the water” to see how these changes impact the lives of growers, the environment and consumers, especially the less affluent among us.

It is OK for groups to promote improved animal welfare but not to the extent of negatively impacting human welfare.

Maybe it is time for the poultry industry to rethink some of the animal welfare issues related to its operations and set up a proactive system of training and monitoring for compliance with agreed-upon protocols. Cage density for layers and floor density for broilers and turkeys may be a good place to start.

It is likely that a few constructive steps voluntarily taken by the industry may postpone or even prevent a round of new regulations like those experienced with food safety.

[Dr. Charles Beard is vice president of research and technology at the U. S. Poultry & Egg Association (USPEA). He wrote this article for the September issue of “News & Views,” the newsletter of USPEA.]

HOW IS THE AVIAN DISEASE PROGRAM SERVING YOU?

During the second 1999 Meeting of the Unit of Avian Health Advisory Council (UAHAC), Mr. Mark Adams, President of the New York Poultry Association (NYPA) revealed concerns about the service provided to poultry producers. These concerns had prompted him to write in the President’s Report on NYPA News that “some members have expressed a desire for Penn State to be responsible for diagnosis lab work and the extension veterinarian and for Cornell to cover other areas for both New York and Pennsylvania”. Producer members of the AUHAC were surprised because they had not had previous knowledge of complaints about the diagnostic and extension service provided by the Avian Disease Program (ADP). Those producers expressed their support for the service. After thorough discussion by the Council, it was concluded that some of the problems cited by Mr. Adams may have been accentuated by delays in submission of the written report. The UAHAC has decided to seek advice from the producers as to what measures can be implemented to better serve the industry.

Please call or fax your concerns and suggestions regarding the extension and diagnostic service provided by the UAH to Mr. Robert Kaplan, Chairman of the UAHAC:

Mr. Robert Kaplan, K-Brand Farms
Glen Wild Rd. (Box 119)
Woodridge, NY 12789
Fax 914-434-6837
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WHY DOES INFECTIOUS LARYNGOTRA-CHEITIS SHOW UP IN VACCINATED FLOCKS?

Infectious laryngotracheitis (ILT) is a respiratory disease of chickens characterized by tracheal moist rales, coughing, sneezing, and bloody expectoration. In susceptible flocks it may cause significant mortality, and loss in production, while in vaccinated flocks, mortality may be negligible. In addition, ILT may be economically devastating because some countries impose restrictions on imports from countries where ILT is present.

How to prevent ILT? The best way to prevent ILT is to keep the ILT virus (ILTV) away from the chickens. If the risk of introducing ILTV is present, then the best form of prevention is vaccination. ILTV may be introduced in a chicken flock through contaminated trucks, crates, egg flats and boxes, personnel and equipment. ILTV may also be introduced in a farm when infected or vaccinated chickens or pheasants, the only two species known to become naturally infected, are brought to a farm.

What is the risk of ILT in New York State farms? The risk of introducing ILT in New York State farms is low due to the distance between farms. Because of the geographical isolation of NYS farms, and because ILT is not prevalent in the state, the greatest risk of introduction of ILTV in NYS poultry farms is through vaccinated pullets.

May ILT vaccines start an outbreak? Like other herpesvirus (shingles and cold sores in humans, for example), ILTV remains dormant for weeks or months after initial infection. ILTV hides from the immune system in nerve cells (trigeminal ganglia), and may be reactivated as late as 15 months after vaccination. When this happens, the shed virus that reach susceptible chickens, multiply in the trachea. With each multiplication cycle, (and there are thousands of them in a chicken before it becomes immune or dies), ILT vaccine viruses have the opportunity to reacquire their original virulence.

What is the risk of ILT vaccine-induced outbreak? To date, all vaccines in the market are live-attenuated virus vaccines. The less attenuated the vaccine, the more likely to start an outbreak. The degree of attenuation of a vaccine depends on the method of production, and the producer. Attenuation of ILTV is achieved by successive passes of the virus in tissue culture or in chicken embryos. Vaccines produced in tissue-culture, also called tissue culture origin (TCO) are the most attenuated. TCO vaccines are so attenuated that they produce little or no post-vaccination reaction, but have to be applied by drop in the eye to induce protection. The chicken embryo origin (CEO) vaccines, on the other hand, range in degree of attenuation from the old-fashioned fully virulent virus that had to be applied in the cloaca (and had full spreading potential), to mild viruses that have limited spreading ability. The degree of protection, and post-vaccination reaction is greatly influenced by degree of attenuation. Manufacturers of ILT vaccines work hard to achieve the correct balance of virulence to induce good protection with minimal reaction. In general, vaccines for water administration require more aggressive strains and higher titer than those recommended for eye drop. Vaccines recommended for spray administration should also have a high titer but milder strains are necessary to avoid respiratory reactions.

