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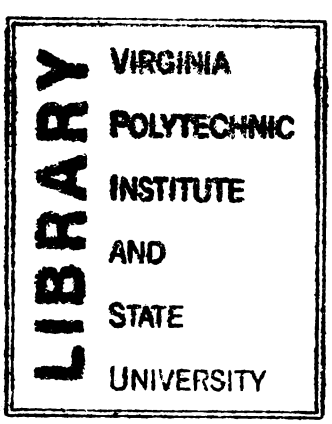

Issued in furtherance of Cooperative Extension work. Acts of May 8 and June 30, 1914, and September 30, 1977 in cooperation with the U.S. Department of Agriculture. Mitchell R. Geasler, Director. Virginia Cooperative Extension Service, and Vice Provost for Extension, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061; Clinton V. Turner, Administrator, 1890 Extension Program, Virginia State University, Petersburg, Virginia 23803.

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PAPER DELIVERED TO THE NATIONAL TURKEY FEDERATION
MEETING - WEEK OF JANUARY 10, 1996
ROBERT NICHOLAS

I'm giving this talk to explain what factors in the last ten years caused the turkey industry to be where it is today.

First, feed prices are very low compared to the trend lines of the 1970's and early 1980's. The price support programs in place then made our grain too expensive for domestic or foreign users, subsidized foreign production, and created an unsustainable burden on the taxpayers. The Farm Bill of 1985 provided the income support transition period that led to the 1989 and 1993 Farm Bills, which put the government in a much more limited role. Everyone felt bad about the decline of the mom and pop grocery store in the 1960's, but no one was willing to pay high prices to keep them open. Similarly, few people wanted to pay a small grain farmer the extra one dollar a bushel it would take to make him a decent living.

The decline in foreign grain subsidies removed the justification for their meat subsidies. This, plus the improvements agreed to in GATT, has recreated our export market.

Second, just as everyone knows that California, Texas, Florida, and New York are, in order, our most populous states, they also know that chicken, pork, beef, and turkey are our most popular meats. Let me talk about the trends that caused this ranking:

1. Increasing age of the population and continuing emphasis on health meant increased consumptions of leaner meats. Leaner meat became not only the type of meat people bought because it was good for them but also became the taste people were accustomed to. Once higher fat meat tasted wrong, the battle was over.

2. Increased fast food usage of chicken and introduction of fast food turkey made major inroads for us and into beef consumption.

3. Poultry benefited because it is much more microwavable than red meat; and is there anyone here who doesn't have a microwave?

Let me now turn to the most popular meats, in order, and explain how I think each of them came to have its share of the national per capita consumption of 225 pounds.

Chicken 85 pounds per capita -

The chicken industry simply extended the above trends plus benefited from continued expansion by the marketing concerns who dominate the broiler industry. The entry of new companies into the chicken industry, once chicken was becoming the major meat, certainly helped the expansion.

Pork 55 pounds per capita -

Pork consumption has basically remained between 55 pounds and 65 pounds for 40 years. It suffers from being a red meat but benefits from being perceived as a leaner (less marbled) meat than beef.

Beef 45 pounds per capita -

Everything that went right for poultry went wrong for beef, plus some.

1. Just as the taste of feedlot beef in the 1950's raised beef consumption ahead of pork for the first time in American history, the sharp decline of feedlot beef was foreseeable.

    a. Excess feedlot capacity in the 1980's meant contagious losses for all feedlots.

    b. Most people didn't want beef fed grain for five months - this increased the overcapacity.

    c. The end of tax shelter feeding in 1987 meant the majority of feedlots lost their major source of financing.

2. Beef was in an insolvable demand trap. People wanted lean meats and lean beef was just too tough.

Turkey 25 pounds - I'll talk more on this later

Fish - 15 pounds -

Everyone enjoys the taste of fish; however, the ocean overharvesting, combined with the slowness of development of aquaculture, has kept fish as the most expensive meat.

Having discussed competitive meats, let's discuss the major improvements in the turkey industry.

1. Marketers

    You know, twenty years ago, the people who slaughtered turkeys were called "processors" because that was what they did - processed live turkeys into dead ones. And that was how they thought of themselves. Today, the "big 5" (Rich, Swift, SaraLee and the two cooperative ventures) have described themselves as marketers for probably a dozen years, and that is why we are where we are as an industry.

    The integrated operations in other meat industries look at us with envy. We are efficient but haven't accepted that we are in a commodity business.

While every other meat expanded by acquiring and expanding existing facilities, we did that and have built ten new plants in the last dozen years.

It is great to be part of the U.S. turkey industry - the greatest meat marketing industry the world has ever known.

2. Breeding

The marketing companies still want the same 28-30 pound tom they did fifteen years ago. Many people are surprised that we have reduced market age three days per year and improved feed conversion by 8 points per year.

They shouldn't be. The decline in the number of breeders meant more money was available for research. Our company spends more on research today than the world's turkey industry grossed fifteen years ago! After all, it is only through research expenditures that we will be able to have the efficiency to go after our real competitor - chicken.

You have heard rumors of some of our genetic engineering field trials. They are true. More information will be presented later in the program by our technical staff.

RJN/mcm
9/30/86

Advances in Turkey Fertility

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Stud farms have been the most radical change in turkey breeder industry in the past 10 years. The potential exists in the use of stud farms to save money by reducing tom numbers needed per hen as well as increasing genetic selection pressure to improve performance of progeny. Much of the credit for enabling turkey breeder managers to use this additional management tool must be given to researchers who have developed techniques for short term germplasm preservation (sperm storage). This report is intended to focus on ways stud farms can be utilized in management programs for turkey breeders.

Minimizing Tom Numbers

Formerly, a tom to hen ratio on commercial turkey breeder farms of about 1:10 (tom:hens) has been maintained. This allowed sufficient semen production from one tome to inseminate approximately 10 hens on a weekly or biweekly basis. This required further that a breeder tom needed to produce about 2 billion sperm cells weekly or biweekly. However, we have known for years that toms produce nearly that number of spermatozoa in a 2 to 3 day period. Consequently, most toms on farms were greatly underutilized. Toms can be better utilized on stud farms by collecting semen more frequently. More frequent collections result in the same number of sperm cells from fewer toms in a shorter time period. Consequently, tom:hen ratio can be increased.

More frequent collections also improve the viability of sperm cells. A normal live/dead ratio would be approximately 60 to 70% under former conditions, whereas, if males were collected twice per week, 80 to 90% live would be the norm. Greater numbers of viable cells are correlated with higher fertility. Most stud farm managers find that they can adequately collect from toms two times per week, and some report occasional success with three times per week. This results in a considerable saving in the number of males required per flock.

A second advantage of a stud facility is that many breeders are finding that toms can be photostimulated to produce semen as much as 6 weeks earlier than hatchmate hens can be photostimulated to produce eggs. It was recently reported by a primary breeding organization that toms in their operation were photostimulated at 17 weeks of age to reduce the generation intervals in their selection processes. The advantage in feed saving resulting from earlier photostimulation is self-evident.

The ideal ratio of toms:hens in stud farms is currently about 1:17, but if 48 or 72 hour semen storage were possible, we could possibly see ratios as high as 1:30. More research to improve short-

term semen holding techniques needs to be conducted. As short-term semen holding techniques improve, numbers of males required to maintain acceptable levels of fertility will certainly decline even further.

Maximizing Sperm Utilization by Hens

Creativity in designing novel insemination schedules for turkey breeder hens has been limited by the number of sperm cells that could be collected from a constant number of toms at a weekly interval. Stud farms allow us unprecendented freedom in designing artificial insemination programs for hens. The problem which arises in insemination scheduling is that knowledge of sperm storage capability of the turkey oviduct is very poor. If we knew the physiological storage capabilities of the turkey oviduct at different times of reproduction, we could further maximize the utilization of sperm cells by inseminating the exact number of viable cells at each insemination interval.

Research at North Carolina State University has been attempting to determine what the optimum sperm storage capacity of the turkey oviduct is at all stages of lay. There appear to be two critical times when the hen's oviduct requires large numbers of cells. The initiation of lay requires 2 or 3 inseminations within a 7 to 10 day period for a total of 400 to 600 million cells per hen to obtain a good initial level of fertility, and after 12 weeks of egg production the oviduct requires increasing numbers of sperm cells to maintain acceptable levels of fertility. The oviduct requires 200 million viable sperm cells per week to maintain acceptable fertility at the end of lay. This type of oviducal sperm cell storage capacity suggests a step-up dose insemination schedule might be the best. Numbers of sperm cells inseminated every week may need to increase slightly with each insemination. One such insemination schedule is already being advocated by at least one primary turkey breeding company.

A sperm dose of about 50 million cells per week has been shown to be adequate to maintain a fertility level of greater than 90% for about 9 weeks of lay. The 50 million sperm cells will maintain acceptable fertility for that period of time if and only if the initial inseminations have adequately filled the sperm storage sites. Cells already stored in the oviduct interact with cells which are introduced into the oviduct by subsequent inseminations. Understanding of the exact interaction between stored and freshly inseminated spermatozoa may result in optimum fertility resulting from the minimum number of cells.

Because 50 million spermatozoa would appear to be adequate to maintain weekly fertility, we chose that dosage as the basis of step-up insemination programs. Two such schemes have been tested (Table 1 and 2), neither of which was ideal in all aspects. The results of these experiments are, however, aiding us in developing the best

insemination schedule.

Intervals between inseminations are probably more important than actual doses because each extended interval between inseminations represents a saving in labor and stress on the breeder hens. Interactions of intervals between inseminations and insemination doses are currently being investigated to determine the optimum combination of the two factors which results in maximization of spermatozoa utilization by the hens' oviduct.

As our understanding of oviducal sperm storage capability improves, it aids in conserving numbers of cells produced by superior sires. This conservation should enable one male to service more females.

Improved Progeny Growth

Few data are available to ascertain the genetic advantage accruing to progeny because of stud farms. If selection of breeder candidates is based on body weight, which is highly heritable, it is reasonable to assume that improved growth will result. Individual records within companies with stud farms would be very difficult to interpret because the data are confounded with so many uncontrolled variables. However, Nicholas Turkey Breeding Farms reported on the effects of sire selection on progeny weights in their July-August 1984 Turkey News. They reported for each 1 lb increase in 20 week parental body weight and a .63 lb increase in tom progeny should be realized. If selection pressure were applied only to the male side, each 1 lb increase in 20 week sire body weight should result in about a .3 lb increase in tom progeny body weight at 20 weeks of age. The advantage of stud farms in improving growth is then very clear when viewed in light of potential progeny growth. The greatest motivation to construct more stud facilities in the turkey industry will probably come from the potential growth in progeny that may result and not from reproductive advantages. Companies are currently more interested in growth than reproduction since almost all remaining turkey companies are vertically integrated and have both breeder and market type bird farms.

Summary

Stud farms are a reality in the turkey industry. Some firms have operated such facilities for nearly 5 years. As more evidence becomes available through research and the operation of these facilities, confidence in the facilities will increase and more stud barns will be constructed. New technology for semen holding techniques and better artificial insemination technology will improve the tom:hen ratios on farms and simultaneously increase our genetic selection pressure at the parent level. The time may eventually arrive when primary breeding companies will be able to sell stored semen rather than male line eggs to their customers.

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TABLE 1. Fertility of turkey hens as affected by increasing sperm numbers per insemination.

Sperm #/A.I.[1] (cells x 10^6)	Weeks of Production 1-5	6-10	11-15	16-20
100	94.4	93.3[b]	89.7[b]	81.9[b]
100/200	92.9	90.3[c]	89.9[b]	89.0[a]
200	94.6	95.2[a]	92.9[a]	86.0[a]

[1]100 = inseminated weekly with 100 million cells; 100/200 = inseminated weeks 1-10 with 100 million cells, weeks 11-20 with 200 million cells, and 200 = inseminated weekly with 200 million cells.

[a,b,c]Columnar means with different superscripts differ significantly.

TABLE 2. Effect of increasing sperm numbers on fertility of turkey hens.

Sperm #/A.I.[1] (cells x 10^6)	Weeks of Production 1-5	6-10	11-15	16-20
50	89.6[b]	82.6[c]	84.2[b]	82.5[b]
INC	91.2[a]	87.9[b]	94.1[a]	93.4[a]
200	91.9[a]	94.6[a]	95.7[a]	93.7[a]

[1]50 = inseminated weekly with 50 million cells; INC = inseminated initially with 50 million cell dose which was increased by 25 million triweekly, and 200 = inseminated weekly with 200 million cells.

[a,b,c]Columnar means with different superscripts differ significantly.

EARLY POULT MORTALITY AS AFFECTED BY HATCHERY MANAGEMENT

John Simms

Today we are going to discuss hatchery related factors that can affect poult quality and subsequent early poult mortality in the field. I think it is important to point out at the beginning of this presentation that even the most sophisticated, state-of-the-art hatchery with the most conscientious, dedicated staff is only as good as the eggs that go into that hatchery. A hatchery such as I have just described, when given poor quality, mishandled hatching eggs can only produce poor quality poults. However, for the sake of this presentation, let's assume our hatchery has received good quality hatching eggs with a true fertility of 93%-95% and the potential for an 80% or higher hatch of all eggs set.

Starting with the incubation room, then proceeding to the hatch room and poult service room, we will discuss the optimum way in which to handle these eggs and poults.

A discussion on poult quality, as affected by hatchery management, would be incomplete without hatchery sanitation. Because of the limited amount of time for this presentation, I will say only that a good hatchery sanitation program is essential to good poult quality. As a hatchery manager, we want to initiate an effective sanitation program that will minimize the introduction of bacteria into our hatchery and prevent the recycling of bacteria in the hatchery from one hatch to another.

Some hatcheries are preheating eggs prior to setting, while others are simply rolling eggs from cold storage into incubators. Preheating eggs before setting, if done incorrectly, can cause uneven hatching. A good preheating compartment should preheat eggs as rapidly as possible with plenty of air circulation through the eggs.

Most multi-stage incubation systems are designed to operate somewhere between 99.2° and 99.5° Fahrenheit. Humidity levels recommended for most incubators generally call for 84° to 86° Fahrenheit wet bulb.

Some incubation systems are more flexible than others when varying from manufacturers' recommendations. For example, the interrelationship of temperature, humidity and air flow in Big J incubation systems require that manufacturers' recommendations be closely followed. The lowering of humidity levels more than one or two degrees Fahrenheit wet bulb can cause increased damper openings, which in turn adversely affect air flow and animal heat balance within the incubation compartment. Uneven hatching between racks, early hatches and dehydrated poults can be the direct result of excessive damper openings.

Another critical area of incubation that can directly affect poult quality is the humidity delivery system. In some incubation systems spray nozzles not only serve as humidifiers, but also as internal coolers. In order to have a

balanced cooling effect from the top to bottom trays within individual incubator racks, it is of utmost importance that all spray nozzles be set at precisely the correct height and that all nozzles be given a good coned spray. Nozzles not spraying properly, or spraying at the wrong height, can in itself create uneven heating conditions. The problem can be compounded further by the fact that malfunctioning spray nozzles will cause incorrect damper openings.

Many turkey hatcheries today are setting eggs from force molted flocks, flocks that have been in production for extended periods of time, and with what I will call good quality normal hatching eggs. These varying groups of eggs provide a real challenge for the hatchery manager. If we are to obtain the highest quality poults that will hatch in the most predictable fashion, we need to alter our setting time for each individual group of eggs, while continuing to operate our incubators and hatchers very closely to manufacturer's recommendations.

Eggs produced from force molted flocks, or flocks that have been in production for extended periods of time, normally require additional incubation time in comparison with normal hatching eggs.

When transferring eggs from incubator to hatchers, care should be taken to handle eggs in a gentle fashion. Trays of eggs should never be banged too hard on the table tops or shoved into the hatchers too abruptly. Hatching trays that utilize excelsior pads also require special attention. We want to make sure that the excess excelsior is tucked down in the tray to avoid air flow blockage. Eggs with an average fertility below 80% should be tested at transfer time with infertilities removed. This will help to reduce the draggy hatching tendencies of eggs with lower fertilities.

Having successfully transferred our eggs into the hatchers we move on to what I consider to be one of the most important aspects of hatchery management -- determining hatch pull time. All too often hatcheries operate their labor force on preset schedules. Because poults dehydrate rapidly in the hatchers after hatching, it is critical that poults be taken off within a reasonable amount of time after hatching. We like to pull our poults when they are still slightly damp. We normally start looking into the hatchers the day before they are scheduled to pull to determine the correct pull time. Even if we have to pull our poults off in the middle of the night, we feel that it is much more desirable to hold the poults in the boxes, rather than hold them in the hatchers over night. Of course, now that we have the poults out of the hatchers, the ideal thing to do at this point to reduce early poult mortality is to take them to the farm. Instead, however, if we are like most turkey hatcheries around the country, we are going to, in the next eight hours, perform no less than five separate services on our newly hatched poults. The goal of the hatchery manager at this point is to perform these various services on the poults and get them to the farm with the least amount of stress possible.

