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INSIDE

Heating the Broiler House: Fuel or Bird Heat?

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Introduction

Broiler growers have three primary options when it comes to heating their poultry houses. Growers can use bird heat (which really isn't much of an option when the birds are small but becomes more valuable as the birds increase in age and weight) or they can burn propane or natural gas fuel. If propane and natural gas are put under the same "umbrella" (let's call it purchased heat), growers have only two primary options - bird heat or purchased heat. To be successful growers must use both options wisely. If growers rely too much on purchased heat they can be faced with excessively high fuel bills, but relying too heavily on bird heat will negatively affect in-house environment, feed conversion, bird health and flock performance leading to reduced returns. It's a balancing act that is difficult to pull off correctly, so this article is aimed at helping growers understand the decisions they face and perhaps making decisions easier.

Differences in Purchased Fuel

At the Applied Broiler Research Unit we burn propane for fuel since natural gas lines do not run by the farm. However, many growers can choose between propane and natural gas so it is important to compare the fuel sources. Even though poultry houses can be heated equally well with propane or natural gas, growers (particularly those who are considering switching fuels) should be aware that there are some significant differences between the two fuels (Czarick and Lacy, 2001a).

One obvious difference is that propane is delivered to the farm on a tank truck as a liquid that is pumped into storage tanks, while natural gas is a gas piped into the house from the main supply line. In fact, growers should notice that the propane tank truck driver will never fill the storage tank 100% full since there must be an air space at the top of the tank to allow the liquid to change into gas for burning. This difference in form (liquid versus gas) makes cost comparisons of the two fuels challenging, but we will look at that subject in a moment.

There are also several less obvious differences between the two fuels. Natural gas is 60% lighter than air, while propane is 156% heavier than air. This means the gas from propane leaks around brooders or furnaces could settle on birds, while natural gas leaks would tend to accumulate above the birds. An additional difference between the two fuels is that there is less heat in a cubic foot of natural gas than in a cubic foot of propane (Czarick and Lacy, 2001a). Although there is almost no difference between the flame temperature of natural gas (3550°F) and propane (3573°F), burning one cubic foot of natural gas produces approximately 1,012 BTU's of heat while burning one cubic foot of propane produces 2,520 BTU's of heat (Czarick and Lacy, 2001a). The exact amount of heat each gas produces may vary a few percent as the composition of the gases change from time to time. Typically natural gas will consist of 94.8% methane, 2.9% ethane, 0.8% propane, 0.2% butane, 0.1% carbon dioxide, and 1.2% nitrogen (Fig.1). Propane or liquid petroleum gas (LPG) is typically a mixture of at least 90% propane, 2.5% butane and higher hydrocarbons, and the balance ethane and propylene (Czarick

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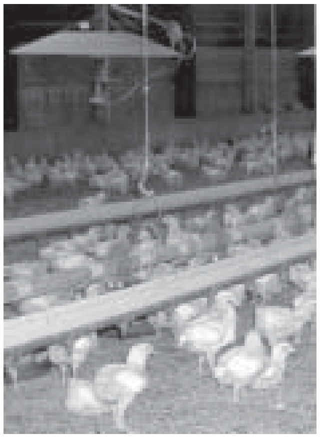
and Lacy, 2001a) (Fig.2). Since burning a cubic foot of propane produces 2.5 times the amount of heat as a cubic foot of natural gas, it takes 2.5 times the volume of natural gas to heat a house as it does propane.



Before going any further, let's explain some terms. The term BTU is a short version of British Thermal Unit. One British Thermal Unit (BTU) is the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit. A BTU is about the amount of heat produced by burning one match. A "Therm" is the amount of gas required to produce 100,000 BTU's. Propane is sold by the gallon, while natural gas is sold by the Therm. However, we will address those differences in a minute.

The two fuels are distinctive in the system required to burn them within the poultry house (i.e. pipes, pressure regulators and burner orifices). Different operating pressures and pressure regulators are required for propane and natural gas. Propane systems operate at 11 inches of water column pressure, while natural gas systems operate at 7 inches of pressure. In addition, because natural gas produces less heat per cubic foot than does propane, the gas supply lines to the brooders/furnaces must be larger in houses using natural gas heat. For instance, a 100 ft., one-inch gas pipe will carry 333,000 BTU's/hr of propane compared while the same amount of natural gas produces only 206,700 BTU's/hr, or 37% less heat (Czarick and Lacy, 2001a). This means that you must change the in-house piping if you switch from propane to natural gas, otherwise the brooders/furnaces will either burn poorly or not at all because of lack of fuel. The orifices in the brooders/furnaces will also need to be changed if you switch fuels since larger orifices are required for natural gas than for propane. The switch from propane to natural gas can become expensive equipment-wise and these costs must be weighed against the savings in the natural gas purchase price. Switching from natural gas to propane generally requires less expensive equipment changes since the only the regulators, smaller orifices and hooking up the propane tanks to the existing gas lines is required. However, propane would have to be priced attractively enough to warrant switching.

As mentioned earlier, it takes 2.5 times the volume of natural gas to heat a poultry house as it does propane, but that doesn't mean it will cost 2.5 times as much because the two fuels are priced differently. Natural gas is sold by the "Therm" (which we said earlier was 100,000 BTU's) while propane is sold by the gallon (Czarick and Lacy, 2001a). One Therm of natural gas is approximately 100 cubic feet. One gallon of propane produces 91,500 BTU's of heat. To convert the cost per Therm of natural gas to an equivalent cost per gallon, divide the cost per Therm by 1.09 (100,000 BTU's/91,500 BTU's). To determine the equivalent cost per Therm multiply cost per gallon of propane times 1.09 (Czarick and Lacy, 2001a). There are also usually additional service charges associated with natural gas that vary from place to place and may add 5% or more to the bill (Czarick and Lacy, 2001a).

Keeping Birds Warm With Purchased Heat

Since heating costs can account for as much as 40% of a grower's out-of-pocket expense for growing birds (Donald et al., 2001), efficient fuel management can mean the difference between profit and loss. One important way to save fuel is to prevent temperature stratification, with warm air staying near the ceiling and cold air collecting at bird level (Donald et al., 2001). Proper ventilation and air inlet management are critical to promoting good air mixing during colder weather.