How to prevent vaccine-induced ILT outbreaks? If the birds brought to a farm are not vaccinated, there will no risk of vaccine-induced ILT, but the risk of a field outbreak will increase. To prevent the field outbreak, and vaccine-induced ILT there is a need to assure good vaccination coverage in all your flocks. The best possible coverage starts with high virus titer in the vaccine. ILT is not a virus that multiplies to high titers, and because of this the vaccines should be used at full dose, they should not be cut to half or fourth doses. If possible, the vaccine should be applied by eye drop. Great care should be taken to protect the virus from inactivation, by using the vaccine within two hours of reconstitution, protecting it from heat and disinfectants, and by adding skim milk to the water. Since mass application through drinking water or spray greatly increases the chances that some chickens will not receive the vaccine, it is advisable to revaccinate the flock with a full dose within 5 to 7 weeks of the first application. If 10% of the chickens were missed in the first vaccination, only 1% will remain susceptible after the second vaccination.

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POINTS TO REMEMBER WHEN USING PHYTASE IN THE DIET

Due to biotechnological advances, microbial phytase which currently has a reasonable price, is available to poultry producers for use in commercial flocks. Due to approaching the laws related to nutrient management in Concentrated Animal Feeding Operations (CAFOs) for implementation, and due to the bad publicity surrounding the contribution of phosphorus from animal wastes to environmental pollution, every poultry producer should seriously consider the use of phytase in their operation. The results of extensive research with broilers, turkeys, and laying hens during the past several years have clearly indicated that the phosphorus content of the diets for these classes of poultry can be reduced considerably in the presence of phytase. The results of a number of research studies with laying hens, both in Europe and in the U.S., including the results of research at Cornell University, have shown that a diet with 0.1-0.13% available phosphorus in the presence of 100-300 units phytase can result in comparable performance to the control groups which were fed a normal level of 0.4-0.45% available phosphorus. At this time, we **do NOT** recommend that poultry producers reduce the available phosphorus of the layer diets to the extent that has been shown to be safe under laboratory/experimental conditions. We rather believe that poultry producers should strictly follow the recommendations of the manufacturers of phytase. For example, BASF, Corp. (the manufacturer of Natuphos), recommends that the available phosphorus content of the layer diets should be reduced only by 0.1% when 300 units phytase is used per kg diet. The layer industry should consider using the normal levels of available phosphorus which they were normally using prior to the availability of phytase and only reduce the available phosphorus content of the diet by 0.1% in the presence of phytase. For example, if a poultry producer for a particular strain previously was using a sequence of 0.45, 0.40, and 0.35% available phosphorus for periods of 18 to 38, 38 to 58, and 58 to 78 wk of age, respectively (or more correctly 450, 400, and 350 mg/hen/day available phosphorus), now in the presence of phytase, the producer should consider using 0.35, 0.30, and 0.25% available phosphorus, respectively (or more accurately 350, 300, and 250 mg/hen/day available phosphorus) in the presence of 300 units phytase per kg diet. Even with this approach, it is still important that the following points are seriously taken into consideration to prevent the possibility of any unforeseeable production losses.

1. ENVIRONMENTAL TEMPERATURE: You should remember that phytase is an enzyme and can maintain its activity only when the premix and the finished feed are stored under favorable environmental temperatures. When the environmental temperature is high (like many hot days that we were experiencing in most parts of the U.S. in the previous summer), then, the enzyme may lose some or most parts of its activity, depending on the severity and the length of the period of elevated environmental temperatures. One should remember that the manufacturers of various sources of phytase are aware of this phenomenon, and their products can tolerate relatively well the adverse effects of high environmental temperatures. Additionally, the manufacturers of phytase normally are providing the industry with premixes that they may contain about 30-40% or even a greater level of activities than their label claims. This means that the phytase premixes may have a margin of safety of 30-40% or greater. Yet, when the layer diets did not have phytase, the phosphorus in the diet was in the form of inorganic sources of phosphorus. Inorganic sources of phosphorus in contrast to phytase are not temperature sensitive. This is a drawback for using any kind of enzyme, including microbial phytase, in the diet. You always should remember this important point and make every effort in storing the premixes of enzymes, including phytase, at cold environmental temperatures and reduce the batch size in order to decrease the feed storage period prior to use.

Additionally, it should be remembered that the phosphorus requirement of various classes of poultry, including laying hens, in term of mg/hen/day, is greater during the high environmental temperatures of the summer months. Phosphorus is an important mineral which is involved in almost all the metabolic processes dealing with the energy metabolism. The metabolic rate is considerably higher during the elevated environmental temperatures of the summer months, because the bird should increase her physical activities (panting) for releasing the internal heat of body metabolism to the environment for maintaining the body temperature constant which is crucial for survival. The higher phosphorus requirement during the high temperatures of the summer months, in fact, is due to a higher rate of metabolism. Regardless of the presence or absence of phytase in the diet, producers should consider a higher daily phosphorus allowance (mg/hen/day) for hens in similar stages of egg production in the summer months than in the other seasons of the year. For example, if the daily available phosphorus allowance for a flock of laying hens under moderate environmental temperatures, and in the second phase of egg production (38 to 58 wk of age), is 400 mg/hen/day without phytase, and 300 mg/hen/day with phytase, these allowances should be moderately increased (e.g., 430 mg/day/hen without phytase and 330 mg/hen/day with phytase) during the summer months. This is a proper and well worth the effort safety factor that should really be considered by producers.