The first step in out poult servicing area is usually sexing. Occasionally we need to remind sexers of the value of the product they are handling and hopefully encourage them to reduce any rough handling that may develop.

After sexing, poults will probably be debeaked, desnooded, toe clipped and injected. Careful attention to these services can help to greatly reduce stress on the newly hatched poults.

We have found that by toe clipping poults just past the nail bud area, rather than all the way back to the first joint, we can greatly reduce bleeding. The toe nail that eventually grows back from this light detoeing will in effect gnarl under and not be sharp enough to injure other birds by scratching.

In the area of debeaking, we again are subjecting our poults to a stressful service that requires extremely precision work and great attention to quality control. The burn hole must be placed just ahead of the nostril area, about a dime's width. Debeaking a poult into the nostril area can cause the nostril to become sealed and lead to secondary infection later in the bird's life. Debeaking into the tongue area is usually always fatal.

Quality control checks should also be made periodically during the service day on the auto-injectors. An operator using improper technique or a malfunctioning auto-injector can do a lot of damage in a short amount of time. Utilizing a green dye in the injectable and blowing a gentle airstream over the neck of the poult, allows the quality controller to better evaluate each auto-injector operators performance.

Once service has been completed, poults should be placed into rows having plenty of air space between stacks to allow for good air movement. Room ceiling fans or circulating fans can be used to help avoid heat buildup around stacks. It is recommemded that lights be turned off on poults awaiting delivery.

When poults are delivered to the farm, a good poult delivery receipt provides spaces for the necessary information on poult quality and condition of brooding facilities where poults are to be placed. In addition, a twenty-four hour temperature recording disk that has been onboard the delivery van during tranport from the hatchery to farm is presented to the farm manager, assuring him that the poults were maintained at the proper temperature.

In conclusion, there are several factors in the hatchery that can affect poult quality. These include fine tuning incubation and hatching equipment, not straying too far from manufacturer's recommendations, following an effective well designed sanitation program, handling eggs and poults with T.L.C. and making every effort to minimize the amount of stress placed on the poults during servicing and delivery.

Ventilation of Livestock Buildings

H. Noel Dykes, Jr.
International Minerals & Chemical Corporation

After proper nutrition, ventilation is perhaps the most critical factor in livestock production. It probably is also the most abused. With proper ventilation, animals produce more eggs, more milk, more meat and remain healthier than those in a poor environment. Working conditions for the caretaker are much better also; such as, breathing less dust and ammonia, removing less wet litter, having a more even temperature, etc. Proper ventilation can also reduce fuel costs, make buildings last longer (less sweating), and reduce the workload of the producer. As with any program with so many advantages, there are a couple disadvantages. One is that electric usage is greater. The other is the risk of suffocation in the event of a power failure, blown fuse, belt breakage, etc. We will discuss later how to greatly reduce this risk.

In our discussion of ventilation, we shall be referring to power ventilation. I know of no one sharp enough to advise as to how to ventilate through window or curtain openings and stay ahead of Mother Nature. You would be fortunate to be right 50 percent of the time. It is most difficult to out-guess changes in wind direction, wind velocity, temperature, or humidity. I have just answered the question as to why we ventilate with fans and increase the electric bill; i.e., Control of the Environment.

Most of the following will be directed to poultry buildings, but is applicable to other farm buildings. We should define power ventilation as the use of one or more fans to achieve some measurable static, or negative pressure. We then will define static pressure as the creation of a partial vacuum in a closed building due to the running of a fan. The amount of static pressure can be measured by a hand held, or wall mounted, static pressure gauge, and only when you can measure it are you completely ready to start power ventilating. Static pressure is basically a lower pressure reading than the barometric pressure. For example, if you measured static pressure of 0.1 inch and the outside barometric pressure was 30.1 inches water column, the inside pressure of the building would be 30.0 inches water column. Because the inside pressure is less than the outside pressure, the atmospheric pressure forces air to rush into the building through any cracks or openings to try to equalize the pressures. This is how power ventilation works.

Without getting too involved, in most cases you will want to keep the static pressure in a range of 0.03 to 0.10, with 0.05 to 0.08 being ideal for most situations. Below 0.03 inch static pressure the air enters the house too slowly and drops to the floor, creating cold spots and possibly wet spots. Above 0.10 inch static pressure, the air enters too fast and does not give the swirling motion necessary to move air and heat from the ceiling back down to the floor before being exhausted. In addition, very high static pressure makes fans run very inefficiently because they cannot move nearly the volume of air they are capable of. This greatly increases the electric cost per CFM of air moved.

There are certain priorities in what we ventialte to achieve. Naturally, we must bring in oxygen, but this is satisfied by the following three priorities:

1. Ammonia removal
2. Moisture control
3. Temperature

Growers sometimes make temperature their first priority in ventilating in order to save fuel, but this almost always ruins a flock because of ammonia blindness. The presence of high levels of ammonia, even for short periods, will blind birds, give poor growth, unevennes, poor fleshing, poor processability, and subjects birds to much greater disease risk. Since ammonia is so important, let us examine it in detail.

Ammonia gas is produced from nitrogen in the birds' droppings in the presence of heat and moisture. Keeping the litter moisture under control (25 to 30%) will help, but we must constantly remove ammonia from the building. We do this with the use of one or more timer fans, which pulls the proper amount of static pressure when it runs. Some houses will have to be closed up as tightly as possible to achieve enough static pressure; others that are newer and tighter may have to have the air inlets cracked slightly to achieve proper static pressure. By running the timer enough minutes out of every ten minute cycle, you can pull the ammonia level down to a satisfactory one. When starting chicks on old litter, you will probably find that it requires at least 0.10 CFM per bird. Start with this before the chicks arrive, and at placement time, the grower can go up or down with his timer setting, based on the ammonia level. Whenever a grower goes into the house and smells too much ammonia, he should immediately increase the timer (assuming proper static pressure) by 1/2 minute or more. He should then again check the house in a half hour to see if this increase was enough. By constantly monitoring ammonia levels and timer settings, a flock can be kept free of blindness. Some growers I have worked with could not smell ammonia because of constant exposure to it. If this is the case, suggest that another member of the family check the house daily. One

of the surest ways to blind a flock is for the grower to turn the timer down at night because of a low temperature forecast in order to save fuel. My advice would be to leave the timer set high enough for ammonia control and increase the brooder thermostats. This will result in a much better environment for the birds, and even though it will make the fuel cost a little higher, it will result in a better bottom line cost at the end of the flock.

The second ventilation priority is moisture removal. This makes problems with manure burns and breast blisters, and makes the house and equipment last longer. Again, the timer is used (at the same static pressure as that required for ammonia control) to pull more air into and out of the house. The secret is to pull a greater volume of air through to pick up moisture and take out through the fan. In most cases, this air will have to be heated in order to not cool the house too much. The rule of thumb is that for every 20° rise in temperature, the water holding capacity of the air will doubles. As an example, if you bring in 30° air and it warms to 70° as it mixes with the house air, it will expand to the point where it will hold four times as much water vapor. If floors or insulated walls are getting wet, you can dry them out in a few days by increasing timers and keeping the temperature right. The exceptions to this would be a flock with very watery droppings, or uninsulated walls in cold weather. I would also run a few fan thermostats a little lower so that on a mild day the fan may stay on longer, speeding up the drying process.

The third priority is temperature. To achieve this while we are concentrating on ammonia and moisture control, the grower must properly use his brooder controls. He must also be aware that if he cheats on fuel, he will pay for it in high feed conversions or disease or poor bird quality. Keeping all three priorities in perspective is a bit of an art and requires practice, but can be very profitable to do.

As discussed earlier, use only enough timer fans to pull desired static pressure. This will ensure better air flow for longer periods, and will use much less electric than using all the fans in a house. In almost all partial house brooding, one fan will pull enough static pressure to successfully ventilate it. As you get into the whole house, such as 15,000 to 20,000 capacity broiler house, it will probably require two 36 inch fans running together, or synchronized, to pull the desired static pressure. This means the timer clocks must be set to run together. In some cases, this can be achieved by using a switch to turn one off until the other fan catches up to it. In other cases, you may need to turn one off at the breaker box until the other fan comes on. Again a little practice makes this easy.

Thermostats are quite important for temperature control, but are often neglected or set too high or low. You never want to have a fan running on thermostat when brooders are running to give you the desired temperature. This would mean that either the brooders or fans, or both, are set wrong. Try to have your lowest fan thermostat setting 3 to 5° higher than the temperature your brooders are set to deliver. Always have your timer fan or fans on the lowest thermostat setting. This will prevent a very high static pressure situation on a milder day when some fans may be on thermostat. In addition, stagger your thermostat settings so that all fans do not run at the same temperature. Too many fans on at a low thermostat setting without enough inlet opening will cause such a high static pressure that the shutters will not open. This can cause a dangerously high temperature and ammonia, and costs a lot more electric per CFM of air being moved. As an example, on four week old birds with stoves on to keep 75°, perhaps two fans would be on 78-80°, one on 81-82°, two on 84°, and the last one on 86°. As they come on and run, the grower has time to adjust his air inlets or curtains to feed the additional fans.

To give you an idea of how much opening is required, figure 200 square inches of opening per 1,000 CFM of fan power. For example, a 36 inch fan drawing 8,000 CFM only requires 1,600 square inches of opening. This is much less than most growers think is required. Most houses have enough cracks to feed a couple fans without opening anything.

There are a number of things that need to be checked to ensure maximum efficiency of fans. Be sure that shutters are clean and move up and down freely. Keep wire guards free of dust and feathers. Be sure fan belts are tight and in good repair. Keep the screen covering on air inlets clean. Don't run static pressure over 0.10 inch.

At the start, we talked about the risk of suffocation. The following are do's and don'ts. Don't ever turn fans off at the switch or fuse box when lowering curtains or windows on warm days. Don't ever unplug fans for the same reason. Do install a power failure relay on timer fans circuits. Do install a curtain minder to drop the curtains in the event of a power failure or high temperature rise.

By following these precautions, you can power ventilate with a minimum of risk and increase your bottom line profits. For more details or clarification, contact us at: Sterwin Laboratories, Inc., P.O. Box 537, Rt. 113, Millsboro, DE 19966.

VENTILATION

IT'S EFFECTS ON POULTRY HEALTH

H. NOEL DYKES, JR.

I. INTERACTION OF VENTILATION AND POULTRY HEALTH

A. Most obvious is Keratoconjunctivitis (ammonia blindness).

1. Results from inadequate air flow, two much moisture.
2. Greatly reduces weight, fleshing, yield, grade.
3. Makes chicks more susceptible to other diseases.

B. Poor air quality leads to more respiratory problems.

1. Dust irritates respiratory tract.
2. Excess moisture makes bird work harder to breathe.
3. There is less dilution of viruses in the house because virus and bacteria particles are not being moved out.
4. Vaccine reactions will be much more severe in dust or ammonia.

II. POWER VENTILATION

A. Reasons to use:

1. Control temperatures
2. Control moisture
3. Control air quality
4. BASICALLY TO CONTROL ENVIRONMENT

B. Mother Nature is a bitch.

III. DEFINITION

A. Power ventilation - Use of one or more fans to produce static pressure for air movement.
B. Static Pressure - Creation of partial vaccuum due to fan running.
C. C.F.M. Air Movement - Cubic feet/minute.

IV. TYPES OF POWER VENTILATION

A. Positive Pressure - Blowing air into house.
B. Negative Pressure - Exhausting air out of house.

1. Used in majority of poultry operations.

V. PRIORITIES IN VENTILATING

A. Ammonia (NH_3) Removal

1. Leads to blindness
   a. Causes low eight, poor quality, reduced F/C

B. Moisture Removal

1. Control litter caking and excess humidity

C. Heat Removal - THERMOSTATS

D. Light Control (e.g., pullets) - House stays closed up

VI. POWER/NATURAL VENTILATION

A. Cannot mix power and natural

1. Go all power to pull static pressure or go all natural by dropping curtains wide on both sides of house.
2. Can suffocate birds by having too much opening to pull any static pressure but too little opening for natural air currents to work.

B. NEVER unplug fans or turn off at switch.

1. Extremely dangerous policy.
2. Could forget to turn fans back on when closing up in evening or if someone else closes up for you (e.g., son, wife, neighbor, etc.).

VII. TIMERS

A. Function - To cause fan to run a certain amount of time out of 10 minute cycle.
B. Purpose - To supply oxygen and control NH_3 and moisture.
C. Run the least number of fans possible. Run one if it will pull enough static pressure. If not, synchronize two.

VIII. THERMOSTATS

A. Function - To cause fan to run above a predetermined point.

B. Purpose - Used exclusively for excess heat removal.

C. Staggered settings

1. Does not let all fans run at same time.
2. Allows grower to adjust inlets and/or openings as additional fans come on.
3. LOWEST THERMOSTAT SETTING ALWAYS ON TIMER FAN(S).
   a. Start lowest thermostat setting at 3° above desired room temperature.

D. Set all thermostats according to conventional or end-brooder.

E. Avoid thermostats "fighting" stoves.

IX. STATIC PRESSURE SETTINGS (SHOW PRESSURE GAUGES)

A. Best range is 0.05" - 0.10" (ideal is 0.07" or 0.08").

B. Maintain an appreciable level.

1. 0.07" - 0.10" COLD WEATHER
2. 0.05" - 0.08" COOL to MILD WEATHER

C. Extreme

1. Maximum is 0.10"
2. Bare minimum is 0.03"

D. Air pressure is related to air speed.

1. Air moving too fast above 0.10 inch and is shooting across ceiling dragging out heat.
2. Air moving too slow below 0.03 inch and is falling on floor next to walls.

E. Make sure fans are at optimum operating efficiency.

1. Tight belts
2. Clean screens and shutters
3. Shutters work freely (graphite best lubricant)

F. One timer should pull good pressure in 1 and 2 chambers (or 1/2 house) and usually two timers synchronized for whole house.

1. Sometimes one fan will handle whole house for 2-3 weeks.

G. Two houses running same number of fans and set at same static pressure are pulling same volume of air through house even though one house is tighter than the other.

H. Extreme static pressure will cause shutters to droop.

1. Check by opening door.

X. VOLUME OF AIR/STATIC PRESSURE

A. Occasions when static pressure not feasible:

1. Extremely loose house - Too many fans to achieve decent pressure (high air volume).

a. Need to push WINTERIZING house.

X. VOLUME OF AIR/STATIC PRESSURE (CONT.)

2. Only 24 inch and/or 30 inch fans available.

a. Too much volume by time you synchronize enough small fans for good pressure.

3. Need to readjust vents if necessary.

XI. SYNCHRONIZATION OF FANS

A. How to read timer face.

B. At switchbox (be sure both timers are NOT on same circuit).

C. At fan control by turning off fan timer as it comes on and turning back on when other fan comes on.

D. Two people - Turn off timer that is ahead of other and when it reaches that time partner waves and first timer is turned back on.

E. Use of "C" clip - Have nimble fingers.

F. Avoid "see-saw" effect.

XII. INLET OPENING

A. Rule of Thumb - Need 200 in^2 of opening per 1,000 C.F.M. of fan capacity.

1. 8,000 C.F.M. fan needs 1,600 in^2 opening.

B. Try to use inlets first to feed fans.

1. Use inlets to "ventilate" house such as one or two extra fans in cold weather.

C. Should only use back curtain (opposite far side) when feeding three or more thermostat fans.

1. Pulling air across house at decent pressure causes "cooling" effect.

D. Figuring opening for 36 inch fan.

1. Vents (e.g., 20 vents 7 inches x 48 inches).

a. 1,600 in^2 (area) ÷ 960 lineal inches = 1.66 inches per vent or 1-1/2 to 1-3/4 inch opening.
b. 1,600 in^2 ÷ 20 (#vents) = 80 in^2/vent ÷ 48 inches (length) = 1.66 inches/vent

2. Curtains (e.g., 150 foot chamber)

    a. 150 feet x 12 inches/1 = 1,800 lineal inches available so 1,600 in^2 ÷ 1,800 inches = 0.88 inch = or ≈ 1 inch opening or back curtain.