During cold weather some growers may overlook the need of birds for fresh air and focus solely on house or litter temperature. Yet propane gas combustion occurs according to the following formula:

$$\underset{\text{(Propane)}}{CH_3\text{-}CH_2\text{-}CH_3} + \underset{\text{(Oxygen)}}{5\,O_2} \longrightarrow \underset{\text{(Carbon dioxide)}}{3\,CO_2} + \underset{\text{(Water)}}{4\,H_2O}$$

Natural gas is combusted in a similar manner and according to the following formula:

$$\underset{\text{(Methane)}}{CH_4} + \underset{\text{(Oxygen)}}{2O_2} \longrightarrow \underset{\text{(Carbon dioxide)}}{CO_2} + \underset{\text{(Water)}}{2\,H_2O}$$

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This means the combustion of one molecule of fuel generates one or more molecules of carbon dioxide and several water molecules. In fact, burning one gallon of propane requires 850 cubic feet of air and produces 108 cubic feet of carbon dioxide and 0.8 gallons of water (Czarick and Lacy, 2001b). The water and carbon dioxide generated by burning these fuels must be exhausted from the house since they do not dissipate. If water is not exhausted from the house environment, moisture can collect on curtains, equipment and (maybe most importantly) in litter. Excess litter moisture can evaporate causing young birds to chill. Increased litter moisture in litter can also lead to an increase in ammonia within the house. The accumulation of ammonia can also force the grower to either live with health consequences on the birds or pay extra to ventilate the ammonia out of the house.

Brooder stoves are often burning right over chicks. Since burning brooder stoves consume oxygen and carbon dioxide is heavier than air, the air around chicks can be the lowest oxygen level in the house. If the house is not properly ventilated carbon dioxide will tend to collect near the birds, making breathing difficult and worsening ascites in the flock later on. It is generally recommended that carbon dioxide concentrations should be kept below 5,000 ppm (fresh air has about 500 ppm of carbon dioxide) which can normally be accomplished through typical timer fan settings. In view of these facts, it is crucial that the 0.1 to 0.2 cfm per bird be provide to young birds during the brooding period. This minimum ventilation can go a long way towards determining how well the flock does at settlement time.

To get good moisture removal with minimum fuel cost it is imperative to bring cool outside air into the house in such a way that it mixes with the warm air near the top of the house. This incoming air can then be warmed so that when it falls to the floor it will be able to pick up as much moisture as possible, and will not chill the birds (Donald et al., 2001). The best control of fuel usage and proper mixing of incoming air is achieved with static pressure controlled vent boxes and properly set fan timers. For those growers who are still using curtain crack ventilation, minimum fuel usage is all but impossible. Curtain crack ventilation is by far the least effective and is quickly becoming the least desirable method of minimum ventilation.

Keeping the House Warm With Birds

Since a day old chick does not produce much heat, growers must rely heavily on propane or natural gas to maintain house temperatures when birds are small. As birds age and their weights increase, it becomes possible to use bird heat for a significant portion of heat required to maintain proper house temperatures. A broiler produces approximately 5 BTU's of heat per pound of body weight per hour. However, to produce the same amount of heat as burning one gallon of propane, approximately 18,000 pounds of birds are required (Czarick and Lacy, 2001b). This extra body heat makes it much easier to maintain adequate temperature and air quality (conditions that help optimize performance) during cooler periods, while burning a minimum amount of fuel.

Birds produce heat as they digest feed and the more feed consumed and digested, the more heat produced. For instance, Czarick (2001) has indicated (Table 1) that 23,000 three-week-old birds produce the same amount of heat has six conventional pancake brooders while the same number of four-week-old birds produce the same amount of heat as 10 conventional brooders. When birds are distributed unevenly there is too much bird heat being produced in the densely populated areas and not enough in the sparsely populated areas. The furnaces/brooders will run in sparsely populated areas, but exhaust fans may come on to cool heavily populated areas of the house (Czarick, 2001).

Growers must also keep in mind that it is vitally important to maintain uniform bird densities to optimize performance. Bilgili and Hess (1995) reported that increasing the density from 0.9 square feet per bird to 0.8 square feet per bird decreased the bird weight from 5.88 lbs. to 5.77 lbs. and increased feed conversion from 1.85 to 1.88. In cold weather it is not uncommon to have higher densities in the brood area than in other parts of the house because the birds never uniformly distribute after being turned out of the brooding chamber. This can even be a problem in houses with clear curtains on bright, sunny days and high light intensities if the nonbrooding areas are kept too cool. It is important to be sure that the non-brooding areas are warmed a day or two before turning birds out of the brooding chamber so that birds are encouraged to quickly and evenly distribute themselves throughout the house. In solid sidewall or black-out curtained houses bird distribution problems can be even worse since at full intensity the light levels in these houses are often 100 times dimmer than what is experienced in the typical conventional clear curtain house (Czarick et al., 2001). These lower light levels dramatically reduce bird activity which means it takes significantly longer for the birds to spread out. Low light levels coupled with cooler temperatures in the nonbrood areas can make it almost impossible to get uniform bird distribution. In addition, if the birds have not evenly distributed by three to four weeks of age, they most likely never will (Czarick, 2001). The problem of too many birds in some parts of the house and not enough in other parts can result in birds in the crowded brooding area having lower weights and higher feed conversions than birds in less dense areas of the house. Not only do these bird density differences decrease flock uniformity and negatively affect flock performance, heating costs are also affected.