2. STRAIN DIFFERENCES: Strain differences may exist with regard to phosphorus requirement. This can be true with the strains that currently are used by the industry or the ones that have been recently introduced, and still, not enough practical information is available about their phosphorus requirement. With regard to phytase, to our knowledge, no strain comparison has been reported yet. Currently, we have an experiment in progress in which the response of four commercial strains of laying hens to different levels of phosphorus with and without phytase is under consideration. Here again, it is possible that a particular strain does not do as well as the others with low phosphorus, phytase-supplemented diet. Consequently, producers should consider the response of each strain with regard to available phosphorus which is used with and without phytase separately and do not assume that all strains will be responding similarly.

3. THE PHOSPHORUS SOURCE IN THE DIET: Depending on the preference and the price, some producers may use a simple corn-soy diet and rely completely on inorganic sources of phosphorus for providing the phosphorus need, while others may use animal sources of protein, such as meat and bone meal, which is also a good source of phosphorus in the diet. In the latter situation, the quality and consistency of phosphorus level in the meat and bone meal (or other sources of animal protein) should receive serious consideration. When inorganic sources of phosphorus are used in the diet, producers can have a higher confidence that the desired level of phosphorus is in the diet. Although rendering companies have done an outstanding job for maintaining the nutrient consistency of the product from one batch to another, still such confidence cannot exist when the meat and bone meal or other animal sources of proteins are used in the diet as compared to when the inorganic sources of phosphorus are used. Because the phosphorus content of the diet is reduced when phytase is used in the diet, then the quality of the meat and bone meal with regard to consistency of phosphorus content becomes more critical. Consequently, it is advisable to consider a higher margin of safety for phosphorus content of the diet when animal sources of protein as compared to inorganic sources of phosphorus is used in the diet. With regard to inorganic sources of phosphorus, you should remember that the availability of phosphorus are is identical in different sources. The availability of phosphorus in monobasic calcium phosphate is greater than in dibasic calcium phosphate, and this, in turn, is greater than in defluorinated phosphate. If a value of 100% is given to availability of phosphorus in the form of monobasic phosphate, then the availability of phosphorus in dibasic calcium phosphate is about 95% and in defluorinated phosphate is about 90%. Because monobasic calcium phosphate is not commercially available, then it appears to be preferable for producers to use mono-dicalcium phosphate (a combination of mono- and dicalcium-phosphate) which has a higher phosphorus availability than dicalcium phosphate or defluorinated phosphate.

4. CALCIUM LEVEL IN THE DIET: It is well established that a high dietary level of Ca reduces the activity of phytase. However, with the range of calcium level that is normally used by the industry (3.5-4.2%), the use of 300 units phytase / kg diet provides enough activity to release at least 0.1% phosphorus from phytate-phosphorus. Most investigations regarding the use of phytase in layer diets, although they did not involve a Ca correction, no adverse effect on performance or shell quality was reported. The data from our station indicated that hens fed an available phosphorus sequence of 0.15-0.10-0.10% for the age periods of 30 to 42, 42 to 54, and 54 to 66 wk, respectively, had comparable performance and shell quality to the unsupplemented-phytase control group which were fed an available phosphorus regimen of 0.40-0.35-0.30%, for a similar age period. The manufacturer of the phytase source that we used in our experiment (Natuphos 600, BASF, Corp.), recommends giving a credit of 0.3% Ca for every 300 units phytase used per kg layer diets. We feel that producers should follow the recommendation of the manufacturer, although, as was mentioned before, it does seem that this Ca correction will be necessary.

5. VITAMIN D_3 CONTENT OF THE DIET: The results of experiments with both broilers and laying hens have shown that the active form of vitamin D_3 [i.e., $1,25(OH)_2D_3$] per se is effective in releasing some part of the phytate-phosphorus and make it available to the birds. Also, it has been shown that some additivity or synergistic effects exist between phytase and the active form of vitamin D_3 for increasing the availability of phytate-phosphorus to the birds. An active form of vitamin D_3 is expensive and currently is not available for commercial use to the poultry industry. Nevertheless, because vitamin D_3 should be converted to its active form for expressing its physiological functions, the presence of an adequate dietary level of vitamin D_3 may also help the supplemental phytase in releasing the phosphorus from its phytate form. Because vitamin D_3 is important for absorption and metabolism of both Ca and phosphorus, the adequacy of this vitamin when phytase is used in the diet has become more critical and should receive serious consideration.