E. Definitely check static pressure with static pressure gauge to determine when to start opening.

1. Possible to run 2 or 3 fans before static pressure exceeds our limits.

F. Avoid using doors to feed fans.

1. Causes fresh, cool area at opening.
2. Areas between doors hot and stuffy; no air movement.

XIII. CONTROLLING AMMONIA (NH_3)

A. Ammonia gas is result of degradation of poultry manure.

1. 50 ppm or more harmful to poultry (KERATOCONJUNCTIVITIS).

B. Increase timer(s) as needed.

1. Use 1/2 minute increments usually unless NH_3 is strong then go one minute jumps.

C. Best time to check NH_3 is ≈ one minute before timer comes on.

1. Make sure no fans are running on thermostat or you will observe false situation (vs. right time).

D. Pockets can be removed by cracking inlets in NH_3 and/or hot pockets.

1. Reason for chain adjustments on vents.

E. NEVER TELL GROWER NOT TO TOUCH VENTILATION BECAUSE YOU SET IT!!

XIV. CONTROLLING MOISTURE

A. Increase timer(s) as needed.

1. Use 1/2 minute increments usually unless humidity is high (or litter wet) then go one minute jumps.

B. More volume of air to remove moisture via increased <u>timers</u>, <u>decent static pressure</u>, and <u>burning fuel</u> to maintain minimum temperature (if needed).

C. Wet spots can be dried out by opening vents in that area to allow more air volume to flow over wet area and remove moisture.

D. NEVER TELL GROWER NOT TO TOUCH VENTILATION BECAUSE YOU SET IT!!

XV. CONTROLLING DUSTY HOUSES

A. If NH_3 is still strong we MUST run enough timer to control NH_3 regardless of dust.

B. Build moisture by:

1. Decreasing timer to MINIMUM levels to control NH_3 and increase down time.
2. Increase thermostat settings 3°-5° above normal settings to allow temperature to build up and moisture stay in house longer.

C. Takes much longer to return dusty conditions back to normal.

1. Takes better than average managment usually.

D. NEVER TELL GROWER NOT TO TOUCH VENTILATION BECAUSE YOU SET IT!!

XVI. TYPES OF INLETS

A. Soffit - Air comes in at top of sidewall (under roof overhang) and usually directed along ceiling.

1. Can be used with auto. vent. system.

a. styrofoam doors best with rod or cable.
b. Wood okay only if you use metal rod.

2. Manual with chain.

B. Sidewall - Used in most new houses.

1. Styrofoam doors and auto. vent. system

C. Poly Flap

1. Brought air in across attic (to be preheated) and dropped in on other side.
2. Poor air movement (very low - or none - pressure).
3. Allowed heated air to go up in attic and condense on cold roof metal and condensation ruined insulation.

D. Plywood Duct - Used in double and triple deckers.

1. Uneven air distribution.
2. Incoming air NOT heated up appreciably in duct.
3. Plywood best used for shed.

E. Split Plate - Continuous slot at top of sidewall with hinged plywood doors.

1. Seal up (at least) two of very three doors (they become warped).
2. Hinges rust and hard to open.

    a. Plastic hinges best for this type.

F. Winches window with baffle board.

1. Must crack windows to provide air.
2. Diverter boards should be set in open position since windows control air.

Round Hill Farms - Light Research

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We conducted a test comparing electric usage between conventional incandescent light bulbs versus screw-in fluorescent bulbs.

The test was conducted over a one year period in two separate two-story, power ventilated, turkey houses. The houses were 40' x 300' with a total of 24,000 square feet per building. Both buildings have two rows of lights on each floor or a total of 38 lights per floor. In the houses with incandescent bulbs, we used 100-watt bulbs in the top floor, brooder area, and 40-watt bulbs in the bottom floor, grow-out. In the other building, we replaced 100-watt bulbs with 13-watt fluorescent and 40-watt bulbs we replaced with 9-watt fluorescent. The fluorescent bulbs are equivalent to incandescent bulbs in light output. Lights were on 24 hours when birds were housed.

To measure the amount of electricity used, we installed two electric meters in each house. One meter was installed on complete electrical system; feeders, lights, fans. The other on the lighting circuit only. The cost of the fluorescent bulbs was $9.75 per bulb, for a total of $741.00. We also needed to replace 8 bulbs, over the test period, at a cost of $78.00. Here are the test results of total electric used: Conventional bulbs: total electric used - 53,174 kilowatts, lights only - 28,322 kilowatts. Fluorescent bulbs: total electric used - 32,467 kilowatts, lights only - 7,337 kilowatts.

The fluorescent bulbs used 20,985 less kilowatts over a one year period. If electricity costs ten cents per kilowatt used, the fluorescent bulbs saved the grower $2,098. The pay-back in a building of this size is five months. The test also indicated that lighting is 50% of the total electric usage in a power ventilated turkey house. The new lights did not change bird growth performance.

CONVENTIONAL BULBS versus FLUORESCENT BULBS

1. Test Buildings:
   A. 2 - two story power ventilated houses
   B. 76 light bulbs in each building
      38 - 100 watt - 13 watt fluorescent
      38 - 40 watt - 9 watt fluorescent
   C. Lights on 24 hours while birds housed

2. Meter readings at end of one year:

Conventional*	Fluorescent*
53,174 kw	32,467 kw

*Total electric: feeders, fans, lights.

Conventional**	Fluorescent**
28,322 kw	7,337 wk

**Lights only

28,322 kw - 7,337 kw = 20,985 kw
20,985 wk x $.10/kw = $2,098.50/year
$741.00 ÷ $2,098.50 = .353(cost of bulbs $ saved)
.353 x 12 = 4 months pay-back period

The Effect of Light Sources and Light Intensity on Growth Performance of Male Turkeys

by
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Agricultural enterprises have been placed at an economic disadvantage in recent years because of astronomical increases in the cost of energy. Highly mechanized farm operations have been most severely affected because of their extensive use of energy sources in the form of oil, electricity and natural gas. Because of high energy costs, it is mandatory to reduce energy usage.

The turkey industry uses electricity extensively and is constantly looking for ways to become more energy efficient. One approach is to use light sources that will provide maximum illumination per unit of energy. It is well known that growth, agonistic behavior and reproduction of the turkey is controlled by a combination of daylength, light intensity and wavelength of the light. The ideal light source appears to be natural daylight. Unfortunately, daylength varies depending on the season of the year. It is therefore necessary to provide supplemental artificial light during the Fall and Winter months in order to assure maximum growth performance. Energy efficient light sources are being developed but their light intensity may be far in excess of that needed to promote growth and minimize aggressive behavior.

Comparative efficiencies of light sources currently being considered for possible use by the turkey industry are presented below:

Light source	Average lumens per watt	Average lamp life (hours)
Incandescent	15	1,100
Fluorescent	60	18,000
Sodium Vapor	120	16,000
Mercury Vapor	35	20,000
Multi-vapor (Halide)	80	12,000

The least energy efficient light source appears to be the common incandescent lamp. Lumen output per watt is four and eight times that of incandescent light for fluorescent and sodium vapor lamps,

respectively. In addition, lamp life for fluorescent and sodium vapor light is 16 and 15 times that of incandescent lights, respectively.

Under these conditions, a typical grower house 50' wide and 350' long would require four rows of 34-100 watt incandescent bulbs or a total of 136 bulbs to provide the necessary levels of light intensity during the growing period. Assuming the birds would be reared on 24 hour lights, these bulbs would consume 326 kw of electrical energy per day. Assuming a cost of $.057 per kw, it would cost $18.58/day or $5723 per year if we assume the building is used 44 weeks out of the year. Fluorescent bulbs can provide the same number of lumens for $4.65/day or $1432 per year while sodium vapor lamps would cost only $2.33/day or $718 per year to operate. On the national basis that would mean a savings in energy costs over incandescent bulbs of $27,000,000 year for fluorescent bulbs and $31,500,000 per year for sodium vapor lamps. These operating costs plus the long life of fluorescent and sodium vapor lamps may make it more economical for the turkey industry to use light sources other than incandescent lights. Before the use of these alternate light sources can be recommended, however, research must first be conducted to evaluate the spectral differences between various light sources and their effects on growth parameters of turkeys. The results of these studies will help determine the most economical light sources for optimizing growth potential of male and female turkeys.

EXPERIMENTAL PROCEDURE

Large White turkey males were hatched on February 28 and October 16, 1985 (Experiments I and II, respectively) and assigned to brooding pens. When the birds were 8 weeks of age, they were reassigned to light controlled pens. From 8 through 24 weeks of age they were exposed to 24 hours of light per day from light sources consisting of incandescent, sodium vapor, daylight fluorescent and warm fluorescent. Within each light source the males were exposed to light intensities of 1 or 8 foot candle power (10.8 and 86.1 lux, respectively). The experimental design was as follows:

Experimental Design

	Light intensity (lux)*	
Light Source	10.8	86.1
Incandescent		
Na Vapor		
Daylight Fluorescent		
Warm Fluorescent		

* 1 foot candle power of light intensity = 10.76 lux.

Each treatment combination consisted of two pens of 25 birds each. Data were obtained on growth feed efficiency and mortality at two week intervals. Data on feather scores and live market quality were obtained when the birds were 16, 20 and 24 weeks of age. Heterophil-lymphocyte (H/L) ratios, as a measure of stress, were also obtained when the birds

were 20 weeks of age. Agonistic behavior data were obtained when the birds were 17 weeks of age. Only growth and feed efficiency data from experiments conducted during the Spring and Summer and Fall and Winter will be reported here.

RESULTS

Experiment I

Results obtained on body weight through 24 weeks of age are presented in Table 1. Differences in body weight between the various light sources and light intensities were small and not significantly different statistically. Data on body weight gains between 8 and 24 weeks of age also showed no significant differences among light sources or light intensities (Table 2). Feed efficiency (Table 3) was significantly higher for males reared under incandescent lights only during the 8 to 12 week growing period but unaffected by either light source or light intensity thereafter.

Experiment II

Body weight and period body weight gains were unaffected by either light sources or light intensities (Tables 4 and 5, respectively). Feed efficiency was significantly higher for males reared under incandescent lights only during the 12 to 16 week period (Table 6). Light sources or light intensities had no significant effect on feed efficiency thereafter.

SUMMARY

Two experiments were conducted, utilizing approximately 800 Large White male turkeys, to determine the effects of different light sources and light intensities on growth and feed efficiency through 24 weeks of age.

Results obtained showed that daylight fluorescent, incandescent. sodium vapor and warm fluorescent lights have essentially equal effects on growth and feed efficiency of Large White turkeys. Light intensities of 10.8 and 86.1 lux (1.0 and 8.0 foot candles) were also equal in their effects on the growth parameters under study.

These results suggest that turkey producers would be well advised to convert their current lighting systems to more energy efficient light sources such as fluorescent or sodium vapor lamps.

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Table 1. Body weights of male Large White turkeys from 12 to 24 weeks of age by light sources and light intensities (Experiment I)

	Body Weight (lbs.)[1]			
Treatment	12 wks	16 wks	20 wks	24 wks
Light Source				
Incandescent	12.4[a]	20.2[a]	27.8[a]	33.6[a]
Daylight Flour.	12.7[a]	20.0[a]	27.4[a]	33.4[a]
Warm Flour.	12.4[a]	20.0[a]	27.5[a]	33.3[a]
Sodium Vapor.	12.4[a]	20.3[a]	27.5[a]	33.6[a]
Light Intensity				
10.8 lux	12.5[a]	20.1[a]	27.6[a]	33.6[a]
86.1 lux	12.4[a]	20.1[a]	27.5[a]	33.3[a]
Experimental mean	12.5	20.2	27.6	33.5

[1] Means within a light treatment and week with different superscripts are significantly different from each other($p \leq 0.05$).

Table 2. Body weight gains of male Large White turkeys from 8 to 24 weeks of age by light sources and light intensities (Experiment I)

	Body weight gains (lbs.)[1]			
Treatment	8-12 wks	12-16 wks	16-20 wks	20-24 wks
Light Source				
Incandescent	7.0[a]	7.8[a]	7.5[a]	5.8[a]
Daylight Flour.	7.1[a]	7.4[a]	7.4[a]	6.0[a]
Warm Flour.	6.9[a]	7.6[a]	7.5[a]	5.8[a]
Sodium Vapor.	6.7[a]	8.0[a]	7.2[a]	6.0[a]
Light Intensity				
10.8 lux	7.0[a]	7.6[a]	7.5[a]	6.0[a]
86.1 lux	6.9[a]	7.7[a]	7.4[a]	5.9[a]
Experimental mean	7.0	7.7	7.5	6.0

[1] Means within a light treatment and week with different superscripts are significantly different from each other($p \leq 0.05$).

Table 3. Feed efficiencies from 8 to 24 weeks of age by light sources and light intensities (Experiment I)

Treatment	Feed efficiencies[1],[2]			
	8-12 wks	12-16 wks	16-20 wks	20-24 wks
Light Source				
Incandescent	.426[a]	.342[a]	.271[a]	.241[a]
Daylight Flour.	.422[a]	.337[a]	.277[a]	.233[a]
Warm Flour.	.416[ab]	.345[a]	.274[a]	.226[a]
Sodium Vapor.	.407[b]	.349[a]	.264[a]	.249[a]
Light Intensity				
10.8 lux	.417[a]	.338[a]	.274[a]	.231[a]
86.1 lux	.418[a]	.349[a]	.270[a]	.243[a]
Experimental mean	.418	.344	.272	.236

[1] Means within a light treatment and week with different superscripts are significantly different from each other($p \leq 0.05$).

[2] Feed efficiency = pounds of bird produced per pound of feed consumed

Table 4. Body weights of male Large White turkeys from 12 to 24 weeks of age by light sources and light intensities (Experiment II)

Treatment	Body Weight (lbs.)[1]			
	12 wks	16 wks	20 wks	24 wks
Light Source				
Incandescent	12.5[a]	20.4[a]	27.4[a]	32.8[a]
Daylight Flour.	12.8[a]	20.4[a]	28.0[a]	34.0[a]
Warm Flour.	12.8[a]	20.4[a]	27.4[a]	33.0[a]
Sodium Vapor.	12.9[a]	20.4[a]	27.2[a]	33.0[a]
Light Intensity				
10.8 lux	12.8[a]	20.4[a]	27.6[a]	33.0[a]
86.1 lux	12.7[a]	20.4[a]	27.4[a]	33.0[a]
Experimental mean	12.8	20.4	27.5	33.0

[1] Means within a light treatment and week with different superscripts are significantly different from each other($p \leq 0.05$).

Table 5. Body weight gains of male Large White turkeys from 8 to 24 weeks of age by light sources and light intensities (Experiment II)

	Body weight gains (lbs.)[1]			
Treatment	8-12 wks	12-16 wks	16-20 wks	20-24 wks
Light Source				
Incandescent	6.8[a]	7.8[a]	6.9[a]	5.4[a]
Daylight Flour.	7.0[a]	7.6[a]	7.6[a]	6.0[a]
Warm Flour.	7.0[a]	7.6[a]	6.8[a]	5.7[a]
Sodium Vapor.	7.1[a]	7.6[a]	7.0[a]	5.6[a]
Light Intensity				
10.8 lux	7.0[a]	7.6[a]	7.2[a]	5.7[a]
86.1 lux	6.9[a]	7.7[a]	7.0[a]	5.7[a]
Experimental mean	7.0	7.7	7.1	5.7

[1] Means within a light treatment and week with different superscripts are significantly different from each other($p \leq 0.05$).

Table 6. Feed efficiencies from 8 to 24 weeks of age by light sources and light intensities (Experiment II)

	Feed efficiencies[1],[2]			
Treatment	8-12 wks	12-16 wks	16-20 wks	20-24 wks
Light Source				
Incandescent	.339[a]	.341[a]	.267[a]	.196[a]
Daylight Flour.	.423[a]	.315[b]	.275[a]	.217[a]
Warm Flour.	.431[a]	.311[b]	.268[a]	.207[a]
Sodium Vapor.	.412[a]	.317[b]	.244[a]	.224[a]
Light Intensity				
10.8 lux	.411[a]	.317[a]	.269[a]	.217[a]
86.1 lux	.421[a]	.324[a]	.258[a]	.204[a]
Experimental mean	.416	.321	.264	.211

[1] Means within a light treatment and week with different superscripts are significantly different from each other($p \leq 0.05$).