As birds produce heat during feed digestion, they also produce moisture through respiration and defication. This moisture must be removed from the house to prevent condensation, caked litter and ammonia build up. For every pound of weight a bird will produce 0.010 lbs. of moisture. For every 90,000 BTU's of heat produced by the birds nearly 21 gallons of moisture is added to the house, as compared to the 0.8 gallons of water produced by the burning of one gallon of propane which produces the same 90,000 BTU's of heat (Czarick and Lacy, 2001b). In a sense, the heat produced by the birds is a "wet" heat compared to the "dry" heat produced by the brooders/furnaces. The greater the amount of "wet" heat used, the greater the potential for build-up of moisture (Czarick and Lacy, 2001b). Many times growers create moisture problems for themselves when they cannot maintain desired air temperatures with bird heat alone. Instead of supplementing the bird heat with a small amount of heat from furnaces/brooders, which would not only keep the house temperature up but dry out the house as well, growers will often cut back on their timer fan settings (Czarick

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and Lacy, 2001b). Reducing timer fan settings does maintain more of the bird heat and keep the temperature up but, it also retains more of the moisture generated by the birds. The more timer fan settings are reduced, the greater the potential for moisture buildup (Czarick and Lacy, 2001b). Once moisture has built to the point that caked litter begins to form, it will be very difficult to dry it back out. It would be less expensive to burn a small amount of fuel as needed throughout the flock than to wait until a serious moisture problem has developed and have to burn excess fuel to try and correct the problem.

Summary

Broiler growers have limited options when it comes to heating their houses. Purchased fuel (propane or natural gas) is costly and its use must be managed frugally to prevent expenses from getting out of hand. With older birds, bird heat can be used to temper fuel usage although it is a delicate balancing act to determine how much of each heat source to rely upon. If a grower depends too heavily on purchased fuel, most of his/her returns will go to pay the gas bill. If bird heat is used too much, moisture levels can build and result in undesirable house conditions which can negatively affect flock performance.

Growers considering switching fuels must consider both the cost of the fuel itself and any additional plumbing and equipment costs (pressure regulators, orifices, etc.) associated with the switch. While both fuels work equally well for heating poultry houses, there are significant differences between the two which growers should be aware of and must consider before making a switch. Regardless of the fuel used, birds must be evenly distributed throughout the house to help keep fuel use to a minimum. Uneven distribution will not only increase fuel usage but will negatively affect flock uniformity and performance. Be sure to preheat the nonbrooding areas for a day or two before turning birds out of the brooding chamber to assist in a quick and even distribution. Proper management and balancing of bird heat and fuel throughout the growout period will help insure positive flock performance and a profitable return at harvest time.

Growers considering switching fuels must consider both the cost of the fuel itself and any additional plumbing and equipment costs associated with the switch.

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Table 1. Heat Production of 23,000 Broilers (Czarick, 2001)

Bird Age (Weeks)	Heat Production (BTU's/hr)	Equivalent number of conventional pancake brooders	Equivalent gallons of propane per day
1	35,000	1	9
2	88,750	3	22
3	183,750	6	46
4	303,750	10	76
5	432,500	14	108
6	602,500	20	150
7	778,750	25	195

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Fig. 1. Gases in Natural Gas