Please note that the commercial availability of microbial phytase is probably the best thing that has happened to the poultry industry during recent years. The results of research on phytase for use in poultry rations has been extremely consistent, reliable, and reproducible. We seriously recommend considering using phytase in the diet for those that still have not adopted this practice in their operation. However, we also recommend that producers take the aforementioned points seriously into consideration just for insurance purposes. When phytase is used in the diet, the production manager should seriously look for the signs of phosphorus deficiency in the flock (reduced egg production, egg weight, shell quality, cage layer fatigue, etc.). If any of these symptoms can be seen in the flock that production manager cannot easily attribute them to other reasons, then they should moderately increase the phosphorus content of the diet and look very carefully for possible responses. Such an effort would be appropriate to prevent the possibility of any production problems that may arise from phosphorus deficiency.

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DEVELOPMENTS IN RESEARCH

The following are extracts of some of the papers presented at the 1999 annual meeting of the Poultry Science Association.

Several papers were presented on the importance of omega-3 fatty acids for humans and methods for enrichment of food with these important fatty acids.

* Simopoulos (The Center for Genetics, Nutrition and Health, Washington, DC) reminded the audience that the diet of our ancestors was less dense in calories, was high in fiber, rich in fruits and vegetables, and consisted of lean meat and fish. As a result, the diet was lower in total fat and saturated fat, but contained equal amounts of omega-6 and omega-3 fatty acids. Linoleic acid (LA) is the major omega-6 fatty acid and alpha-linolenic acid (LNA) is the major omega-3 fatty acid. In the body, LA metabolized to arachidonic acid (AA), and LNA is metabolized to eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). The ratio of omega-6 to omega-3 was in the range of 4:1 to 1:1, with more longer polyunsaturated fatty acids (PUFAs) than today's diet. Whereas today, this ratio is about 10-25:1, indicating that western diets are deficient in omega-3 fatty acids compared with the diet on which humans evolved and their genetic patterns were established. Omega-3 and omega-6 fatty acids are not interconvertable in the human body and are important components of practically all cell membranes. Omega-3 and omega-6 fatty acids are involved in eicosanoic metabolism, gene expression and intercellular cell communication. The PUFAs composition of cell membranes is, to a great extent, dependent on dietary intake. Therefore, an appropriate amount of dietary omega-6 and omega-3 fatty acids needed to be consider in making dietary recommendations, and these two classes of PUFAs should be distinguished because they are metabolically and functionally distinct and have opposite physiological functions. Their balance is important for homeostasis and normal development. Studies with human newborns indicate that DHA is essential for normal functional development of the retina and brain, particularly in premature infants. Also, a balanced omega-6:omega-3 in the diet is essential for normal growth and development and should lead to decreases of cardiovascular disease, other chronic diseases, and improve mental health.

* Van Elswyck (Omega-Tech, Inc.) spoke about the methods for enrichment of poultry with DHA (C22:6, n-3). Dr. Van Elswyck mentioned that in the U.S., the intake of DHA is about 150 mg / day. Many international groups recommended at least 1,000 mg / day to support good health. Given the responsiveness of poultry meat and eggs to changes in dietary fatty acids, enriched poultry could help narrow the discrepancy between DHA intakes and recommendations. Direct supplementation of DHA for poultry are fish oil and marine algae. Flaxseed supplies LNA which has limited capacity to be further metabolized to DHA in the body. Supplying 230 mg DHA to the hen from marine algae (Gold DHA™) increases egg yolk DHA to 150-175 mg per egg. This would represent 8-9 times higher than that of normal eggs and 75% deposition efficiency from the diet. Importantly, only marine algae supply this level without potential for off-flavors. Supplying broilers with 245 mg DHA from Golden DHA™, yields breast meat with 75 mg of DHA per 100 g without adverse changes in shelf-life. This increase would represent DHA levels 5 times higher than that found in a typical broiler meat.

* Lewis and Seberg mentioned that dietary intake of omega-3 fatty acids reduces the risk of heart disease, inhibit prostate and breast cancer, delay the loss of immunological functions, and are required for normal fetal brain and visual development. The U.S. has not established a Recommended Daily Intake for omega-3 PUFAs. However, Canada has established the Canadian Recommended Nutrient Intake (CRNI) at 0.5% of daily energy intake. Dietary sources of omega-3 PUFAs are fish, egg, poultry, canola oil, and soybean oil. Food consumption studies in the U.S. indicated that most Americans do not meet the CRHI for omega-3 fatty acids. Mean omega-3 PUFAs intake was 78% of the Canadian recommendation for midwestern women during pregnancy. In midwestern women with the risk of breast cancer, their daily intake is 50% of CRNI. Increased consumption of omega-3 PUFAs require identification of a food source that the public would consume in sufficient amounts to meet the Recommended Daily Intake. Omega-3 fatty acids-enriched eggs can be produced by modifying the hen's diet. When 7% of cod liver oil, canola oil, linseed oil are added to a commercial layer diet, the egg omega-3 PUFAs increases from 1.2% of yolk egg fatty acids to 6.3, 4.6, and 7.8%, respectively. Consumption of omega-3 fatty acids-enriched eggs for four weeks did not increase the plasma level of cholesterol and low-

density lipoprotein (LDL) significantly. Plasma triglycerides are decreased by the addition of omega-3 enriched-eggs to the diet. Omega-3 fatty acids may influence LDL particle size, causing a shift toward less atherogenic particles. Blood platelet aggregation is significantly decreased in participants consuming enriched eggs with omega-3 PUFAs. Overall results of the study today demonstrate positive effects and no negative effects from consumption of omega-3 PUFAs-enriched eggs. They recommended that the consumption of omega-3 fatty acids enriched-eggs should be encouraged so that the daily intake of omega-3 fatty acids meet the current Canadian recommendation.