[2] Feed efficiency = pounds of bird produced per pound of feed consumed

Turkey Enteric Viruses

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Salmonella - Effect, Control and Prevention

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Salmonellosis is of economic importance to the turkey producing industry for two reasons: 1) Production performance losses and 2) Public health concerns. It is estimated that production losses and control programs cost the United States turkey industy approximately 10 million dollars annually. Salmonellosis by non-host adapted serotypes is a major public health problem in the U.S. According to one estimate, approximately 2,500,000 persons in the U.S. are affected each year by salmonella at a cost of up to $1.2 billion a year in medical expenses. About 30% of the outbreaks reported during the past seven years were poultry related.

The Minnesota turkey growers have a long history of organized progress toward the goal of eliminating salmonella from their production system. In 1986 sixty-four percent of the flocks were negative at the time of official test. Control programs over the past fourteen years have significantly reduced some of the salmonella serotypes that have been recycling in the flocks. Two examples of this are S. heidleberg and S. st. paul. Table 1 shows the number of salmonella isolations from Minnesota candidate flocks at the time of official test (16-20 weeks).

Table 1. Salmonella isolations from Minnesota candidate flocks at the time of official test (16 - 20 weeks).

SEROTYPES	FY 1972	1980	1981	1982	1983	1984	1985	1986
S. Pull/Gall	0	0	0	0	0	0	0	0
S. Typhimurium	9	3	1	2	0	1	0	0
S. heidelberg	8	33	36	17	9	2	2	4
S. st. paul	24	19	31	17	17	3	2	2
S. san diego	3	16	12	10	7	0	0	0
S. agona	0	9	9	5	6	3	3	3
S. reading	9	3	2	3	9	8	0	1
S. hadar	0	0	1	6	3	0	0	0
S. livingstone	0	0	3	17	16	15	6	1
S. indiana	0	0	0	0	0	4	15	15
S. enteritidis	0	1	0	1	1	0	0	6
other serotypes	10	17	14	15	9	6	12	6
% Candidate Flocks Positive	26	51	65	57	45	28	28	36

After several meetings between industry representatives of the California Poultry Health Board and Minnesota Turkey Growers Association, a Minnesota-California Cooperative Salmonella Agreement was established in 1980 to share information on salmonella serotypes encountered in turkey breeder flocks primarily concerned with interstate movement of hatching eggs and poults. In 1984, 100% of the eggs for Minnesota breeder replacements came from out-of-state sources. This exchange of information has helped both states in their attempts to control this bacterial infection. This cooperative program has helped to emphasize the importance of cleaning, disinfecting and management programs of breeder flock facilities and hatcheries to keep from recycling salmonella serotypes. It also pinpoints the importance of minimizing the introduction of salmonella into breeding flocks through contaminated feed, feed ingredients and other external sources. These control programs have contributed to the total reduction of salmonella isolations at the time of the official test.

Poultry feed has been well documented as a source of salmonella contamination for poultry flocks and subsequently processed carcasses. Meat and bone meal samples taken from turkey feed mills in Minnesota have been constantly monitored for salmonella contamination.

Table 2 shows salmonella isolations from feed and feed ingredients for the last seven years.

Table 2. Summary of Salmonella Isolations from feed and feed ingredients

	PRODUCT		
YEAR	FINISHED FEED	FISH SOLUBLES	MEAT & BONE MEAL
1978 - 79	0/104[a]	0/4	--
1979 - 80	3/673 (0.44%)	3/18 (16.6%)	39/62 (62.9%)
1980 - 81	0/24	4/35 (11.2%)	52/354 (11.7%)
1981 - 82	--	--	245/1163 (21.1%)
1982 - 83	--	--	116/712 (16.3%)
1983 - 84	--	--	75/442 (17.0%)
1985			187/844 (22.8%)
1986 (THROUGH MARCH)		--	7/150 (4.6%)

[a]Number positive/number tested

The isolation rate from animal by-products varied from supplier to supplier. A study was conducted in 1985 to compare the contamination rate in samples from different suppliers.

Table 3 shows percent salmonella isolations from eight different suppliers of animal by-products. Isolation rate varied from 0 to 55.5%. The elimination of salmonella from feed would likely contribute to a reduction of carcass contamination.

Table 3. Percent Salmonella isolations from eight different suppliers of animal by-products.

Source Code	# Samples Tested	# of Isolations	% Isolation Rate
1	174	29	16.7
2	18	0	0
3	234	130	55.5
4	346	22	6.3
5	8	0	0
6	16	2	12.5
7	8	0	0
8	20	3	15

Salmonella isolations made from whole feed and meat meal samples in the year 1985 are shown in Table 4.

Table 4. Salmonella isolations from whole feed and meat meal in 1985 (several sources)

	Serotypes	Whole Feed	Meat Meal
1	S. senftenberg	5	32
2	S. cerro	5	25
3	S. montevideo	7	10
4	S. infantis	2	4
5	S. agona	1	9
6	S. johannesburg	1	8
7	S. ohio	1	7
8	S. indiana	1	1
9	S. st.paul	1	0
10	S. oranienburg	0	19
11	S. thomasville	0	18
12	S. newington	0	13
13	S. anatum	0	8
14	S. bareilly	0	6
15	S. bredeney	0	4
16	S. adelaide	0	4
17	S. brandenburg	0	3
18	S. derby	0	3
19	S. livingstone	0	4
20	S. binza	0	8
21	S. mbandaka	0	4

	Serotypes	Whole Feed	Meat Meal
22	S. manila	0	4
23	S. rosenthal	0	3
24	S. tennessee	0	1
25	S. illinois	0	1
26	S. litchfield	0	1
27	S. havana	0	1
28	S. worthington	0	1
29	S. arizonae	0	1
30	S. newhaw	0	1
31	S. minneapolis	0	1
32	S. kentucky	0	0
		24	206

Surveys were conducted from time to time on the use of animal by-products in rations fed to breeding flocks. Table 5 shows the results of this survey from 1981 to 1986.

Table 5. Rations fed to Minnesota breeding flock candidates

	1[a]	2[b]	3[c]	4[d]
	1981 - 82			
Starting Ration	4[e]	52	36	8
Growing Ration	2	56	34	8
Breeding Ration	7	58	35	0
	1983 - 84			
Starting Ration	30	30	24	16
Growing Ration	15	35	31	19
Breeding Ration	25	38	37	0
	1985 - 86			
Starting Ration	29	59	12	0
Growing Ration	25	62	12	1
Breeding Ration	27	62	11	0

[a]No animal by-products and pelletized feed.
[b]No animal by-products in mash feed.
[c]Animal by-products and pellitized feed.

[d]Animal by-products in mash feed.
[e]Percentage

Minnesota Turkey Growers Association made specific suggestions to Minnesota hatcheries and breeder flock owners for breeder candidates. The four suggestions made were:

a) Breeder rations contain no animal by-products and be pelletized.
b) Breeder rations contain animal by-products be pelletized
c) Breeder rations fed as mash contain no animal by-products
d) Breeder rations fed as mash contain salmonella-free animal by-products.

At the present time, there appears to be a shift to the use of mash feed without animal by-products and pelletized feed in breeder flocks.

Monitoring the environment, hatchery debri and 10 day mortality for salmonella provides a considerable stimulus for breeder flock owners to continue to control this infection. Intensive moritoring of 89 barns on 27 breeder flock facilities was done in 1985. Salmonella isolations from different sources in the order of frequency are listed in Table 6

Table 6. Salmonella isolations from different sources in the order of frequency

	Serotypes	Environ mment	Hatchery debris	10 Day	Whole feed	Meat meal	Birds	Total #
1	S. indiana	68	14	36	1	1	105	225
2	S. arizonae	4	103	11	0	1	37	156
3	S. senftenberg	4	20	10	5	32	76	147
4	S. heidelberg	0	0	0	0	0	105	105
5	S. montevideo	0	4	4	7	10	21	46
6	S.enteritidis	0	40	0	0	0	19	59
7	S. cerro	2	0	1	5	25	8	41
8	S. worthington	0	0	0	0	1	37	38
9	S. agona	15	0	0	1	9	10	35
10	S. brandenburg	1	17	0	0	3	12	33
11	S. hadar	25	0	0	0	0	0	25
12	S. st.paul	11	0	0	1	0	17	29
13	S. anatum	4	0	0	0	8	15	27
14	S. derby	1	0	0	0	3	23	27
15	S. ohio	4	0	0	1	7	10	22
16	S. oranienburg	0	0	0	0	19	0	19
17	S. thomasville	0	0	0	0	18	0	18
18	S. livingstone	0	0	0	0	4	12	16
19	S. bredeney	7	1	0	0	4	2	14
20	S. johannesburg	2	0	0	1	8	2	13
21	S. newington	0	0	0	0	13	0	13
22	S. manhattan	0	1	10	0	0	0	11
23	S. binza	1	0	0	0	8	0	9

Serotypes		Environment	Hatchery debris	10 Day	Whole feed	Meat meal	Birds	Total #
24	S. mbandaka	3	0	0	0	4	0	7
25	S. infantis	0	0	0	2	4	4	6
26	S. schwarzengrund	6	0	0	0	0	0	6
27	S. bareilly	0	0	0	0	6	0	6
28	S. manila	0	0	1	0	4	0	5
29	S. adelaide	0	0	0	0	4	0	4
30	S. rosenthal	0	0	0	0	3	0	3
31	S. kentucky	2	0	0	0	0	0	2
32	S. tennessee	0	0	0	0	1	1	2
33	S. sandiego	0	2	0	0	0	0	2
34	S. illinois	0	0	0	0	1	0	1
35	S. newhaw	0	0	0	0	1	0	1
36	S. litchfield	0	0	0	0	1	0	1
37	S. minneapolis	0	0	0	0	1	0	1
38	S. london	0	0	0	0	0	1	1
39	S. alachua	0	0	0	0	0	1	1
40	S. havana	0	0	0	0	1	0	1

The highest number of isolations were of S indiana. S. indiana began its appearance in 1983-84 and was encountered first in animal by-products. The Minnesota Breeder Hen Committee of the Minnesota Turkey Growers Association has made specific recommendations to reduce and eliminate the incidence of this serotype which appears to be increasing year by year. One of the recommendations was to use an autogenous oil adjuvant bacterin.

During the past year interest was continued on the use of autogenous mineral oil adjuvant bacterins for the control of salmonella infections. Several breeder flocks found positive for S. arizonae infection were vaccinated. The environmental samples and hatchery debri from these vaccinated flocks were periodically monitored. Thirteen flocks were vaccinated during the past year. There were no isolations of S. arizonae made from these flocks subsequent to vaccination. The progeny from these flocks have remained negative for S. arizonae infection.

Research was also conducted on the use of outer membrane protein for use in a vaccine. Preliminary results are very encouraging. The results suggested that outer membrane proteins of the organism give better protection than formalin killed whole cell bacterin.

USE AND EFFECT OF HE VACCINE ON COMMERCIAL FLOCKS

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Hemmorhagic Enteritis (HE) is an acute viral infection of turkey caused by Type II Adenovirus. HE is seen both in confined and range grown turkeys. Antibiotic, electrolytes, depopulation with cleanup and disinfection and other approaches have been tried in the past to control the problem mostly without success.

Vaccination against HE has been practiced for over a decade. Vaccination is achieved by drinking water administration of a turkey spleen propagated virus of pheasant origin in four week-old birds. The virus contained in splenic homogenates from these turkeys is alive and when administered is capable of multiplying in the vaccinated birds. This virus multiplication is important to achieve a significant antibody response in the birds receiving the vaccine.

Vaccination with splenic tissue homogenates, although considered to be effective, has many potential problems. The turkeys in which the vaccine is propagated must be free of transmissible disease. If one fails to identify such diseases in the birds being used to prepare the vaccine, these diseases may be transmitted to the flocks(s) receiving the vaccine. This could result in a serious problem depending on the agent(s) being transmitted to the flock receiving the vaccine. In addition the vaccines are not often pretested and too little or too much virus may be given.

For the past two years a white blood cell line from turkeys has been used to propagate HE virus. This tissue culture propagated vaccine has proven to be safe and effective under laboratory evaluation. Poults receiving 100 tissue culture infective doses of vaccine are protected against clinical signs of disease following challange. Some field trials using the tissue culture vaccine have given promising results. Unfortunately, currently there is no federally licensed product in the market.

Factors Affecting Feed Conversion

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PHOSPHORUS IN TURKEY DIETS

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Phosphorus is the most expensive mineral in poultry diets and is the third (or fourth) most expensive nutrient in poultry diets following energy and protein (or lysine and methionine). The cost of phosphorus in poultry diets constitutes about 2 to 6% of the total cost depending upon the quantity required in the diet and the relative cost of phosphorus from the various available sources.

Requirements of Phosphorus in Turkey Diets

According to the NRC (1984), the available phosphorus requirements of turkeys range from a high of 0.60% in the starter diet for young turkeys to a low of 0.25% in the pre-breeder diet for maturing turkeys. The phosphorus in plants is primarily in the form of phytin phosphorus. In general, the phytin phosphorus is considered unavailable or only partially available for poultry. Frequently, the total phosphorus in plant materials is considered about 30% available. Interestingly, the NRC (1984) publication lists the requirement of phosphorus in terms of available phosphorus but its ingredient composition in terms of total phosphorus and non-phytate phosphorus. In addition, the committee cautioned that the biological availability of phosphorus from inorganic sources may vary, but they did not elaborate on this comment.

Source of Phosphorus

Ground yellow corn and other cereal grains are very deficient in phosphorus content. Dehulled soybean meal is also deficient in phosphorus content. These ingredients supply about 20 to 50% of the available phosphorus required for turkeys. Therefore, the major part of the phosphorus in turkey diets must be supplied by animal products or by inorganic supplements.

The phosphorus in animal products is directly related to the amount of bone present in the concerned animal product. Thus, the phosphorus content of the animal products is inversely related to the quantity of protein in these feed ingredients. In general, the phosphorus in the animal products is believed to be highly available. However, the relative bioavailability of phosphorus from the animal products have not been determined in a recent well designed study.

Usually 30 to 60% of the available phosphorus in turkey diets is supplied by the inorganic phosphorus supplements. These supplements are usually supplied at the 1 to 3% level to turkey diets by defluorinated phosphate containing 18% phosphorus, dicalcium phosphate containing 18.5% phosphorus, or monocalcium phosphate containing 21% phosphorus. The defluorinated phosphates are produced by heating a mixture of phosphate rock, soda ash and phosphoric acid to temperatures in excess of 1400°C

to reduce the fluorine concentration to below 1 part in 100 parts of phosphorus. The mono- and dicalcium phosphates are produced by reacting phosphoric acid with limestone, and the phosphoric acid is made from sulfuric acid and phosphate rocks. The final two products vary in quantity of mono- and dicalcium phosphate and are labelled according to the predominating phosphate.

Statistical Treatment of Data in Phosphorus Bioassays

Two general statistical procedures have been used to determine the relative biological value or potency of a test to a standard material in eliciting a response in living matter. These two procedures, the slope ratio assay and the parallel line assay, are described in detail in a book by Finney (1978). As applied to the evaluation of inorganic phosphorus supplements for poultry, diets with graded levels of test and standard phosphates are fed to groups of young chickens or turkeys and measurements of their body weight gain, bone ash, or toe ash compared. The ratio of the slope or response from the test phosphate to that from the standard phosphate provides a relative potency of the test to the standard phosphate.

In the slope ratio assay, a linear response of body weight gain, bone ash, or toe ash to the dietary addition of graded levels of the test or standard phosphate must be obtained for the bioassay to be valid. Within a narrow range of additions of phosphates to a phosphorus deficient diet, no curvature in the response may be detected and the slope ratio assay may be applicable. However, over a wide range of phosphorus additions to the deficient diet a curvilinear response will be obtained. Thus, the application of the slope ratio assay to phosphorus bioassays is limited to a narrow range of phosphorus additions.

Because curvature in the plot of body weight gain, bone ash, or toe ash measurements on levels of added phosphorus exist, the log transformation of the level of added phosphorus provides a linear relationship in some phosphorus bioassays. The parallel line assay may become applicable in such experiments if the lines are parallel and do not deviate from linearity. In such experiments, data from the negative control diet without phosphorus addition and from diets containing high levels of phosphorus must be omitted from the statistical analysis because curvature occurs invalidating the parallel line assay if these data are retained in the analysis. Again, the application of the parallel line assay may be acceptable in some experiments but only where data do not violate the requirements of the parallel line assay.