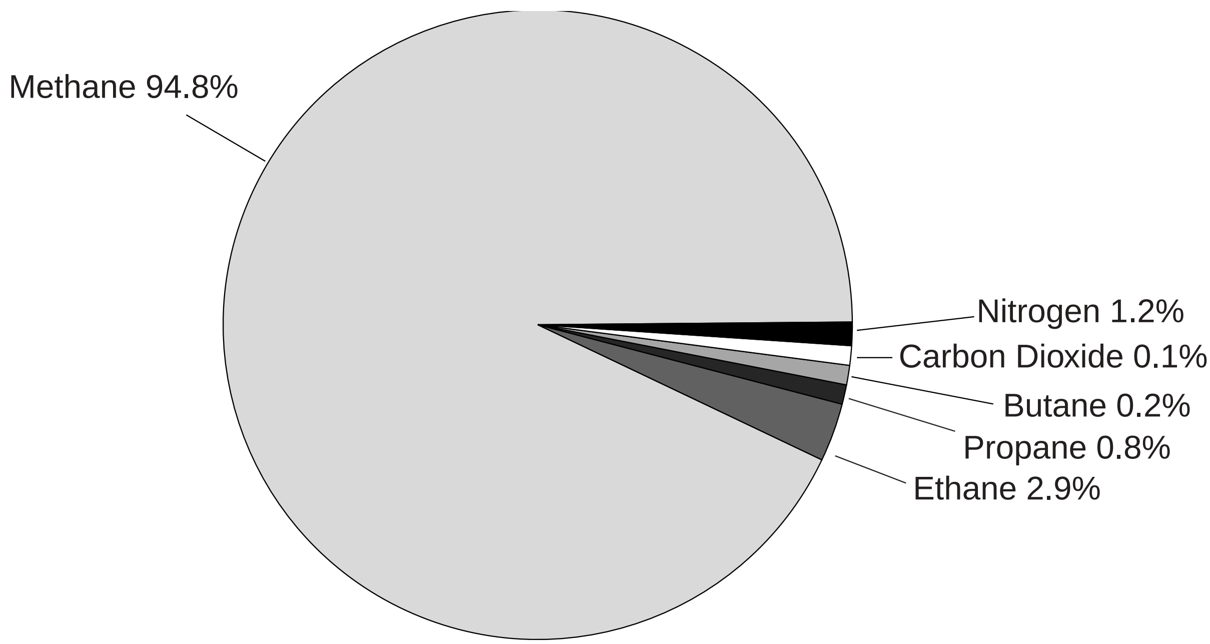

Fig. 2. Gases in Liquified Petroleum Gas (LPG) or propane

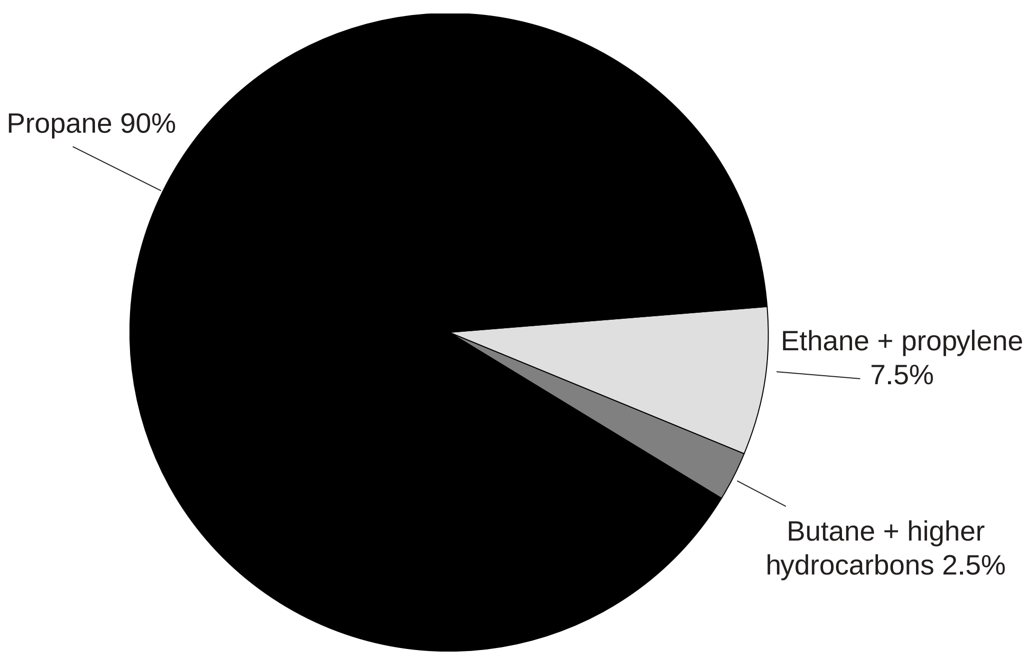

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Photo Courtesy Bernie Adams and BioPort Corporation.

Anthrax on the Poultry Farm

Background

Anthrax is not a problem for most farmers and ranchers in the United States. The disease is only rarely seen in birds (in fact chickens are highly resistant). However, since approximately 85% of Arkansas poultry farms have cattle on them it is prudent that the poultry farmer be aware of the disease. This is especially important considering the current news releases and media coverage of the disease in people and the attendant apprehension about the disease.

Anthrax is found worldwide with the distribution of the disease dependent upon climatic conditions, soil types, etc. Although rare in the United States, there are outbreaks of anthrax in animals. The majority of the bacteria in the genus *Bacillus* species of bacteria do not cause disease, but the organism which causes anthrax, *Bacillus anthracis*, is considered the most pathogenic of the genus. This bacteria is rod shaped and is capable of producing a spore. A spore is a highly resistant form of the bacteria and can remain viable for years.

Anthrax as a disease has a long history. It was reported as a disease in ancient Egypt and Rome. In the late 1800's Louis Pasteur and Robert Koch worked with the disease in animals. In fact, Louis Pasteur developed a vaccine against anthrax in animals in 1881. The disease can affect any warm blooded animal, but is primarily a problem in herbivores (commonly in cattle and sheep and less frequently in goats and horses). It can also infect swine and humans. Reptiles and carnivorous birds are resistant to the disease.

Anthrax in Animals

Animals get the disease via three routes ingestion, inhalation, and skin. The usual route is ingestion of the bacterial spore via contaminated food (such as close grazing of the infected pasture) or contaminated water. The bacterial spore germinates in the intestinal tract or throat mucosal membranes. It is suspected that injury to the mouth mucosa occurs when animals closely graze on sparse pasture and the spore gains entry via these injuries. However, the bacteria can cause disease without an injury being present. The bacteria multiples at the localized site and causes swelling of the surrounding tissue. It then spreads to the regional lymph nodes and from there to the bloodstream, thus, seeding the body tissues. The bacteria produces a toxin which causes edema, tissue damage, shock and is lethal. Animals infected with anthrax may be found without any clinical signs or may exhibit depression, high fever, difficulty breathing, rumen stasis, lack of appetite, and terminal convulsions. Horses commonly have colic and intestinal inflammation. The animals commonly have a bloody discharge at body openings such as the nostrils, anus, etc. The signs observed does depend upon the route of infection. When infection is via the respiratory route the signs are similar to those seen when it is acquired via ingestion, but they tend to develop more rapidly. The disease often has a sudden onset and short course with minimal signs prior to death when the animal has inhaled or ingested the bacteria. Localized skin infections are not common in animals and when they are present usually become systemic.

In animals the disease is tentatively diagnosed by the rapid onset of clinical signs and death. The dead animal will decompose rapidly and there are large amounts of gas present in the carcass.

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In addition, there is no rigor mortis and there is a dark, tarry bloody discharge from the body orifices. In most states the disease is reportable and samples should only be taken for confirmation by a qualified veterinarian. Commonly a sample of blood is taken for bacterial culture from the ear vein of the dead animal (this is done to prevent spore formation since the bacteria will form spores if exposed to the air). It is important to not open the animal to minimize spore formation. Infected animal carcasses should be completely burned (if allowable) and/or buried with quick lime.

Anthrax can be effectively treated in animals if the treatment is started early in the course of the disease. Several antibiotics can be used to treat animals in the early stages of anthrax. Unfortunately, many animals exhibit few, if any, signs prior to death with anthrax so prevention using vaccines in endemic areas is of value.

Anthrax in Humans

In humans the disease can be a skin form, respiratory form, or intestinal form.
The skin form (cutaneous) in humans results when the bacterial spores contaminate a cut or skin abrasion. The lesion that develops is a bump similar to a rash that develops into a hot, painful swelling that becomes a necrotic painless ulcer. The lymph nodes near the ulcer may also become swollen. This form of the disease can cause death but it is rare. Cutaneous anthrax is contracted when contaminated wool or hides are handled. Antibiotic therapy usually results in a complete cure.

The more serious forms of anthrax are the respiratory and intestinal forms. The respiratory form is the result of inhalation of the bacterial spores which subsequently multiply in the lungs causing respiratory difficulty, flu like symptoms, and eventually death (if not treated early in the progression of the disease). The intestinal form is the result of consumption of spore contaminated meat. Following consumption of contaminated meat the bacteria proliferates in the intestinal tract causing vomiting, fever, severe diarrhea and death if treatment is not started early in the course of the disease. However, it should be noted that naturally occurring anthrax in animals is rare in the United States and in humans it is even more so. ■

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Agroterrorism - Are You Prepared?