* Lanktree et al. from Eggland's Best (EB), Inc., informed the audience about the characteristics of the eggs produced by their company. They informed the audience that the company was established in 1988, is comprised of a franchise network of established egg producers which covers most of the U.S. The company provides its franchisees with marketing and technical support. The franchisees produce, process and distribute EB eggs according to a strict program established and controlled by EB. Production follows the "all-natural vegetarian feed program" in accordance with the company's U.S. patent, "Eggs Compatible with a Cholesterol Reducing Diet and Method of Producing the Same". The EB program excludes animal fat and other animal by-products. EB eggs have a seven times higher level of vitamin E, nearly three times more omega-3 fatty acids and iodine, and 25% less saturated fat than regular generic eggs. EB has one of the finest shell egg quality assurance programs anywhere. Franchisees submit weekly egg samples which are analyzed for shell quality, interior quality, vitamin E, iodine, cholesterol and fatty acids. Approximately 28,000 total laboratory tests are conducted annually. Nationwide product and display retail evaluations are contracted through an outside audit company. All EB eggs are USDA graded according to EB's strict quality standards. Each egg is stamped "EB" as assurance of meeting EB's highest standard of flavor, quality, and nutrition. EB has enjoyed record sales growth for the past three years.

* Kornegay et al. (Virginia Polytechnic Institute) reported the results of an experiment which was conducted to determine the effect of a new phytase (Nova SP938) in reducing the P requirement of turkeys. The experiment consisted of four dietary treatments which were used from 0 to 4 wk of age. The birds of the negative control (T_1) were fed a diet with .62% Ca and .28% non-phytate P. The birds on T_2 to T_4 were fed T_1 plus .107, .213, and .320% P as mono-dicalcium phosphate, and T_5 to T_8 were fed T_1 plus 250, 500, 1,000 or 10,000 units / kg phytase as a liquid supplement. A digestion trial was conducted on wk 4 for determination of P and Ca retention, and toe ash was removed for determination of bone mineralization. Also, sample birds were subjected to histological evaluation. Body weight was increased as P or phytase was added to the low-P diet, with the magnitude of the response being greater for the first level of P or phytase. Toe ash weight and ash percentage, and retention of P and Ca increased with the addition of P or phytase. Concentration of Ca and P in excreta increased as the level of Ca and P increased in the diet, but decreased as the level of phytase increased. When compared with the positive control (T_4), the calculated excretion of P was reduced by 45% for birds that received 500 and 10,000 units phytase. There were no differences between treatment with respect to mortality, and the minor lesions observed were not treatment related. In summary, supplementation with Novo SP938 phytase was effective to increase Ca and P utilization and their excretion. The addition of 10,000 units phytase did not cause any problems on health, but rather gave some additional improvements in performance, bone mineralization and P utilization.

* Ledoux et al. (University of Missouri), reported the results of an experiment which was conducted to determine the effect of an enzyme product (Ronozyme W^R) on performance of turkey poults. Five dietary treatments were used in this experiment. The control group was fed a wheat-based diet containing 50% wheat. The poults of T_2 to T_4 were fed the control group plus 200, 300, and 400 g per ton of Ronozyme. Also, a corn-soy diet was used as the reference. The poults were fed the diets for 3 wk. Poults fed the enzyme-supplemented diets were more efficient in converting feed to body weight gain than those fed the unsupplemented wheat control or corn-soy diet. Feed intake and body weight gain were not affected by treatments. AME content of the diets increased with increasing the level of supplemental enzyme. AME of the wheat-based diet supplemented with 400 g enzyme / ton of feed was significantly higher than the AME of the corn-soy diet (1352 vs 1136 kcal ME / lb). Supplementing the wheat diet resulted in reducing digesta viscosity of proximal and distal intestine. The results of this experiment confirmed previous reports on the benefit of supplementing poultry diets containing high levels of wheat, with enzymes capable of degrading the non-starch polysaccharides.