A third procedure explored in our laboratory during the past five years involves the use of the exponential equation. An example of this procedure is outlined in a paper by Noll *et al.* (1984) involving the bioavailability of methionine from various sources. An advantage of this procedure over that of the slope ratio or parallel line bioassay is that all data fit the model and none need to be discarded. With increasing increments of added phosphorus to a moderately phosphorus-deficient diet, body weight gain, toe ash, or bone ash increases in decreasing increments until the response reaches a plateau. When two phosphates of different bioavailability are compared, the body weight gain obtained from feeding

a diet containing a given level of the less potent phosphate will equal that obtained from feeding a diet containing only the biological potency percentage of the more potent phosphate. This relationship holds true at all levels of phosphorus additions.

Relative Bioavailability Values of Commercial Inorganic Phosphate Supplements

Results of experiments conducted during the past two or three decades indicate that the phosphorus from some defluorinated phosphates may not be as available as that from dicalcium or monocalcium phosphate (Nelson and Walker, 1964; Dilworth and Day, 1964; Sullivan 1966; Damron and Harms, 1970; Pensack, 1974; Waibel et al., 1984). However, precise measurements of relative bioavailability of these products have not been determined.

Sullivan (1966) used a triple response method involving body weight, bone ash, and feed efficiency measurements to calculate a scale of values representing the relative biological value of phosphorus from various sources. However, these values are greatly inflated and do not represent a proper relationship of bioavailability between 0 and 100% with respect to a standard. The relative biological values of the phosphorus in these phosphates have been calculated in our laboratory using a series of exponential analyses of the body weight data and bone ash data from his two experiments. When monocalcium phosphate was set as a standard, the phosphorus in dicalcium phosphate samples was 90, 101, and 92% available, and the phosphorus in defluorinated phosphates was 42, 84, and 76% available in the three samples evaluated from each phosphate (Table 1). A difference between two relative bioavailability values of about 15% was required for significance in this study. Therefore, the phosphorus in dicalcium phosphates was more available than the phosphorus in defluorinated phosphates and one defluorinated, as labelled, was much inferior to the others. Further, our exponential analysis of his data indicate that values from the triple response method of calculating relative values of phosphates are misleadingly high and unreliable.

The relative bioavailability values of phosphorus from samples of defluorinated phosphate compared to those from dicalcium phosphate or mono-/dicalcium phosphate as reported by Waibel et al. (1984) are presented graphically in Figure 1. These data also demonstrate the inferiority of phosphorus from defluorinated phosphate in contrast to that from dicalcium or monocalcium phosphate.

Confirmation and extension of the observations mentioned above were reported from experiments (Figure 2) conducted in our laboratory (Potchanakorn and Potter, 1986). Phosphorus in defluorinated phosphates was found to be about 10% less available than that in the dicalcium phosphates and the phosphorus in dicalcium phosphates was found to be about 10% less available than that in the monocalcium phosphate.

Summary

Experiments have been conducted to determine the bioavailability of phosphorus by using body weight gain, bone ash, and toe ash

measurements from chickens and turkeys fed diets containing graded levels of the inorganic phosphate supplements. The slope ratio or parallel line assay provides a satisfactory statistical procedure for treatment of data within a restricted range of phosphorus additions, but the exponential bioassay analysis is applicable to data from diets containing all levels of phosphorus supplementation. Application of statistical bioassay procedures to reported data from experiments involving phosphorus evaluations permit the calculation of more precise relative bioavailability values of phosphorus from various sources. Results from experiments conducted in our laboratory with young turkeys confirm the observation that phosphorus from monocalcium phosphate is about 10% more available than that from dicalcium phosphate, and phosphorus from dicalcium phosphate is about 10% more available than that from defluorinated phosphate.

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Table 1. Relative biological availability value of phosphorus from various sources as calculated by exponential analysis of data reported by Sullivan (1966)[1]

Source	Experiment 1		Experiment 2		
	Body weight	Bone ash	Body weight	Bone ash	Weighted average
Dicalcium phosphate (1)	98±20	105±10	64±20	72±13	90±7
Dicalcium phosphate (2)	139±41	110±10	84±29	80±15	101±8
Dicalcium phosphate (3)	88±17	102± 9	67±21	81±15	92±7
Defluorinated phosphate (5)	55±11	44± 4	28±10	27±16	42±3
Defluorinated phosphate (6)	96±19	89± 7	86±29	65±12	84±6
Defluorinated phosphate (9)	113±26	79± 6	70±23	62±11	76±5
Raw rock phosphate (10)	66±12	59± 5	51±16	52± 9	58±4
Monocalcium phosphate (15)	100	100	100	100	100

[1]From the triple response method, Sullivan reported relative biological values of 100.5, 104.2, 99.7, 82.4, 99.1, 99.6, and 90.3% in Experiment 1 and 96.2, 97.9, 96.3, 82.8, 97.2, 95.5, and 91.2% in Experiment 2 for phosphorus from Sources 1, 2, 3, 5, 6, 9, and 10, respectively. When the relative biological availability values are low by our exponential analysis, the values by the triple response method are greatly inflated.

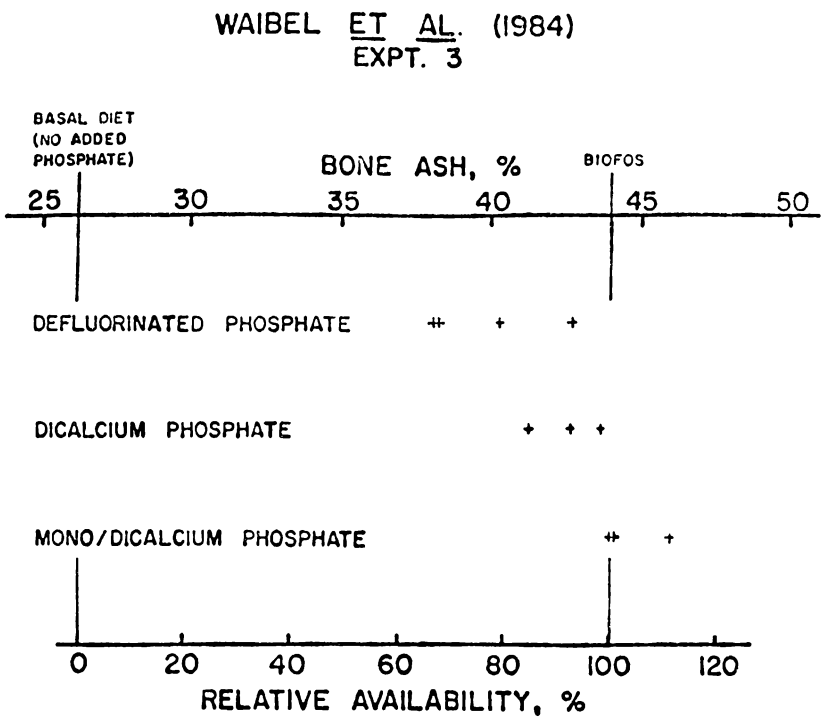

Fig. 1. Relative biological availability values of phosphorus from phosphates as reported in Experiment 3 by Waibel et al. (1984)

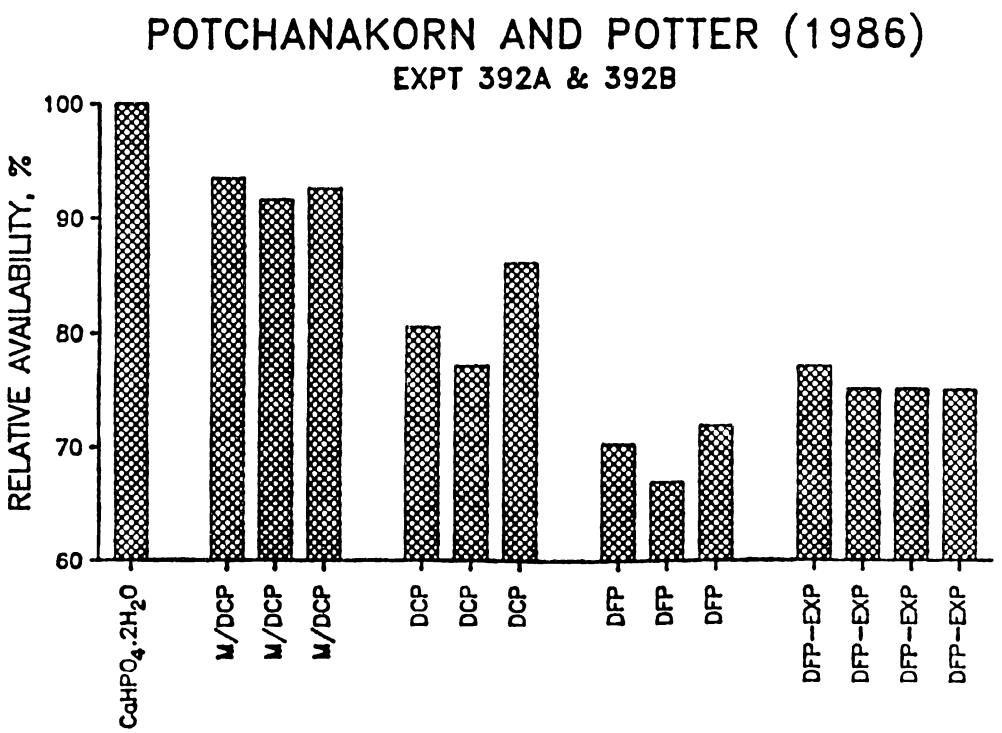

Fig. 2. Relative biological availability values of phosphorus from phosphates as obtained in our laboratory (Potchanakorn and Potter, 1986)

HOW TO MOST EFFECTIVELY USE FLOCK PROFILING

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Flock profiling is currently defined as a sequential antibody testing (e.g. monthly) for specific disease agents such as Avian influenza, Bordetella Rhinotracheitis and Mycoplasma.

The primary purposes of flock profiling are:

1. Establish a history of exposure to various disease agents.
2. Evaluate the efficacy of current vaccination programs.
3. Evaluate the effect of disease on production efficiency.
4. Evaluate the efficacy of management programs in preventing exposure to specific pathogenic microorganisms.
5. Determine the interaction of environment on the severity of specific diseases and associated loss of production.

Knowing the history of disease exposure on a farm makes it possible to develop vaccination programs to prevent disease. By serologically monitoring a flock one can determine the efficacy of current vaccination programs (seroconversion) and determine if the flock is being exposed (challenged) to field strains of the disease agent after vaccination. Determining correlations between production parameters (e.g. feed efficiency, weight gains, mortality) and disease experience makes it possible for the grower to "fine tune" his management for maximum efficiency. Similar correlations are being made with environmental parameters (e.g. temperature, humidity, ammonia).

Current agents for which flocks are being screened include:

Newcastle (NDV)
Avian Influenza (AIV)
Paramyxovirus 3 (PMV_3)
Bordetella Avium Rhinotracheitis (BART)
Chlamydia (ornithosis, psittacosis)
Avian Encephalomyelitis (AE)
Mycoplasma gallisepticum (MG)
Mycoplasma synoviae (MS)
Mycoplasma meleagridis (MM)
Pasteurella multocida (Cholera)
Hemorrhagic enteritis (HE)

Serological test procedures currently used for flock profiling include:

Serum plate agglutination (SPA) (MG, MS, MM, BART)
Hemagglutination inhibition (HI)(NDV, PMV_3)

Agar gel precipitation (AGP)(AIV, HE, AE)
Virus neutralization (VN)(AE)
Enzyme-linked immunosorbent assay (ELISA)(NDV, AE, AIV, MM, MG, MS, Cholera)
Latex bead agglutination (Chlamydia)
Compliment Fixation (CF) (Chlamydia)

There is a trend in diagnostic laboratories to use the ELISA test for flock profiling. The advantages of this test are:

-- Very small sample size (1 to 5 ul = .001 - .005 ml).
-- Sensitivity (10 to 100 times more sensitive).
-- Automated test procedures (spectrophotometer with automatic reader).
-- Linkage to a microcomputer (electronic data manipulation).
-- Easy handling of large amounts of data.
-- Determination of endpoint titer from single dilution.
-- Electronically transmit test results to the producers microcomputer via modem using a bulletin board program.
-- Print data in a easily interpreted format (bar graph).

The small sample size means that 5 or 6 tests can be conducted with 0.5 ml of serum (1.5 ml blood). The automated test procedure greatly reduces the labor involved in conducting the test and significantly reduces the time required to obtain the results. Linking the test equipment to a microcomputer allows one to use a software program that does several mathamatical calculations including antibody titer from a single dilution, average titers, and antibody variability in the flock. This information can then be printed out in a bar graph or other easy to visualize format. It may also be electronically transmitted directly to the producers microcomputer via a telephone modem.

The current disadvantages of the ELISA test system include:

1. Cost of individual tests ($.50 - $1.00).
2. Initial investment of equipment ($ 4,000 - $ 10,000).
3. Test kits not available for some agents.

Expanding the use of this system will greatly reduce the costs of the test kits (volume discounts) and distribute the equipment costs over a greater number of samples. There is considerable research and development being conducted to increase the number of agents for which test kits are available.

FLOCK PROFILING PROGRAMS

The profile one is interested in will depend on the age and use of the flock. A possible list of diseases for breeder and market turkeys might be profiled include the following agents:

BREEDER	GROWER	SPECIAL
AE, NDV, AIV, MG, MS, MM, ERYSIPELAS, SALMONELLA, ARIZONA, & CHOLERA	BART, MG, MS, MM, CHOLERA NDV, AIV, HE, ROTA	PMV-3, CHLAMYDIA, M. IOWAE

The following is an example of a current laboratory report using electronic data collection and reporting.

UNIVERSITY OF MINNESOTA
Avian Serology Laboratory
St. Paul, MN 55108

Serology Report for Flock Number -

OPERATION:
FARM
ADDRESS

TELEPHONE
HISTORY OF FLOCK

VACCINATION PROGRAM

AGE	VACCINE	MANUFACTURER	ROUTE
25 days	Newcastle	Sterwin	Spray

x
x
x
x
x
X
X x
X_____x_____
0 1 2 3 4 5 6 7 8 9
PROFILE RANK

BART ELISA PROFILE

* TOTAL SAMPLES TESTED - 10
* MEAN PROFILE RANK - 0.6
* COPUTER DATA EVALUATION
Insignificant antibody level

PERCENTILE DISTRIBUTION

NEGATIVE	LOW	MODERATE	HIGH
18	0	2	0

UNIVERSITY OF MINNESOTA
Avian Serology Laboratory
St. Paul, MN 55108

Interim Report for Flock Number -

Comments and Interpretations:

There apparently has been minimal exposure to the bacterial organism.

Recommendations:

Since this organism is a environmental contaminant I would encourage you to continue your current isolation and sanitation practices.

Reviewed by:
Dr. Newman DVM
Director Avian Health Programs
86-01-26

Drawbacks of flock profiling are the costs of testing, lack of available tests for some agents and some increase in disease risk by those collecting the blood samples. Extreme caution must be taken if one is going to take samples from more than one farm a day. On breeder flocks, the yolk from cull eggs can be used for quantitation of antibodies.

FLOCK MANAGER:

Specific computer software programs are currently being developed to assist the producer in "fine tuning" his management. The future of flock profiling will include the interactions between disease and environmental parameters. Computer coupled sensors are the "eyes" to record key environmental factors in the turkey house. The sensors record feed and water consumption, temperature, air quality, lights, fans, water pressure and feed bin level. Sensors have their "fingers" in the electrical panels to verify operation or observe the status in the house. Information from several houses can be returned to the central monitor and displayed continuously 24 hours/day. Alert signals informs one when conditions stray from preset limits.

These observations may be correlated with exposure experience to specific disease producing agents. Many parameters currently being determined on each flock includes:

HISTORICAL DATA:

Flock ID_____Farm ID_____Breed_____NO. Housed_____

Date Hatched_____Source_____Feeder Type_____Water Type_____

FLOCK AND ENVIRONMENTAL PARAMETERS

Age_____ Number Died_____ Number Left_____ % Mortality_____

Bird Density_____ Litter Type_____ Litter Condition _____

Ammonia (PPM)_____ House Temperature_____ Light Intensity_____

Bird Weight_____ Uniformity_____ Age to market_____

Time of Feed Withdrawl_____Live-haul Truck_____ Live-haul Crew Leader____

Number/Coop_____ Type of Coop_____ Time of Feed Withdrawl_____

PROCESSING PLANT PARAMETERS

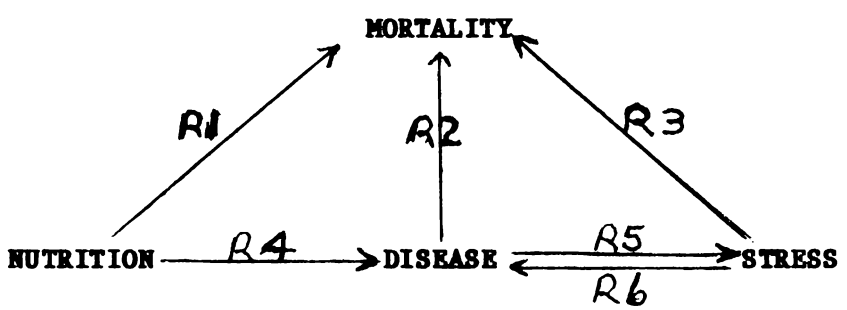
Condemnations - DOA, contamination, airsacculitis, septicemia-toxemia, synovitis, tumors

Grade and yield - scabby hips (cuts & tears), bruising, missing parts, %grade A

Determining correlations between these parameters allows the producer to develop a more realistic cost of specific diseases and to fine tune his management for more economical production and increased profits.