Introduction

Recent events in the United States have resulted in a tremendous increase in security measures to prevent similar events from occurring. There has also been an increased awareness of the public concerning disease prevention and a heightened apprehension concerning farm vulnerability to agroterrorism. Can the agricultural community prevent or reduce the effects of agroterrorism attacks? How can an individual farmer or rancher implement protective measures to prevent their farm or ranch from being a potential site of disease outbreak whether accidental or intentional?

Governmental Systems to Prevent Diseases

Veterinarians provide growers and ranchers with disease diagnoses in the local area. Local veterinarians also work with state and federal agencies in the state to ensure that health certificates that allow the legal movement of animals out of state are issued. Veterinarians provide growers and ranchers with information on animal health and disease prevention as well as quarantining suspect animals. All licenced veterinarians in any state have a list of reportable diseases. If they diagnose a reportable disease an animal or suspect an animal to have one they are bound by law to report the details of the situation to the appropriate state or federal authorities and quarantine the animal until a diagnosis can be confirmed. Most states also have a veterinary public health agency that functions

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to enforce and administer programs designed to prevent the spread of diseases from animals to the public.

The agriculture system of the United States has several systems in place to prevent disease from spreading. Most citizens are aware of the Center for Disease Control which becomes involved in disease outbreaks in people. They are also aware that there is in place a system for inspecting meat, poultry , and other foods to insure wholesomeness. In addition, each state has a state veterinarian in charge of an animal health agency that works to prevent the introduction of animal diseases into that state. These state veterinary agencies are usually a part of the state department of agriculture or another state agency (such as the Arkansas Livestock and Poultry Commission [ALPC]) that administers regulations applying to state livestock. The ALPC monitors diseases that are routinely found in the state and seeks ways to prevent the spread of these diseases.

The federal government also operates veterinary agencies through the Animal and Plant Inspection Service (APHIS) branch of the United States Department of Agriculture. APHIS monitors diseases found in the three regions of the United States (Eastern, Central, and Western regions). There are, of course diseases commonly found in various regions of the United States. Diseases that are not commonly found are classified as foreign animal diseases. Each of these regions is comprised of several states and there is an Area Veterinarian in charge (AVIC) located within each state . The AVIC administers federal programs related to animal health in the state via several veterinary medical officers or VMO's. These programs are designed to reduce the incidence of common diseases and prevent the introduction of foreign animal diseases. There are also several veterinarians in each state that have been specifically trained to recognize foreign animal diseases (called Foreign Animal Disease Diagnosticians or FADD's). These FADD's assist with the diagnoses, prevention and control of any foreign animal disease.

The agriculture system of the United States has several systems in place to prevent disease from spreading.

In the last few years many states have also organized task forces or teams of experts to recognize and respond to emergency disease outbreaks in the state. These task forces are usually comprised of veterinarians or individuals with expertise on a wide variety of animals. Arkansas has such a task force; the Arkansas Animal Disease Emergency Response team (AADER). The AADER team, in cooperation with the animal industries has discussed and planned responses to an animal disease emergency situations. The AADER team has also conducted four disease scenarios over the past two years. Animal industry personnel, state government representatives, federal government agency representatives, emergency management officials, veterinarians, livestock inspectors, county judges, and other necessary people were included in the discussions of response strategies to emergency animal diseases. These scenarios or tabletop discussions have allowed participants to address various strategies (such as quarantines, recognition of sieases control measures, preventative practices, animal movement and animal care) that would be needed in and animal disease emergency outbreak. Disease scenarios have been conducted on Hog Cholera, Foot and Mouth Disease, Exotic Newcastle Disease and Avian Influenza.

Biosecurity and the Prevention of Disease

The nation has responded to the recent terrorist attacks by increased security measures and awareness to prevent future attacks. The best way an individual involved in animal production can assist in the prevention of an agroterrorism attack is by implementing Biosecurity measures. These measures are done to minimize the chance of farm animals being infected by pathogens.

Biosecurity is a term that is frequently used when discussing disease control in poultry. The word itself is a combination of two terms, "bio" and "security". The term "Bio" is from the Greek word bios and means life. The definition of "security" means safety or freedom from risk or danger. When combined together as the word "Biosecurity" translates as life free of risk or in other words safety for the living. In regard to poultry; the word means any procedure or practice which will prevent or limit the exposure of a flock to disease causing organisms. Biosecurity involves many "common sense" procedures which are often overlooked or only carelessly or sporadically followed. Good Biosecurity programs need to address two broad areas: the physical facilities on the farm and the farm management routines.

Physical Facilities to Prevent Disease

A properly planned poultry farm is located and designed to prevent the entrance of disease organisms into the facilities. Changes to physical facilities are often the most difficult and costly to change so poultry facilities should not be hastily planned or constructed. Poultry farms should be located 1-3 miles from any other poultry facility. Farm buildings should be located as far away as possible from main roadways since vehicles (including live haul trucks) can spread disease between flocks. Automobile traffic on the farm should not be allowed to park near house entrances so that the chance of transmission of disease organisms on vehicles to birds is minimized. Facilities should be constructed so that wild birds in and vermin can be effectively excluded. Facilities should also be constructed so that maitenancecan be easily done and should be kept in good repair. All poultry houses should be constructed of wire small enough to prevent wild birds and animals from entering the house.

Farm Management Routines to Prevent Disease

Farm management rountines comprise the second component of Biosecurity programs. Farm routines are the easiest, quickest, and least costly component to change and can have the greatest impact on disease prevention. Farm routines can either assist in the spread of diseases or prevent the disease spread. Thus, it is important to understand how farm routines can cause the transmission of disease organisms from disease sources to flocks. Poultry flocks may be exposed to disease organisms via the following five sources:

1. Diseased or Carrier Poultry
2. Vermin (rodents, wildlife, free flying birds, insects)
3. Personnel (clothing and shoes of on farm caretakers and visitors)
4. Inanimate objects contaminated with disease organisms
5. Contaminated air or water.