* Sefton et al. (Alltech Inc., Nicholasville, KY, and Auburn University) reported the results of a 6-wk experiment which was conducted to compare the efficacy of two sources of microbial phytase; Allzyme phytase, 11,500 PTU / g (Alltech), and Natuphos 600 FTU / g (BASF, Corp.), for laying hens. Six dietary treatments were used. The negative control was fed a diet with 0.1% available P (AP), and the positive control was fed a diet with 0.4% AP. The hens on the other four treatments were fed the negative control plus two levels of phytase premixes, low level (0.5 kg / ton feed) and high level (1 kg / ton feed) from the two sources. Neither egg production nor feed consumption differed among treatments in the first wk. By the third wk, the negative control was significantly lower in egg production than in all other treatments. This difference was maintained for the duration of the

trial. There were no differences between any phytase treatments than the positive control. By the second wk, feed consumption was significantly lower for the negative control than the other treatments and remained so for the duration of the trial. Phytase treatment groups did not differ in feed consumption from the positive control except for Natuphos' high level, which had lower feed consumption in wk 2, 3, and 4 but was not different from the positive control in wk 5 and 6. Negative control tended to have a lower specific gravity than the other treatments, and this was significant when all three biweekly measurements were averaged. The phytase treatments did not differ from the positive control in any measurement period or when the measurements were averaged across time. Egg weights of the negative control were significantly lighter than the high-phytase treatments by wk 6. These data indicated that both phytase sources were equally effective in improving phytic phosphorus utilization.

* Danforth and Zelter (University of Alberta) conducted a study to examine the fertility, hatchability, embryo mortality, and chick weight in double- versus single-yolked broiler breeder eggs. One hundred and forty one double-yolked eggs and 41 single-yolked eggs were collected from a commercial broiler breeder flock and individually identified and weighed prior to incubation for 21 d. Fertility and hatchability were significantly reduced in double-yolked versus single-yolked eggs (fertility 62.5 vs 98.4%, hatchability of fertile eggs 9.3 vs 88.8%). The incidence of early, middle, and late mortality was significantly higher in double yolked than single-yolked eggs. Only solitary chicks successfully hatched from double-yolked eggs. Chick body weight was significantly greater in double-yolked than single-yolked eggs (53.5 vs 43.5 g). These results show that extremely poor hatchability of double-yolked eggs precludes any benefit that may result from hatching a larger chick from double-yolked eggs that have more available nutrients.

* McKeegan et al. (Roslin Institute and National Center for Poultry Studies, UK) reported the results of an experiment which was conducted to determine whether the incidence of feather pecking can be attributed to the source of protein (plant protein vs animal protein) used in the diet. The experiment consisted of 12 groups of 6 birds. Six groups were fed starter, grower and layer diets based only on animal protein (fish meal) and the next six groups were fed a diet made up only of plant protein. Both diets were isocaloric and isonitrogenous, and contained similar levels of other nutrients. Feather damage started at 6 wk of age in three groups; two on animal protein and one on plant protein. Injurious pecking started at 18 wk of age and affected four groups; two on animal protein and two on plant protein. Information from observations of pecking showed that number of vigorous feather pecks were significantly higher in plant protein-fed groups between 13 to 16 wk, but not at any other age. Pecking damage scores, which were not significantly different, did not reflect this increased pecking. Dietary treatments did not have an effect on plasma triglyceride, zinc or egg production. Pecking damage was seen with both dietary treatments, consequently, the results do not support the notion that inclusion of fish meal in layer diets prevent or alleviate feather pecking or cannibalism. However, throughout the experiment, higher number of vigorous, potentially damaging pecks were observed in groups receiving the plant protein. This trend, applied on a commercial scale, could account for perceived worsening of pecking problems with plant protein-based layer diets.

* Merka et al. (University of Georgia) reported the results of a study concerning the feasibility of composting layer manure from a high-rise layer house inside the house. From October 1997 to July 1998, layer manure was composted in an open-sided high-rise laying house. The compost was turned using a prototype compost turning machine powered by a 10 HP gasoline motor. By in-house composting, the volume and weight of the manure was reduced by 34 and 20%, respectively, as compared to that of untreated raw manure. The compost manure had an earth-like odor with improved handling properties and a low moisture content. The compost would not attract flies. The technique is very promising, however, control of drinkers is essential for its success. Composting produced a nutrient dense product (dry weight N, P, and K of 2%, 8%, and 4%, respectively. In a test conducted with pine tree seedlings, one ton of broiler litter per acre was required to meet the P demands of the trees. However, using the compost product, only 500 pounds per acre would be required to meet these same demands. At this rate, the compost material produced from a 100,000 bird layer house would meet the P demand of 2,400 acres of pine tree seedlings per year. A second set of experiments is currently being conducted in a tunnel ventilated high-rise layer house using the same test materials.

* Miles and Bressman (University of Florida) conducted an experiment to determine the effect of dietary vanadium (V) on performance of laying hens in an 8-wk experiment. Ammonium metavanadate was added to a corn-soy diet to supply 20, 40 and 60 ppm V. Feeding vanadium at the two highest levels resulted in a significant reduction in feed intake. Feed conversion was not affected by V supplementation. During the first 4-wk period, egg production was significantly lower for the hens fed 40 and 60 ppm V than compared to those fed 0 and 20 ppm V. During the second 4-wk period, egg production of the group fed 60 ppm V was also significantly lower than those 40 ppm V. Hens fed V-supplemented diets had poorer albumen quality than those fed the control diet. By days 40 and 60, egg shell weight was lower for hens fed 40 and 60 ppm V than those fed 20 ppm or no V. Hatchability of fertile eggs was reduced significantly in hens fed 60 ppm V in the first 4-wk, and for hens fed 40 and 60 ppm V during the second 4-wk period. A significant dose-related decline in percentage total hatch was observed

during the second 4-wk period with the 60 ppm V level having the greatest decline. As the level of V in the diet increased, the percentage fecal moisture also increased. It was concluded that a dietary level of 20 ppm V would result in reducing albumen quality, reducing percent total hatch, and increasing fecal moisture. At 40 and 60 ppm, egg production, feed consumption, fertility and hatchability are reduced and fecal moisture is increased.