An example of a program used to determine data correlations is Path Analysis.

PATH ANALYSIS.



R = CORRELATION

Future parameters to consider in a flock manager program might include:

1. House Conditions such as humidity,and respirable dust particles.
2. Physiological parameters such as hormones (gonadotrophins, thyroxin, steroids) and tissue enzymes (SGPT,lipase, amylase).
3. Vitamin levels (Vitamin D and it's analogs).

Comparative View of Tibial Dyschondroplasia

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TURKEY BREEDER HEN INFERTILITY AND PLASMA CELLS IN THE UTEROVAGINAL SPERM STORAGE GLANDS

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INTRODUCTION

So-called seasonal declines in fertility are a persistent and prominent fertility problem observed in essentially all commercial turkey breeder flocks. Seasonal declines in fertility are characterized by a gradual drop in fertility over the course of an egg-laying period or season, ultimately declining 20-25% after approximately 20 weeks of egg production. The decline in fertility occurs despite an increased frequency of insemination (1-4) or an increased number of spermatozoa inseminated (2,5,6). The fact that fertility remains poor in spite of repeated inseminations with semen of proven quality indicates that the problem is female-related.

Immunological effects have been investigated as a cause of seasonal declines in fertility. Turkey hens isoimmunized with semen had lower fertility than nonimmunized hens (7), and when spermatozoa were incubated in blood serum from fertile and infertile hens prior to being inseminated, significantly lower levels of fertility were obtained when spermatozoa were exposed to serum from infertile hens (8). However, antisperm antibodies were not detected utilizing standard immunological tests. More recently, McCorkle *et al.* (9) adapted the Friberg (10) microagglutination test to demonstrate the presence of antisperm antibodies in the blood serum of artificially inseminated turkey breeder hens.

Ball *et al.* (11) were not able to associate any of the more common pathogens with turkey infertility. They did, however, note increased numbers of lymphoid foci in the lamina propria of the infundibular and isthmal regions of the oviduct. They also noted an infiltration of plasma cells in association with the lymphoid foci.

Recently, Schuppin *et al.* (12) reported finding plasma cells within the primary oviductal sperm storage site, the uterovaginal sperm storage glands, of infertile turkey breeder hens experiencing a seasonal decline in fertility. They theorized the presence of antisperm antibody-producing plasma cells within an oviductal sperm storage gland could explain the empty glands normally associated with a seasonal decline in fertility.

MATERIALS AND METHODS

Birds utilized in this study were relatively fertile and infertile Large White turkey breeder hens selected from flocks experiencing seasonal declines in fertility. Hens from both commercial flocks and from university flocks were used in the study. The hens were inseminated weekly (.025 ml), trapnested, and individual hen fertility was determined based on a macroscopic examination of blastodiscs after 24 hours of incubation.

For ultrastructural studies, tissues were processed, embedded, sectioned, stained and examined with a transmission electron microscope according to the procedures described by Schuppin et al. (13) for uterovaginal sperm storage glands.

RESULTS AND DISCUSSION

Except for the fact that uterovaginal sperm storage glands taken from fertile hens contained numerous spermatozoa, and glands from infertile hens were devoid of spermatozoa, sperm glands from the two classes of hens were morphologically indistinguishable. This agrees with the earlier observation of Schuppin et al. (13).

Previous histological studies of sperm glands from infertile turkey breeder hens generally focused on sections taken from the more distal, closed end of a sperm gland (13-15). This is because the number of resident spermatozoa is usually greatest at that point, and cellular organelles and inclusions show maximum development.

Because, as stated, sections from the more distal aspects of sperm glands from fertile and infertile hens were morphologically indistinguishable, attention was focused on cells nearer to the orifice of a sperm gland. When this was done, numerous plasma cells were detected in sperm glands taken from infertile hens; no plasma cells were seen in glands from fertile hens. The plasma cells were located basally between contiguous sperm gland cells, much as the lymphocytes were in the distal regions of a gland. The incidence of plasma cells was, on occasion, quite high.

The presence of antibody-producing plasma cells within the sperm storage glands of infertile hens suggests that seasonal declines in fertility are the result of an immunological response, as had been suggested by the work of Burke et al. (7), Burke and Rieser (8), McCorkle et al. (9), and Yu and Burke (16). Furthermore, the localization of plasma cells in juxtaposition to the orifice of a sperm storage gland explains the empty sperm glands seen in hens experiencing seasonal declines in fertility. Presumably localized antisperm antibody production precludes spermatozoa from ever entering the oviductal storage sites. This is consistent with the observations of Van Krey et al. (14), Van Krey and Leighton (15), and Harper and Arscott (17), who

showed empty sperm glands were a common occurrence in turkey hens suffering from seasonal declines in fertility.

Schuppin et al. (13) noted a lymphocytic infiltration of sperm storage tubules of turkey breeder hens as early as the onset of egg production. While that observation was inexplicable at the time, it is now believed that such a lymphocytic infiltration is important to successful long-term oviductal sperm storage. Accordingly, if the lymphocytes are regulatory suppressor T-cells functioning to suppress antisperm antibody production, this could explain the hen's protracted immunological tolerance to antigenic spermatozoa despite essentially constant exposure during oviductal sperm storage. Nevertheless, with continued exposure to antigenic spermatozoa, diminished T-cell suppressor activity ultimately occurs, plasma cell infiltration of sperm storage glands results, and subsequent antisperm antibody production by the plasma cells reduces fecundity. Such a sequence of events is consistent with recorded observations regarding seasonal declines in fertility of turkey breeder hens, and is also consistent with the observation of McCorkle et al. (9) that superficial oviductal injury during artificial insemination induces antisperm antibody production.

Thus, the lymphocytes normally associated with the oviductal sperm storage glands are theorized to be regulatory suppressor T-cells which function to allow sperm storage within the structures for extended periods of time. Furthermore, the plasma cells are assumed to secrete antisperm antibodies which explains the absence of stored sperm in turkey hens experiencing seasonal declines in fertility.

SUMMARY

Uterovaginal sperm storage glands taken from fertile and infertile turkey breeder hens were analyzed morphologically utilizing transmission electron microscopy. Sperm storage glands from the infertile hens were generally empty, while glands from the fertile hens contained many spermatozoa. Lymphocytic infiltration into the baso-lateral clefts between contiguous cells of the sperm glands was found to occur in both fertile and infertile hens. Plasma cell infiltration into these intracellular clefts also occurred in infertile turkeys. Plasma cells were not found in the glandular clefts of fertile hens.

Lymphocytes present in the sperm storage glands of fertile hens are theorized to be regulatory suppressor T cells which could explain the hens immunological tolerance to continual exposure to antigenic spermatozoa. Conversely, the presence of antibody-producing plasma cells in the sperm storage glands of infertile hens could explain the absence of stored spermatozoa and the reduced fecundity of these hens.

ACKNOWLEDGEMENTS

This research was supported, in part, by the Virginia Agricultural Foundation and the Virginia Turkey Growers Association.

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FEED ADDITIVE EFFECT ON MYCOTOXICOSIS

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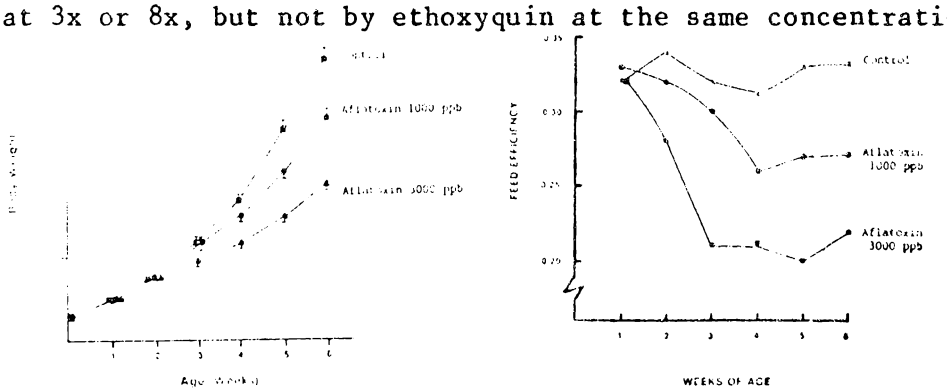
Although every attempt is made to provide the best quality feedstuffs for agricultural producers throughout Virginia and the nation, difficulties are presented by the ommipresent mycotoxins. Although only rarely present in amounts above FDA action levels, even low levels may reduce productivity and increase costs associated with food production. Our objective was to use antioxidants to decrease toxicities in poultry induced by mycotoxin-contaminated corn. Specifically, we added butylated hydroxytoluene (BHT) and ethoxyquin to the feed of chicks previously exposed to the mycotoxin aflatoxin and determined effects on indices of productivity (weight gain, feed efficiency), the target organ (liver metabolic capability), and the immune system (weight of spleen and bursa and the heterophil-to-lymphocyte ratio).

For these studies day-old White Leghorn chicks (11-14/group) were maintained for 6 weeks on diets containing enough aflatoxin to cause significant effects on weight gain within that time frame (1000 and 3000 ppb). BHT or ethoxyquin were was added to the diet in concentrations 3x and 8x above that usually found in feed, beginning when chicks were 15 days of age. Chicks were weighed, and weight gain and feed efficiencies determined weekly. At 6 weeks of age chicks were bled for heterophil-to-lymphocyte ratio determinations (an indication of susceptibility to infectious diseases), and then sacrificed so organs of the immune system (spleen, bursa) could be weighed and metabolic capability of the liver measured. Capability of the liver to metabolize foreign compounds was measured by determining activity of 3 enzymes, one for demethylation, one for hydroxylation, and one for conjugation (glutathione transferase).

In our studies we found that aflatoxin had a significant effect on body weights and on feed efficiencies. These effects were alleviated by BHT at 3x or 8x, but not by ethoxyquin at the same concentrations.



We also found that spleen weights were decreased by aflatoxin, an effect that could be overcome by use of BHT, but not by use of ethoxyquin in the diet. BHT also had capability to prevent the rise in heterophil-to-lymphocyte ratios associated with aflatoxin administration. Decreased size of organs of the immune system (i.e., spleen,

bursa) and increase in heterophil-to-lymphocyte ratios have been associated with increased susceptibility of chickens to infectious diseases. It, therefore, appears that BHT may be useful to at least partially alleviate the increased potential for secondary infections associated with aflatoxin exposure. As used in our studies, ethoxyquin did not have this beneficial effect. Neither antioxidant alone had any effect on organ sizes or heterophil-to-lymphocyte ratios.

Table 1: Effect of Aflatoxin and Antioxidants on Organs of the Immune System

FEED CONTENT[a]		ORGAN WEIGHTS[b]			H/L[b,c]
Aflatoxin	Antioxidant	Spleen	Bursa	Bursa/body weight	
None	None	0.54±0.4	1.3±0.1	0.42±0.03	.34±.04
1000 ppb	None	0.48±0.05	0.88±0.07[d]	0.35±0.02[d]	.53±.09[d]
3000 ppb	None	0.35±0.05[d]	0.52±0.06[d]	0.27±0.02[d]	.59±.06[d]
1000 ppb	BHT 3x	0.64±0.05	Not determined		.39±.04
1000 ppb	BHT 8x	0.67±0.06[d]	Not determined		.44±.06
3000 ppb	BHT 8x	0.74±0.12[d]	Not determined		.36±.04

[a]Aflatoxin was provided from day of hatch; antioxidants from 2 weeks of age until organ weight determinations were made at 6 weeks of age.

[b]Mean ± SE, N = 11-14.

[c]Heterophil-to-lymphocyte ratio at 6 weeks of age.

[d]Significantly different from values in chicks given neither aflatoxin or anti oxidants, $p<0.05$.

Athough BHT was found to improve action of enzymes that detoxify foreign compounds and partially alleviate aflatoxin's inhibitory effects on these enzymes, we found that ethoxyquin had no such capability. It, therefore, appears that these two antioxidants are different with regard to *in vivo* interactions with aflatoxin.

These results indicate that BHT can partially protect young chicks from the adverse effects of aflatoxin-contaminated feed, even when given up to two weeks after continuous exposure to relatively high concentrations of the mycotoxin.

This research sponsored by the Virginia Poultry Federation and the Virginia Corn Commission. The dedicated assistance of Cindy Driscoll, VMRCVM Class of 1987, was necessary for completion of these studies and her work is much appreciated by the authors.

2ME.6

CONTROL OF FOOD INTAKE IN TURKEYS

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While considerable research has been devoted to the study of food intake regulation in mammals, relatively little has been done using birds (Denbow, 1985). Most of the studies which used birds were done using chickens with very few studies utilizing turkeys. The purpose of this presentation is to discuss recent studies investigating the mechanisms of food intake control in turkeys.

Our studies to date have concentrated on the neurochemical control of feeding within the central nervous system (CNS). In order to determine the effects within the CNS, neurotransmitters were injected directly into the right lateral ventricle of the brain. If neurotransmitters were injected peripherally (i.e. intravenously or intraperitoneally), the blood-brain barrier would prevent their entry into the brain. Therefore, peripherally administered neurotransmitters would not elicit a CNS effect.

Catecholamines are neurotransmitters which are synthesized from the amino acid tyrosine as shown in Fig. 1. The catecholamines include dopamine, norepinephrine and epinephrine. Another class of neurotransmitters are the indoleamines which are synthesized from the amino acid tryptophan as shown in Fig. 2. The major indoleamine is 5-hydroxytryptamine (5-HT) which is also known as serotonin. It was of particular interest to study the role of these neurotransmitters in food intake regulation since work with mammals has shown that dietary manipulation of tyrosine, tryptophan and other large neutral amino acids (phenylalamine, leucine, isoleucine and valine) can alter brain levels of their respective neurotransmitters.

As shown in Fig. 3, in adult turkey hens exposed to 6 hr light/day, the intracerebroventricular (ICV) injection of epinephrine and norepinephrine caused a significant decrease in food intake whereas dopamine had no effect (Denbow, 1983). This was an unexpected result since in broilers the ICV injection of epinephrine increased food intake whereas norepinephrine had no effect (Denbow et al., 1981).

Research is necessary to determine at which class of receptors epinephrine and norepinephrine act to alter food intake in the turkey. In mammals, intrahypothalamic injections have shown that epinephrine and norepinephrine increased food intake when acting at α-adrenergic receptors and decreased food intake when acting at β-adrenergic receptors (Leibowitz, 1980). These effects were also site specific since stimulation of food intake occurred when epinephrine was injected into the medial hypothalamus while a decrease in food intake occurred when epinephrine was injected into the lateral hypothalamus.

The ICV injection of 5-HT also decreased food intake in the turkey (Fig. 4). This occurred in both fully-fed and fasted birds and the effect was dose-dependent and occurred almost immediately after injection

(Denbow, 1984). To verify that this effect was due to stimulation of indoleaminergic receptors, quipazine, a 5-HT agonist, was also injected. Quipazine (67 mg) decreased intake and the effect was blocked by methysergide, a 5-HT antagonist.

Broodiness is a serious problem for turkey producers since it substantially raises the cost of poult production. As reported by Wolford et al. (1963), food intake declines markedly at the onset of broodiness. It is not known whether this is a cause or an effect. Wolford et al. (1963) reported that food intake declined before other visible signs of broodiness. Prolactin, a pituitary hormone, has been implicated as a cause of broodiness. Injection of prolactin induced incubation behavior in the chicken (Riddle et al., 1935; Saeki and Tanabe, 1955) and plasma levels of prolactin have been reported to increase at the time of broodiness in the turkey. (Burke and Dennison, 1980; Proudman and Opel, 1981; Etches and Cheng, 1982; Len and Sharpe, 1982). Since prolactin appears to be involved in broodiness, we investigated its role in food intake regulation in turkeys.