Poultry flocks may be exposed to disease organisms via the following five sources

Dealing with Diseased or Carrier Poultry

Carrier birds are those birds which have the disease organism, but do not show disease symptoms. It is impossible to detect carrier birds without testing and often the disease has already spread once these birds have been detected. Thus, it is generally best for growers to avoid contact with all other birds to minimize disease risk. It is also important that no other avian (bird) species be present on the poultry farm since these birds can carry diseases. The utilization of all in / all out facilities can greatly reduce the risk of disease transmission since potentially infected birds are removed from the premises before new birds are acquired. In addition, adequate time should be allowed between flocks to clean and disinfect. All replacement poultry should be from disease free stock. Caretakers should learn to recognize symptoms of disease so diseases can be recognized early and diseases do not spread to other poultry. Dead birds should be quickly removed from poultry houses to prevent disease spread via cannibalism. Dead birds should be disposed off by approved methods such as incineration, composting, or rendering. Since dead birds can carry disease, it is important not to bring dead birds from other farms on to your own farm. In addition, since litter can also carry disease organisms, it is important to keep litter from other farms off you own farm.

Prevention of Disease via Vermin:

All poultry houses should be constructed of wire small enough to prevent wild birds and animals from entering the house. They should be checked and repaired as needed. Since rodents contaminate and consume feed and water, spread many diseases, and destroy and/or damage equipment all poultry buildings should be rodent proofed. The area around a poultry house and farm should be cleaned to prevent rodent infestation and all spilled feed should be cleared away as soon as possible. A baiting program should also be implemented on the poultry farm to keep rodent populations low. Litter and manure beetles can act as disease reservoirs and also damage poultry house insulation and wooden structures. Flies can also spread disease and can be a nuisance on the farm or to neighbors. House condiitons should be maintained to minimize insect numbers and approved pesticide application program should be in place to further reduce the insect population. In addition, maintaining litter in dry condition and repair or water leaks in and around the house is also helpful.

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Prevention of disease from personnel:

Access to the poultry farm should be restricted so that only necessary authorized personnel are allowed on the farm. Farm caretakers should also be cognizant of the possibility of disease spread via daily on farm movement. When multiple age farms can not be avioided, a traffic flow pattern should be established so that the youngest birds are checked first. Clean clothing (coveralls) and boots should be provided for all personnel entering the poultry farm. A log should be maintained so that personnel, vehicle, and equipment can be tracked as to when, who, and why the farm was visited. A footbath containing a disinfectant may help reduce tracking of organisms via footwear. However, it is important to remember that dirty disinfectant footbaths are worse than no footbaths at all. Also remember that cleaning of rubber boots and/or other footwear before disinfecting is advisable since most disinfectants will be rendered useless by large amounts of organic matter such as litter or fecal material.

Prevention of Disease from Inanimate Objects:

Inanimate objects such as equipment should be thoroughly washed and disinfected after use. Do not borrow equipment from other farms for use on your farm. All feed and water systems should be cleaned and disinfected on a regular schedule. Do not bring home and use anything from another poultry farm or area where other avian species are kept without cleaning and disinfecting it first or better yet do not bring on the farm under any circumstance.

Disease Prevention from Contaminated Water or Air.

It is important to not use water that is suspect. Chlorination of water and cleaning of water systems will assist in the prevention of disease. Do not water poultry from ground water sources such as a pond without proper disinfection of the water. Air borne pathogens are more difficult to prevent since poultry need ventilation to reduce humidity, ammonia, dust, and heat. Location of the house as far as possible from other poultry farms will assist in prevention of airborne disease.

Biosecurity is one of the most important tools to use in the prevention of disease. A Biosecurity program should be an integral part of poultry farm disease prevention practices and should be flexible to allow changes as needed. Constant vigilance and common sense can pay big dividends in the reduction of mortality and condemnations from disease. Prevention of disease is always less costly than treatment, control, and/or salvage. Biosecurity practices are vital to the prevention of disease and the protection of both the agriculture industries and food supply in the United States. Biosecurity pracitces are our first line of defense again on-farm agroterrorism. ■

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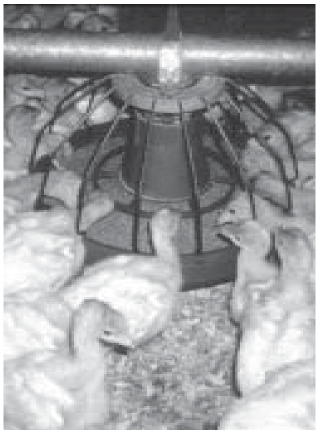

Thinking about Stress and Disease in Turkeys

Stress was originally an engineering term meaning a force that strains or deforms.

What is stress?

What is stress? You have probably been told time after time that reducing bird stress will help to fight *E. coli* infections. But just what does that mean? Perhaps if you think about what stress means to you, it may help you to understand what you can do to decrease the stressors faced by your birds.

The word 'stress' means different things to different people. "Stress" was originally an engineering term meaning a force that strains or deforms. 'Stress' was first used in a biological sense by a Harvard physiologist, Walter B. Cannon in 1914. Cannon used the term to describe the effects that emotions have on physiology and health. However, the term "stress" became popular in a biologic sense beginning with the work of Hans Selye. In 1950, Selye published an influential book summarizing his work studying "The General Adaptation Syndrome"and the diseases of adaptation titled The Physiology and Pathology of Exposure to Stress. Since then, this concept has become so common, that today the biologic sense of the word is probably the first that comes to most peoples' minds.

Awareness of stress and the effects of stress has become so pervasive in our modern society that in June of 1983, Time magazine ran a cover story which referred to stress as "The Epidemic of the 80s." Awareness of the effects of stress has escalated since then. A brief search on the internet brought up the following varied definitions submitted by individuals:

> "Stress is the force applied to a structure to test its breaking strength. We have come to use the term to mean both the forces that pressure us and the damage they cause."
>
> "Stress is the things you let bother you and some things that cause stress are school, work, money, driving, and just people."
>
> "Stress is any demand or change, whether positive or negative, in a person's life. The graduate school experience is inherently stressful."
>
> "Stress is the body's response to any demand or pressure."
>
> "Stress is like a ghost. It cannot be seen but it can be felt."
>
> "Stress is the mental, emotional, or physical response of our bodies to changes in our lives. Stress in itself is neither positive nor negative. Rather, our reaction to stress can be positive or negative."