* Jalal et al. (University of Nebraska and Finnfeeds International, England) studied the effect of two phytases (A and B) on performance of laying hens (40 to 60 wk of age) fed various levels of available P (AP). A corn-soy diet with AP levels of .35, .25, .15, and .1% were used. The factorial experiment consisted of AP levels of .25, .15, and .1%, phytase sources of A and B, and phytase levels 250 or 300 units / kg diet. The diet with .35% AP was not supplemented with phytase and was considered as the control group. Feed intake was significantly influenced by dietary treatments. Hens fed .25% AP and supplemental phytase B had the highest feed intake, while those fed .1% AP without phytase had the lowest feed intake. There were no differences in egg production, egg weight and shell quality. Egg mass was significantly greater for hens fed phytase B with all AP levels. Feed conversion for hens fed .1% AP without phytase was the least efficient and showed significant differences than the other diets. Percent bone ash was uncharacteristically greater in hens fed the lowest AP level (0.1%) in the absence of phytase, but mortality was 22% in this group. Treatments supplemented with phytase A and B had significantly greater percent shell than the control group. Protein digestibility was not influenced by the treatments. Methionine, cystine and TSAA digestibilities were significantly influenced by AP levels and the presence of phytase. The diet with .1% AP and no phytase had the lowest values for TSAA digestibilities. Alanine and glutamic acid digestibilities were significantly improved in diets with phytase. Digestibilities of other amino acids, including lysine and arginine, were not influenced by dietary treatments. Supplementation of a normal corn-soy diet with phytase improved feed intake, egg mass and amino acid digestibility.

* Ledoux et al. (University of Missouri) reported the results of a 21 d battery study with turkey poults which was conducted to determine the effect of phytase on apparent ileal digestibility of nitrogen and amino acids and on apparent digestibility of energy. Poults were fed a corn-soy diet formulated based on an ideal protein basis. The four dietary treatments consisted of the corn-soy diet plus 0, 200, 400, and 600 units phytase / kg diet (BASF, Corp.). There was no effect of dietary treatment on body weight, feed consumption, and feed conversion. On the other hand, there were linear increases in the ileal nitrogen digestibility, and AME with increasing phytase level. Ileal digestibility of phenylalanine, isoleucine, methionine, leucine, lysine, and tryptophan were increased linearly with increasing the level of supplemental phytase. The increase in cysteine digestibility with increasing phytase levels contained both linear and cubic components. Increasing the phytase level resulted in a linear increase of apparent digestibility of nonessential amino acid glycine. Results indicated that supplementary phytase supplied by Natuphos was effective in improving the energy utilization and digestibility of amino acids in turkey poults fed an ideal protein diet.

* Boling et al. (University of Illinois) conducted an experiment to determine the effect of phytase on the PER (protein efficiency ratio; g weight gain per g protein intake) of several feed ingredients fed to chicks. Ingredients evaluated include: soybean meal, canola meal, cottonseed meal, peanut meal, corn gluten meal, wheat middling, wheat bran, rice bran, defatted rice bran, and meat and bone meal. All ingredients, except soybean meal and meat and bone meal are first limiting in lysine. Based on the determined protein content, each feed ingredient was added to a corn starch-dextrose diet to provide 10% protein diet. The test ingredients were the only source of protein and were fed with 0 or 1,200 unit phytase / kg diet. Casein was also evaluated in the assay to serve as a phytate-free control diet. Graded levels of soybean protein (5, 10, and 15% crude protein) were also fed with and without 1,200 units phytase / kg diet to representative groups so that slope-ratio protein efficacy could be assayed. The results showed that phytase addition did not improve PER values for any feed ingredient evaluated. The results indicated that 1,200 units / kg phytase did not increase amino acid availability in several phytate-containing feed ingredients as assayed by a PER or slope-ratio growth assay.

* Boling et al. (University of Illinois) reported the results of an experiment which was conducted to determine whether citrate can release the phytate P in a laying hen experiment. A corn-soy diet containing .1% AP was supplemented with 0, 1, 2, 3, and 4% citrate. The control group was fed a diet with .45% AP. The experimental diets were used from 22 to 40 wk of age. No differences in performance was observed during the first four wk on experimental diets. By 26 wk of age, birds on diets containing 0 to 4% citrate had significantly lower body weight than the control group. Egg production, feed consumption, feed efficiency, and egg yield were significantly depressed in groups fed 0 to 4% citrate by 30 wk of age. Thus, the addition of citrate to a low-AP diet did not support performance. The mean daily AP intake of hens fed a diet with .1% AP plus phytase was 95 mg. The results indicated that citrate cannot improve the utilization of phytate P by laying hens.