Prolactin was injected ICV into adult turkey hens that were exposed to either a short photoperiod (6 hr light/day) or a long photoperiod (14 hr light/day). The former group was not laying eggs while the latter group was in egg production. The ICV injection of 800-3200 ng of prolactin had no significant effect on food intake in turkeys maintained under a short photoperiod (Denbow, 1986). However, in Large White turkeys exposed to 14 light/day and in production, the injection of 800, 1600 and 3200 ng of prolactin decreased food intake in a dose-dependent manner with 1600 ng being the most effective (Table 1). It appears that prolactin, acting synergistically with another hormone (s) whose levels increase during egg production, decreased food intake by acting within the CNS.

Finally, we have recently been investigating the effects of another peptide, cholecystokinin (CCK), on food intake. CCK is a peptide originally isolated from the small intestine and recently shown to also be located in the CNS. CCK is known to be involved in gastrointestinal function. In fed turkeys, intravenous injection of CCK decreased gizzard motility and caused duodenal refluxes (Savory et al., 1981).

The ICV injection of as little as 50 ng of CCK significantly decreased food intake in adult turkey hens (Fig. 5). This effect was dose-dependent and was seen independent of other behavioral changes. The decrease in food intake was not due to the leakage of CCK from the brain into the blood system since intravenous injections of similar doses of CCK had no effect.

It is clear that food intake regulation in the domestic turkey is a complex system involving the interaction of a multitude of neurotransmitters and hormones. Much remains unknown about this system. A clearer understanding of this complex regulatory system will be necessary before we can hope to practically control food intake.

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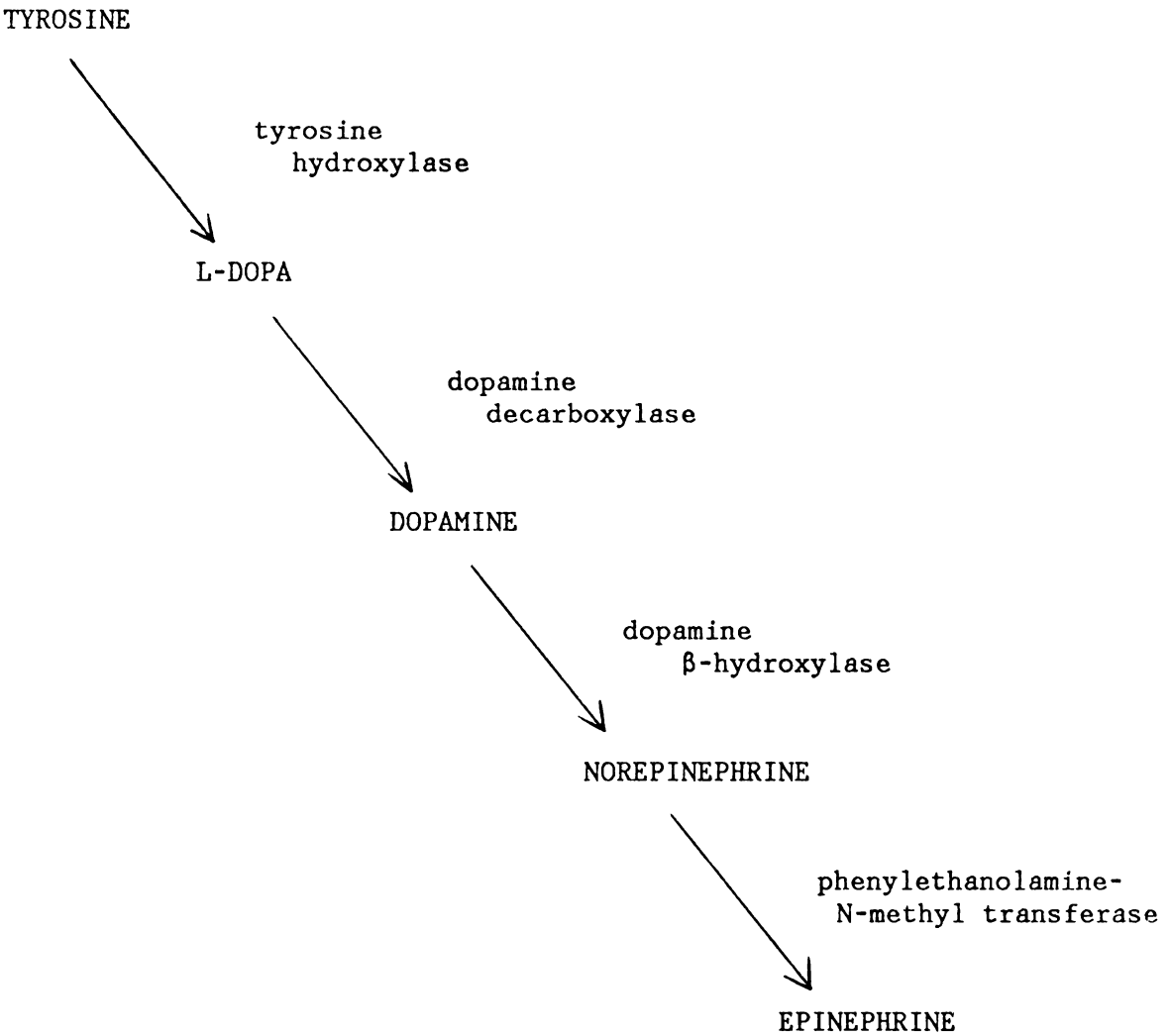

Fig. 1. Catecholamine Synthesis

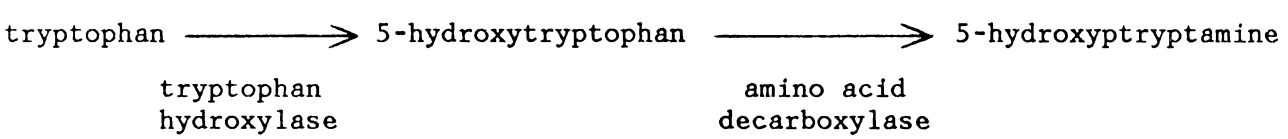

Fig. 2. Indoleamine Synthesis

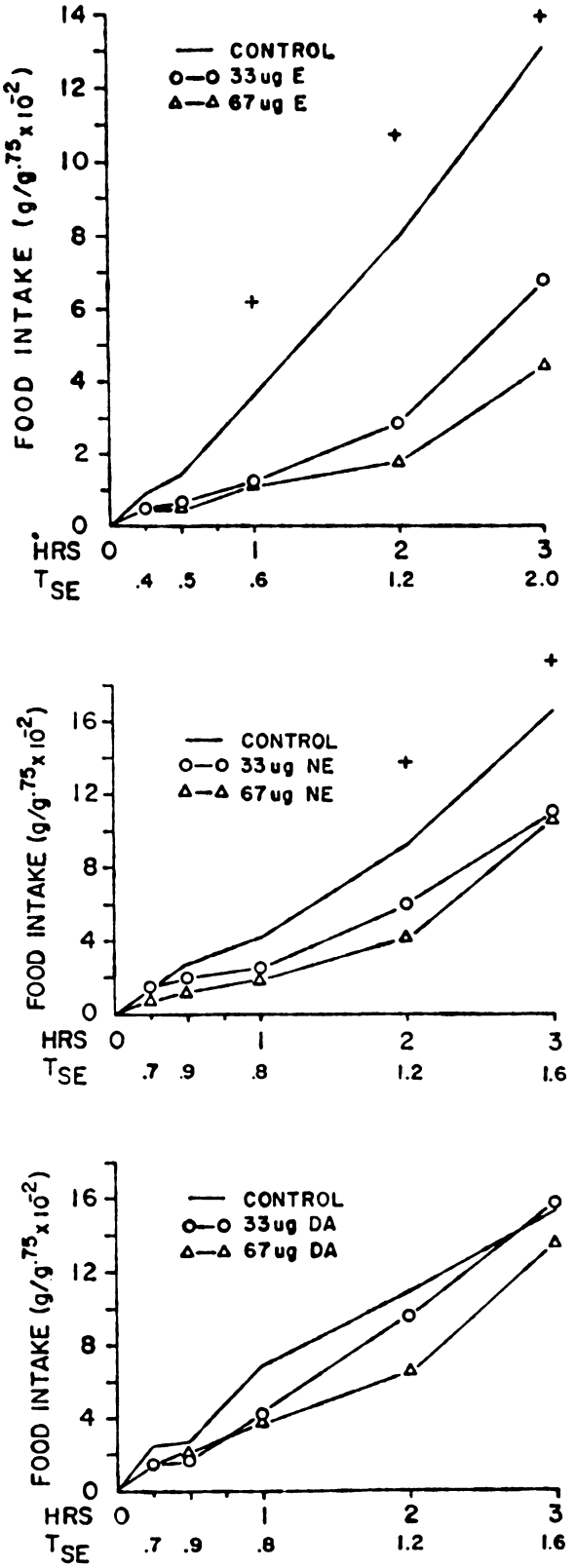

Fig. 3. The effect of intracerebroventricular injections of epinephrine (E), norepinephrine (NE), and dopamine (DA) on cumulative food intake of adult turkey hens. +, significant differences at these time time periods (P≤.05). HRS, hours; TSE, treatment standard error (Denbow, 1983).

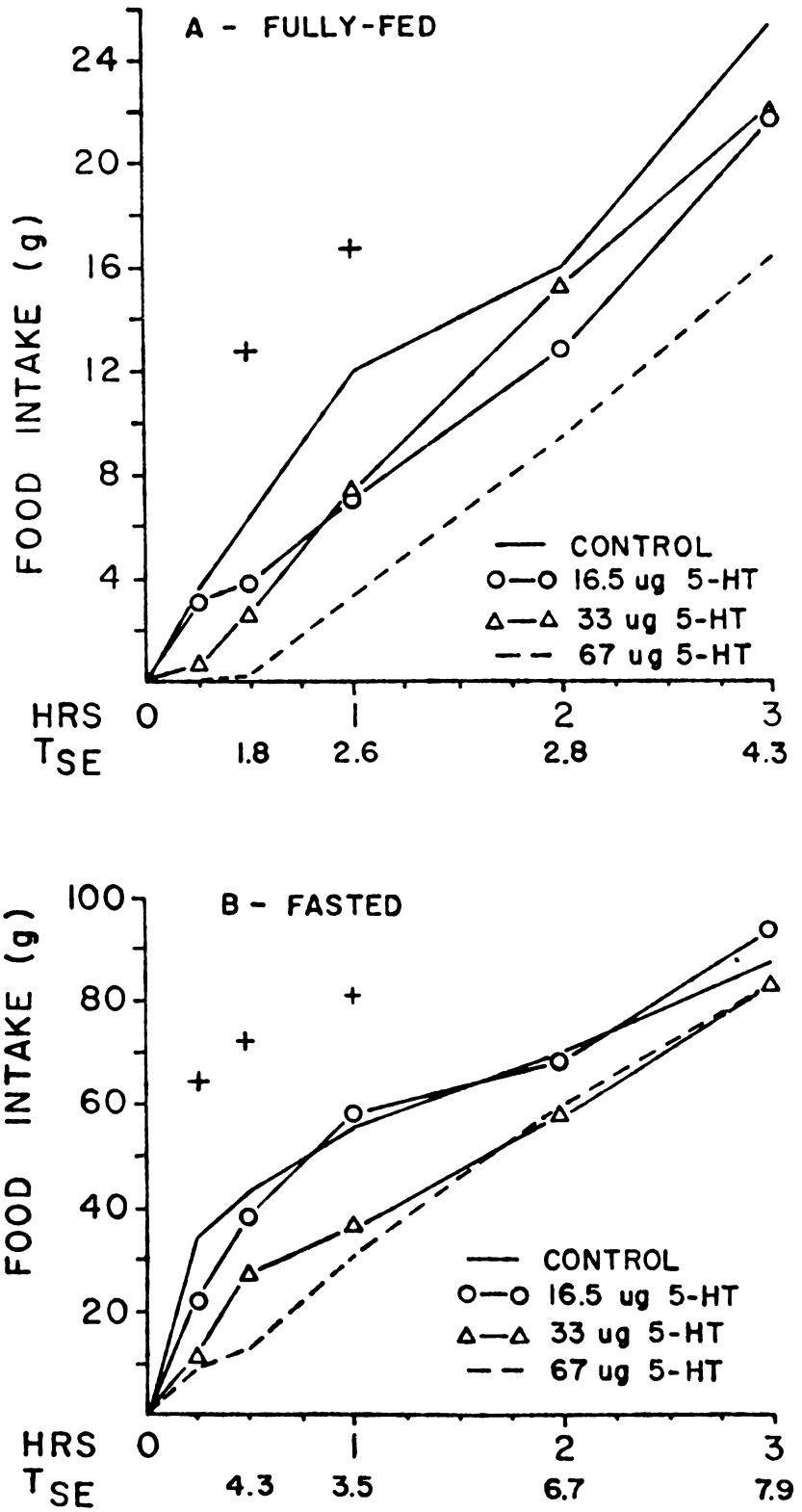

Fig. 4. The effect of intracerebroventricular injections of hydroxytryptamine (5-HT) on cumulative food intake of either fully-fed or 24-hr fasted adult turkey hens. +, significant differences at these time periods ($P \leq .05$). HRS, hours; TSE, treatment standard error (Denbow, 1984).

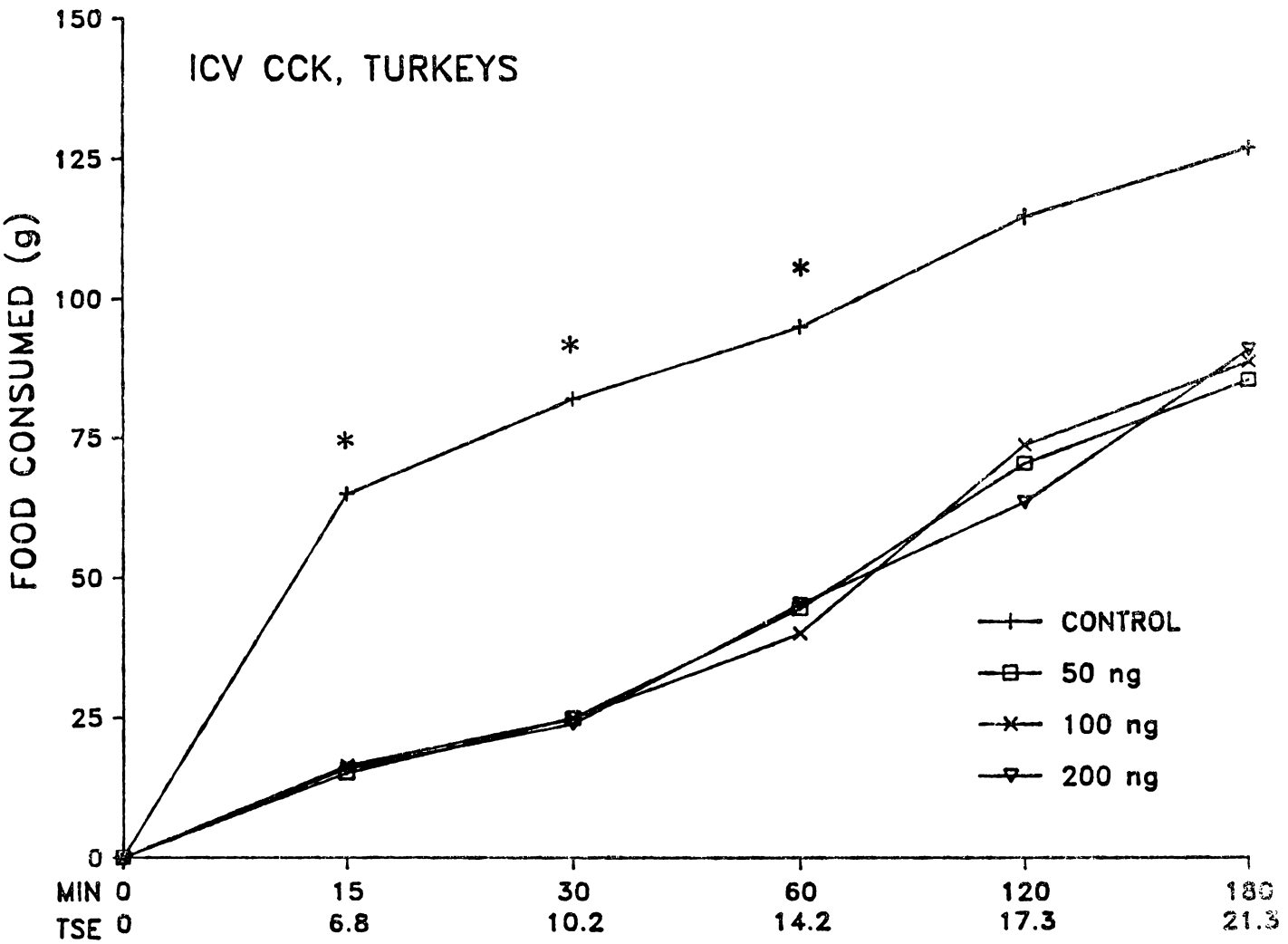

Fig. 5. The effect of intracerebroventricular injections of cholecystokinin (CCK) on cumulative food intake of 24-hr fasted adult turkey hens. +, significant differences at these time periods (P≤.05). HRS, hours; TSE, treatment standard error.