As William Shakespeare once said "NOTHING IS GOOD OR BAD BUT THINKING MAKES IT SO", which is one reason the effects of stressful situations are so different for different individuals. In today's world our stressors include but are certainly not limited to:

Traffic jams, deadlines, eating on the run, an angry spouse, or boss, or parent, teenagers, bills to pay, a job, no job, new job, job changes, moving, living on unemployment, endless chores, screaming kids, school, tests, pop quizzes, getting called on in class, talking in front of an audience, writing assignments, bereavement, divorce, poverty, friends, no friends, errands and demands, demands, and more demands. And today we know the fear of war, fear of terror, fear of the unknown.

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Stress would seem to be a scientifically unworkable concept. However, we know that stress has adverse effects, even without ever having resolved the problem of precisely defining stress or even agreeing on ways to measure this condition. The best we can try to do is measure 'stress' by concentrating on the effects stressors have in our lives. Transferring this thinking to our animals, we need to pay attention to the effects of stress on reproduction, immunity, and metabolism, all of which serve as indicators of animal well-being.

What does stress do to animals?

It has been documented that stress can lead to an increased susceptibility to disease. The confusing part is that stress can also lead to an increased protection from disease. The effects of stress are so variable because: 1) The effects are specific for the type, degree, and duration of stress; 2) Effects are influenced by the complexity of the immune system and the neuro-endocrine system; 3) Effects are strongly influenced by individual genetic differences in physiology as well as the psychological response or perception of different stressors; and 4) The development of each individual response to stress is strongly influenced by the environment, which includes all previous experience, as well as nutrition and disease.

Research on stress

Our research program uses an experimental disease model to produce *E. coli* air sacculitis and osteomyelitis in turkeys by "stressing" birds with injections of one of the major chemicals involved in the birds' response to stress. A general response of birds to stress is the release of ACTH from the anterior pituitary gland which stimulates the adrenal cortex to increase the synthesis and secretion of corticosterone, the major glucocorticoid in birds. Dexamethasone, the chemical we inject, is a synthetic glucocorticoid that is commonly administered to cattle for the treatment of many problems including mastitis, ketosis, udder edema, respiratory disease, inflammatory musculoskeletal disease, and induction of parturition. However, dexamethasone usage is a good example of a treatment that can become worse than the problem when used in excess. Just remember that a little stress is good for you, but too much is a killer. Dexamethasone decreases immunity to coccidiosis in chickens and in our studies, dexamethasone treatment leads *to E. coli* and *S. aureus* air sac infection and osteomyelitis. This model clearly and reproducibly shows that too much stress can lead to an increase in disease in turkeys and that by reducing the effects of stress you can dramatically increase the health of your birds.

What can be done about stress?

But, what can you do about it ??? If the effects of stress are so complex, why even bother trying? Probably the easiest and most important thing you can do is to just think. Think about how your birds can be stressed, and then do all that you can to fix the situation. A lot of things just can't be changed, but many can be improved by a little consideration. I've had fun trying to list the stressors I know can be faced by poults throughout a growout and I've listed them below.

My challenge to you is to try to think of more. What is it in your particular situation that can produce unexpected changes in the environment, unexpected surprises for your birds. What are they afraid of? A turkey grower in Kansas, after reading this list, realized that running the housekeeping tiller in his brooding house was really scaring his poults. He believes that since he stopped tilling, his birds have had less osteomyelitis. Coincidence? Maybe. But if you add together all of the little things you can do to make birds more comfortable and less fearful, you will make a big difference in bird health. For turkey growers, one of the greatest stressors on the poults is having to move their birds from one house to another in a multi-stage system. We need to find alternatives to these types of management practices that really impact health and disease. We are searching for ways to improve the birds' stress response through genetics and nutrition. But until real solutions are found, decreasing stress is up to you. Think about ways to decrease the fear and reduce the changes faced by your birds. If you think of any other stressors for this list, or have some good ideas on how to decrease stress, please let me know. My email is **grhuff@uark.edu** and I'd be happy to hear from you.

Since September 11, all Americans have experienced a new kind of stressful anxiety caused by not knowing what will happen next, a feeling of loss of control and an inability to plan our next response. Perhaps this general uncertainty, even though it is so hard to describe, so hard to even know when we are feeling it, may be our best connection to understanding the stress experienced by our poultry flocks. As humans we have developed an intuitive feeling for the concept of stress from our personal experiences. For your birds, the term stress can be used to describe everything from the discomfort caused by high or low environmental temperatures, or running out of feed, to the anguish of emotional or physical conflict with no place to hide. Perhaps the best thing you can do to reduce stress in your flocks is to try to maintain a sense of consistency as best as possible. Make careful observations and be aware of ways you can reduce fear and uncertainty. And continue to think about how sometimes big changes and sometimes small changes in our lives and our environment can profoundly affect the way we feel. ■

SOME STRESSES ON TURKEYS DURING PRODUCTION

Hatching, Catching, Handling
Beak and toe trimming
Vaccination
Transportation, Cold Stress
Open field stress
Heat stress
People
Ammonia, dust, endotoxin
Disease
Social hierarchy
Overcrowding
Genetic selection for fast growth
Extended lighting schedules
Running out of feed
Running out of water
Wet litter
Moving from brooder houses to grow-out houses
Catching and transportation to processing plant

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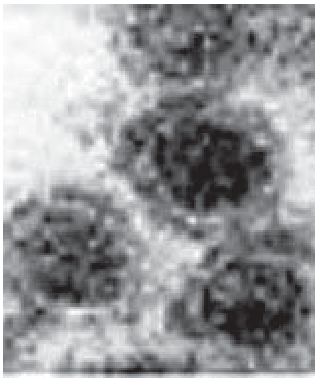
Center of Excellence for Poultry Science • University of Arkansas



SOURCE: Center for Disease Control and Prevention. http://www.cdc.gov/dvbid/index.htm