* Lu et al. (Iowa State University) conducted two experiments to determine the effect of different cultivars of corn on digestibility of starch, crude protein, and fat and on the metabolizable energy (ME_n) value of broiler chick diets. Normal corn (NC) and high-oil corn (HOC) cultivar were evaluated in Exp. 1, while NC, waxy corn (WC), and sugar-2 corn (S-2C) cultivar were

evaluated in Exp. 2. Diets were fed to broiler chicks from day-old to 5 wk of age. Ileal digesta and excreta were collected when chicks were 2 and 5 wk old. Starch type, amylose-to-amylopectin ratio, starch viscosity, and amylopectin chain length and branch chain of five different cultivars of corn also were determined. In Exp. 1, digestibility of dry matter, starch, and protein, and ME_n of diet containing HOC were higher than the normal corn on the basis of both ileal digesta and excreta measurements. In both experiments, starch digestibility and ME_n values determined based on excreta were greater than those determined with ileal digesta, showing that additional starch digestion and energy utilization occur at the distal intestine. In Exp. 2, digestibilities of protein and starch of the diet containing S-2C were increased compared with NC and WC diets at 5 wk of age showing the effect of starch crystalline structure on the starch digestibility. The starch of S-2C has a different branch structure and less crystalinity compared with WC and NC. Thus, S-2C corn was more digestible than WC and NC. Also, greater digestibility of S-2C was probably related to its lower viscosity compared with the high viscosity of starch of NC and WC.

* Conjugated fatty acid (CLA) is a mixture of positional and geometric isomers of linoleic acid (cis-9, cis-12). Previous experiments at the University of Wisconsin indicated that dietary CLA increases the ratio of palmitic to palmitoleic (C16:0/C16:1) and stearic to oleic (C18/C18:1) in egg yolk and induced chick embryonic mortality in low-fat diets. The objective of this experiment (Aydin et al., University of Wisconsin) was to determine the effect of CLA on the egg fatty acid content and hatchability of Japanese quail. The birds were fed diets with CLA levels of 0 (diet A), .25 (diet B), .5 (diet C), 1 (diet D), 2 (diet E), and 3% (diet F) for two months. Eggs collected daily were stored at 15 C for 24 h and then incubated. Eggs were assayed for fatty acids at 45 d of feeding the experimental diets. At the end of experiment, all the males and females were killed and body, liver, heart, oviduct, and testicle weights were measured. Total CLA content of yolk (%) from groups A, B, C, D, E, and F were .3, .84, 1.39, 2.27, 5.59, and 10.66%, respectively. The ratio of C16:0/C16:1 in groups B, C, D, E, and F increased about 2, 2.5, 3, 3.2, or 3.5-fold compared to control. The ratio of C18:0/C18:1 in groups A, B, C, D, E, and F were .28, .4, .48, .49, .69, and .83%, respectively. Diets D, E, and F caused 100% embryonic mortality 6, 10, and 12 d after feeding, respectively, while percent hatch in groups A, B, and C were 66, 83, and 50%, respectively. Diet B increased egg size, while diets E and F significantly reduced the egg size when compared to the control. Liver as percent of body weight from both male and female quails increased in all CLA fed groups except group B compared to the control. These results indicated that dietary CLA has a significant impact on fatty acid metabolism which results in increased yolk saturated fatty acids. * Garcia et al. (University of Georgia) conducted two experiments to determine the relative bioavailability of methyl sources, methionine and choline. The basal corn-soy diets contained 0.74% TSAA and 1,896 and 1,969 mg/kg choline in experiments 1 and 2, respectively. In experiment 1, six levels of TSAA (0.74, 0.82, 0.9, 1.06, and 1.22%) and two levels of betaine (0 and 682 mg/kg) were used in a 6 x 2 factorial arrangement of the treatments. Female broilers were fed the experimental diets for 21 days. In experiment 2, male broilers were fed the diets for 20 days. The basal diet containing 0.74% TSAA was supplemented with 0, .04, .08, .012, .016, and .2% methionine or 0; 314; 628; 942; 1,256, and 1,570 mg/kg betaine in experiment 2. In experiment 1, the chick methionine requirement with either 0 or 628 mg/kg betaine was determined using the broken-line linear statistical model. The TSAA requirement for body weight gain was .85% with 0 mg betaine/kg, and .81% with 682 mg betaine/kg. For feed conversion ratio, the TSAA requirements were 0.89% and .85% with 0 betaine and 682 mg betaine, respectively. The relative bioavailability of betaine compared to methionine was 64 and 67% for body weight gain and feed conversion, respectively (on a molar basis). In the second experiment, the slope ratio assay indicated 50 and 56% relative bioavailability for betaine for body weight gain and feed conversion, respectively, when compared to a standard source of DL-methionine.

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