Table 1. The effect of intracerebroventricular injections of prolactin on cumulative food intake (g) of Large White turkey hens exposed to 14 hr light per day

Treatment	Time (min)				
	15	30	60	120	180
.05 N $NaHCO_3$	24.4	31.5	55.9	73.6	110.6
800 ng prolactin	13.7	14.3	43.7	48.0	62.7
1600 ng prolactin	11.7	12.2	32.5	47.1	59.2
3200 ng prolactin	18.8	32.5	46.0	51.9	57.3
TSE[1]	6.4	6.8	7.4	8.1	15.6
	---------- F (1,30) values ----------				
Linear contrast	0.17	0.26	0.76	2.31	4.40*
Quadratic contrast	2.13	7.20+	4.10*	4.23*	3.03

[1]TSE, standard error of the treatment mean (N=8).

*P≤.05.

+P≤.01.

(Denbow, 1986)

Hatchery Quality Control Program

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From the beginning of recorded history man has compiled information on the incubating and hatching of eggs. In ancient China and Egypt, 50,000 egg capacity incubators were used. Manure was used as a heat source and eggs were hand turned. In the Phillipines, they incubated eggs with palm and ash and a man laid on top to conserve heat. Using a still air incubator it was only practical to set eggs at one level. However, with the advent of fans, forced draft incubators allowed hatcheries to set eggs from the floor to the ceiling and mechanically turn all eggs at one time. Presently, sophistication in monitoring and changing air movement, temperature, humidity and CO_2 are such that they can be changed by few key strokes on a computer keyboard.

Despite all this sophistication and improvement over the years, the US still hatches turkey eggs on the average at about 77% of all eggs set (Eggs, Chickens, and Turkeys, 1986). A fertility problem can account for 8% of the problem, but still leaves 15% fertile eggs that do not hatch. In 1985, 255 million turkey eggs were set and only 197.5 million poults were placed (180.5 million processed = 91%), that meant a loss of 38 million poults during incubation.

To help prevent loss and continue to provide a quality product, a quality control program is a necessity. Quality control programs mean some expense, but the rewards in providing a quality and efficient product ensure long term profitability. The major components of a hatchery quality control program should include: breeder flock information, egg cleanliness and storage information, setter and hatcher information, and growout performance data.

Breeder Flock Information

Many breeder flock factors can influence final hatch and early mortality. Nest contamination, insemination crew, disease, and moldy feed are factors that should be identified and information recorded. The fact that these factors are checked will show their importance to the producer.

Egg Storage and Cleanliness

Contamination can just as easily occur in the egg storage room as in the nest. Care must be taken to prevent sweating of the egg while in storage, to clean the storage room regularly and maintain proper humidity and temperature which minimizes storage loss. Chart recorders can help tell the origin of temperature and humidity problems. Checking water temperature and disinfectant

concentration help to maintain consistency at the breeder farm. Recording the age of the eggs prior to setting and whether they were dipped or not could also help to explain or to prevent decreases in hatchability.

Setters and Hatchers

Individual hatchers and setters will perform differently. Identifying the units that are not performing is the first step in solving a problem. Many times where the controls are located, differences in air intake, or the setters position relative to the outside wall or wash room can affect hatchability. Macroscopic examination of early deads (at candling or transfer) to determine infertiles and early deads can help direct attention to either the breeder flock insemination process (fertility problem) or a handling and/or storage problem. Early deads are identified as positive development from 0-6 days of incubation. Early deads are distinguished from middle deads by the lack of development of the eye. Middle deads (a period of low embryonic death) usually indicate a major problem in normal temperature, ventilation, turning or more commonly a sign of contamination. Middle deads are identified as poults that died in the 7-16th day of incubation and are distinguished from early and late deads by the presence of a large black eye and no feathers. Late deads (17-25 days of incubation) are distinguished from middle deads and pipped by the presence of feathers and not having pipped through the air cell. Hatch residue should be collected on the same sample trays to determine percent pipped alive (presence of hole in shell) or pipped dead (pipped through membrane but not through shell). Identification of malformations can help to determine breeder flock nutritional deficiencies. A realizable goal for hatcheries to obtain would be to have 5-6% infertiles, 2-3% early deads, .5-1.0% middle deads, 2% late deads 3% pipped deads and 3.5-4.0% pipped alive. This would give a hatch of total eggs of 81-84% for turkeys. I can foresee even higher goals as improvements in fertility, handling and incubation are realized.

Tests for contamination of water sources, fluff, and incubators should be conducted routinely. This should be coordinated with the inspection of poults for disease lesions and bacterial contaminations.

Growout Performance

Performance of the poults during the first two weeks can well indicate factors relating to servicing of the poults, temperature or humidity during hatch, or delivery of the poults. Mortality during the first three days may indicate a contamination or humidity problem. Observation of beak trimming, detoeing, injection or other factors relating to the quality of the poult should be identified if possible.

Evaluation of Program

Now you have started collecting the mass of figures, what do you do with them? Collecting figures by grower or breeder flock sometimes seems too much to handle. A simple computer programs that can collate, organize and establish relationships between management factors, observations, flock data and fertility, hatch of fertiles and hatch of total eggs set has proven to be very good tool. Data is entered per flock by age of flock, length of storage, date set, setter, position of rack, humidity, temperature, hatchers, or any other factor that would be beneficial to study.

A multiple correlation computer program has been successfully used by researchers at Virginia Tech (Weaver, Wesley, and Hulet) to study relationships between management procedures and carcass quality. This same program is very applicable to quality control programs for hatcheries. This program can sort information to make comparisons between different flocks, companies, insemination crews, days of storage, weeks of lay, strains, etc. Relationship between management factors and egg production, fertility, and/or hatchability can be established and shown in Tables or by graphs. Problem areas can be identified for further examination. One factor we have investigated is lowering humidity of the incubator during incubation to try and control water loss. The ideal water loss has been established as between 11.5 and 12% loss at 25 days of incubation (Meir et al., 1984; Christensen and McCorkle, 1982). The results investigated hatch of fertile eggs over all eggs incubated for 9 months time (Table 1):

Table 1. Percent hatch of fertile eggs for eggs incubated at 86 or 84° WB.

	84[1]	86°WB[1]
Hatch of fertile eggs ($\bar{X}$%±SE)	86.77±.36[2]	85.68±.35
No. of observations	489	1806
No. of eggs per rack	3062.18	2980.21
Storage age of eggs (days)	12.53	9.25
Age of breeder flock (weeks)	11.31	12.99

[1]84°WB = 55% Relative Humidity; 86° WB = 60% Relative Humidity.
[2]Significantly different at P<.01 level.
[3]Setting rack.

Conclusions

Quality control programs can be beneficial in establishing a standard of operation for your hatchery. It can evaluate problems or opportunities to improve production performance, be used to research improved management practices and statistically analyze data, and be used to make management decisions on production factors based on solid information.

References

Christensen, V. L., and F. M. McCorkle, 1982. Turkey egg weight losses and embryonic mortality during incubation. Poultry Science 61:1209-1213.

Eggs, Chickens, and Turkeys, 1986. Agricultural Statistics Board, National Agricultural Statistics Service USDA.

Meir, M., A. Nir, and A. Ar, 1984. Increasing hatchability of turkey eggs of matching incubator humidity to shell conductance of individual eggs. Poultry Science 63:1489-1496.

POULTRY SCIENTIFIC LITERATURE COMPUTERIZED REVIEW PROGRAM

Virginia Tech
Poultry Science Department
Cooperative Extension Service
College of Life Sciences & Agriculture
Developed By: John H. Wolford, Head, Poultry Science Department
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703-961-5898

In order to provide the Virginia and Delmarva poultry industries with a more timely access to the implications of published poultry research data, a computerized scientific literature review program has been developed. Specifically, the objectives of this computerized information system are:

1. Provide the poultry industry timely access to research data which may have a bearing on the techniques, procedures, programs and management approaches implemented and/or contemplated to be changed.

2. Provide the poultry industry with a summary of refereed journal scientific articles in a form which will stimulate reading of the entire article, stimulate discussion sessions by poultry extension specialists with industry personnel or stimulate earlier industry adoption of research.

3. Provide the poultry indsutry with access to a computerized information system which will allow routine monitoring of the current scientific literature and allow a key-word search procedure for an in-depth review of specific topics.

The computerized summary developed was abstracted from the original published article and was based on the author(s)' interpretations rather than that of the individual preparing the summary. However, obviously the reviewer did make the decision as to the information that would be incorporated into the computerized summary. Routine checking procedures have been used to maintain the highest accuracy; but an in-depth editorial review procedure has not been used, thus occasional errors may occur. Remember, this computerized summary system is designed to provide a "General" way to monitor the scientific literature and that you must read the original article to ascertain specific interpretations that should be made.

SPECIAL RECOGNITION: Special thanks and recognition are made to James R. Shelton, Computer Programmer in the Poultry Science Department and R. Craig Woods, Systems Analyst in the Extension Special Programs unit for their expert initiation and handling of the computerization aspects of the project, to Beth A. Hulet for her many hours of inputing the handwritten copies onto the Virginia Tech mainframe computer and to Elaine M. Dobyns for her ability to keep everything straight.

JOURNALS BEING REVIEWED

In terms of the infromation provided, each computerized listing will include: (1) author(s)' name(s), (2) year published, (3) article title, (4) journal name, volume and page numbers, (5) 3 to 15 line synopsis of the article, (6) a number to identify topic category areas. The journals presently included in this scientific literature review program are:

Applied Animal Behaviour Sicnece (was Applied Animal Ethology through 2/84)
Archiv fur Geflugelkunde (German Journal of Poultry Science)
Avian Diseases
Avian Pathology
British Journal of Nutrition
British Poultry Science
Japanese Poultry Science (Nihon Kakin Gakkaishi)
Journal of Food Science
Journal of Heredity
Journal of Nutrition
Poultry Science
Theorectical & Applied Genetics

Every article appearing in each of the lsited journals dealing with the domestic species of broilers, ducks, layers and turkeys will be included in the review process. Obviously, the program was initiated with a zero base. At the present time, articles have been abstracted from each of the lsited journals beginning with the 1984 volume of the journal. Two exceptions are the British Journal of Nutrition which has been completed back through 1980 and Applied Animal Behaviour Science (formerly Applied Animal Ethology) which has been completed back through the first volume which was published in 1975. As time permits, every attempt will be made to include earlier volumes of each journal listed in the review process.

CATEGORY ASSIGNMENTS

For convenience of use in the Virginia Tech Poultry Science Extension program and distribution to specific audiences, each abstracted article is assigned to one of the following categories:

1. Behavior
2. Broiler Breeder Nutrition
3. Broiler Breeder Production & Reproduction
4. Broiler Nutrition
5. Broiler Production
6. Disease
7. Ducks
8. Food Science
9. Genetics
10. Incubation
11. Layer Nutrition
12. Layer Production & Reproduction
13. Nutrition
14. Physiology
15. Poultry Egg Marketing
16. Poultry Egg Products
17. Poultry Meat Marketing
18. Poultry Meat Products
19. Processing
20. Pullet Nutrition

21. Pullet Production
22. Turkey Breeder Nutrition
23. Turkey Breeder Production & Reproduction
24. Turkey Nutrition
25. Turkey Production

Assignment of an article abstracted to one of the 25 categories is done on the basis of relative applicability or generality. For example, if the information is judged to be rather general or very basic in nature, the article would be assigned to one of the discipline oriented categories such as Behavior (1), Disease (6), Genetics (9), Incubation (10), Nutrition (13), Physiology (14) or Processing (19). However, if the information is judged to be production or product oriented, the article would be assigned to one of the production or product oriented categories such as Broiler Breeder Nutrition (2), Broiler Breeder Production & Reproduction (3), Broiler Nutrition (4), Broiler Production (5), Layer Nutrition (11), Layer Production & Reproduction (12), Poultry Egg Marketing (15), Poultry Egg Products (16), Poultry Meat Marketing (17), Poultry Meat Products (18), Pullet Nutrition (20), Pullet Production (21), Turkey Breeder Nutrition (22), Turkey Breeder Production & Reproduction (23), Turkey Nutrition (24), or Turkey Production (25). The one exception is relative to the Ducks (7) category to which any article abstracted having ducks as the experimental species is automatically assigned to the Ducks (7) section.

KEY WORD SEARCH

The system has been designed to provide users a review potential of articles relative to specific topics through the use of a KEY WORD search procedure. In this search procedure, if the KEY WORD is located in either the title or summary of the article, it will be included in the printout requested.

One potential problem is that the key word selected may not appear in either the article title or summary. For example, an article may contain data evaluating the effect of levels of various amino acids (methionine, lysine, argenine, threonine) on growth rate of young turkeys. It is possible that only the words "amino acids" may appear in both the title and summary, thus the use of only "methionine" as a key word would result in the article being missed. In order to prevent missing an article, it is suggested that the following KEY WORD search procedure be used:

1. Use a very specific "KEY WORD" such as "methionine" for the initial search phase.
2. Use a less specific "KEY WORD" such as "amino acid" for the second search phase.
3. Use a very general "KEY WORD" such as "protein" for the final search phase.

JOURNAL SOURCE AND COST

For information purposes, the call number, 1985 subscription cost and subscription address of the journals being reviewed in this program are provided:

1. Applied Animal Behaviour Science
   Call No. - SF1, A67
   Cost/Yr. - $133.30
   Elsevier Science Publishers, B.V.
   Journals Department
   P. O. Box 211
   1000AE Amsterdam, The Netherlands

2. Archiv fur Geflugelkunde
   (German Poultry Science)
   Call No. - SF481, A67
   Cost/Yr. - $212.00
   Archiv fur Geflugelkunde
   Universitat Hohenheim
   470 Kleintierzucht
   Postfach 700 562
   D-7000 Stuttgart 70,
   Federal
   Republic of Germany

3. Avian Diseases
   Call No. - SF995, A8
   Cost/Yr. - $30.00
   Avian Diseases
   University of Pennsylvania
   New Bolton Center
   Kennett Square, PA 19348-1692

4. Avian Pathology
   Call No. - SF995, A85
   Cost/Yr. - $60.00
   Business Manager
   Haughton Poultry
   Research Station
   Haughton, Huntingdon
   Cambshire PE172DAUK

5. British Journal of Nutrition
   Call No. - QP141, A1, B7
   Cost/Yr. - $280.00
   Cambridge University Press
   32 East 57th Street
   New York, NY 10022

6. British Poultry Science
   Call No. - SF481, B7
   Cost/Yr. - $103.00
   Longman Group Limited
   Subscriptions (Journals)
   Dept.
   Fourth Avenue
   Harlow, Essex CM 19 5AA
   Great Britain

7. Japanese Poultry Science
   (Nihon Kakin Gakkaishi)
   Call No. - SF481, N69
   Cost/Yr. - $75.00
   Japan Publishing Trading Co., Ltd.
   P. O. Box 5030
   Tokyo International
   Tokyo, Japan

8. Journal of Food Science
   Call No. - TX1, F65
   Cost/Yr. - $50.00
   Subscription Dept.
   Institute of Food
   Technologists
   Suite 2120
   221 N. LaSalle Street
   Chicago, IL 60601

9. Journal of Heredity
Call No. - S494, A2, J7
Cost/Yr. - $45.00
Journal of Heredity
818 18th Street, N.W.
Washington, DC 20006

10. Journal of Nutrition
Call No. - RM214, J6
Cost/Yr. - $95.00
The Jounral of Nutrition
Subscription Department
9650 Rockville Pike
Bethesda, MD 20814

11. Poultry Science
Call No. - SF481, P77
Cost/Yr. - $60.00
Poultry Science Association
309 West Clark Street
Champaign, IL 61820

12. Theoretical & Applied Genetics
Call No. - SB123, 28
Cost/Yr. - $430.00
Sumnger-Verlag New York, Inc.
Service Center Secaucus
44 Hartz Way
Secaucus, NJ 07094