West Nile Virus Encephalitis: An Emerging Infectious Disease

History and Background

The first documented case of West Nile virus (WNV) encephalitis was in 1937 in a feverish woman in the West Nile region of Uganda, Africa. This virus was identified as a Flavivirus of the Japanese Encephalitis Serocomplex. There are several other Flaviviruses in this complex that can cause encephalitis in people (such as St. Louis encephalitis and Murray valley and Kunjin encephalitis of Australia). There have been infrequent outbreaks of fevers associated with West Nile virus since the 1930s in Israel in the 1950s and South Africa in the 1970s. However, many infections were apparently without symptoms and the disease was only a problem in Africa, West Asia, Eastern Europe, and the Middle East. It was detemined early that the virus was transmitted via mosquitoes. In 1990s there were outbreaks of the disease caused by a new variant of the virus. In 1999, the first infection of WNV was documented in the Western Hemisphere in Connecticut, Maryland, New York and New Jersey. There were 62 human cases (seven fatal) in the affected area and numerous cases in horses and birds. There were, in fact, tremendously high mortality rates in wild birds (particularly crows) that coincided with the outbreak in humans and horses. The reservoir for the virus is wild birds. Mosquitoes feeding on the birds become infected and can the transmit the virus to other birds, horses, or people. In 2000, there were 21 cases (two fatal) in humans in the New York area. These outbreaks prompted a 5 area surveillance program. The five areas monitored were human patients for signs of WNV, animals for neurological signs, mosquitoes for the virus, dead birds for virus, wild, captive and sentinel chickens for antibodies.

The Spread of West Nile Virus in the United States

The surveillance program showed (as expected) that the disease has spread from the original area around New York city. Human cases in 2001 are currently at 41 with others pending confirmation. The surveillance program to date has detected WNV in approximately 4000 crows and 1400 other birds in 27 states and the Washington, D.C. area. However, it should be noted that these numbers may increase as states continue surveillance. The number of equine cases of WNV in 2001 (as of October 31, 2001) stands at 347 cases in 18 states. Many of the infected horses have either died from the encephalitis or were euthanized. WNV has been detected in dead birds in Arkansas. The most recent cases have been in the El Dorado and Ft. Smith areas. Since this disease is spreading and could have an impact on the animal and public health in Arkansas it is important to discuss a few details.

West Nile Virus Infections in Humans and Animals

To date, WNV has only been confirmed in dead wild birds in Arkansas; no human cases have been documented. The Arkansas Department of Health and the Livestock and Poultry Commission are continuing their surveillance programs and have encouraged citizens to contact their offices if they find any dead wild birds found in their yard. Persons at risk for the disease include the elderly and individuals with a compromised immune system. Horses are at risk and can die from the disease, although most seem to recover. They contract the disease by being bitten by WNV infected mosquitoes. Signs in an infected horse are those resulting from inflammation of the brain and Central Nervous System (CNS). These signs can be seen with any disease that infects the CNS and

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WEST NILE- continued from page 13

include: fever, appetite loss, depression, head tilt, muscle tremors, head pressing, paralysis of the hindlegs, impaired vision, and other types of CNS signs. It is important to contact your veterinarian so a correct diagnosis can be made. There is no specific treatment other than supportive care of the animal. A vaccine has been recently approved for horses but it's effectiveness is unknown at present.

Birds also develop an encephalitis and can die from the disease. Typically, birds do not show signs of WNV other than a high mortality. Experimentally infected geese have developed CNS signs such as twisting of the head and neck, depression, weight loss, and death. Exotic birds also can become infected as evidenced by deaths in exotic birds at the New York zoo in 1999. Chickens and turkeys have been experimentally infected with the WNV but they did not develop clinical signs. The susceptibility of gamebirds and many exotic and pet birds to WNV is still unknown.

Prevention of West Nile Virus Infections

Since WNV is spreading and could become an important human and animal disease (especially in horses), procedures and practices to prevent or minimize the impact should be considered. Prevention of the disease is most effectively done by management of mosquitoes (which serve as the vector) and prevention of mosquito bites. This can be done by using effective mosquito repellants, wearing long sleeve shirts when outside, keeping window screens in good repair and reducing areas where mosquitoes breed. A reduction of mosquito breeding areas can be done by disposing of items that can hold water, cleaning livestock water troughs regularly and removing vegetation from around ponds. Drain pipes, gutters and bird baths should be cleaned and maintained. Ornamental pools should be aerated or stocked with small fish to consume mosquito larvae. Vaccination may be a very effective way of preventing the disease in horses. If you develop symptoms of an illness it is very important to seek medical attention for a proper diagnosis. It is also important to seek veterinary care if any of your animals become ill so a proper diagnosis and treatment regime can be started. If you have questions concerning West Nile virus (WNV) in humans you should contact your physician, local public health department or health care provider. Questions regarding WNV in animals should be directed to your veterinarian, county extension agent, or the Arkansas Livestock and Poultry Commission. ■

Coming Events:

January 16 - 18, 2002 — **International Poultry Trade Show**
Georgia World Conress Center
Atlanta, Georgia
Contact: U.S. Poultry and Egg Association
Phone: (770) 493-9401

February 22-23, 2002 — **Poultry Federation Spring Meeting**
Arlington Hotel
Hot Springs, Arkansas
Contact: The Poultry Federation
Phone: (501) 375-8131

March 11-15, 2002 — **Short Course on Modern Poultry Production**
University of Arkansas
Fayetteville, Arkansas
Contact: Dr. Frank T. Jones
Phone: (501)* 575-5443

April 8, 2002 — **Poultry Science Scholarship Golf Tourney**
University of Arkansas
Poultry Science Department
Valley View Golf Course
Farmington, Arkansas
Contact: Diana Bisbee
Phone: (501)* 575-2025

April 9 - 10, 2002 — **Poultry Symposium**
Holiday Inn Convention Center
Springdale, Arkansas
Contact: The Poultry Federation
Phone: (501) 375-8131

*Area code is scheduled to change in northwest Arkansas in Jan. 2002.
New area code number is 479.

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