pork industry handbook

Michigan State University Extension

Colibacillosis

(*E. coli* scours, Baby pig scours, Postweaning *E. coli* Diarrhea, Edema disease, gut edema)

Authors
Harley W. Moon, USDA - Agricultural Research Service
Erwin M. Kohler, The Ohio State University

Reviewers
Martin E. Bergeland, University of Minnesota
E. Wayne Boland, North Dakota State University

E. coli diarrhea, or scours, baby pig scours, postweaning *E. coli* diarrhea, and colibacillosis are popular names used to label an intestinal disorder of newborn or recently weaned pigs. The disease is characterized by large amounts of liquid feces. Edema disease, gut edema, or *E. coli* enterotoxemia are names for a different type of colibacillosis, which is characterized by accumulation of fluid in the tissues of young pigs.

Some strains of *Escherichia coli* bacteria can cause such intestinal disorders, but other bacteria, viruses, poisons, and nutritional or genetic factors can cause disorders with similar clinical signs. Within any herd, these different agents can cause disorders concurrently or sequentially. This fact sheet will inform readers of the current knowledge about *E. coli* infections.

It is necessary to conduct laboratory tests to establish an accurate diagnosis. Properly collected specimens are required for meaningful diagnostic efforts. Even then it may be difficult to establish the diagnosis for a particular diarrhea or death loss. Frequently, chemotherapeutic agents are administered on the assumption that the diarrhea is being caused by *E. coli* when, in fact, the disease is being caused by a virus such as transmissible gastroenteritis (TGE) or rotavirus or another factor or agent that is completely unaffected by the drugs used.

Cause

E. coli bacteria are normal inhabitants of the intestinal tract and are present in large numbers in the large intestine but not the small intestine of normal animals. However, certain strains are classed as pathogenic, meaning that they produce disease. The *E.coli* strains causing diarrhea or edema disease in pigs have special abilities to multiply to high numbers in the small intestine without necessarily invading other tissues of the body. There is probably at least one pathogenic strain in each herd. These strains produce toxins which manifest the disease symptoms.

The strains causing diarrhea in newborn or recently weaned pigs produce enterotoxin (enterotoxigenic *E. coli*) that causes massive fluid loss from the body into the intestine. Consequently, large quantities of pale yellow, watery feces are passed. The fluids are lost at such a rapid rate that the pig becomes dehydrated and also develops acidosis because a large proportion of the electrolytes lost are basic (alkaline). The liquid feces usually are quite alkaline. Pigs are thirsty and continue to nurse or eat until they become too weak and depressed to do so.

The *E. coli* strains causing edema disease produce edema disease toxin (shiga-like toxin or verotoxin) which is absorbed from the intestine into the blood. Edema disease toxin damages the walls of the small blood vessels throughout the body. The damaged vessels leak fluid (edema fluid) that accumulates in tissues creating a clear gelatinous mass (edema) either in the eyelids, under the skin, or in the wall of the stomach. Edema in the brain results in nervous signs (staggering, head tilting, stumbling, dog sitting position, lying on side making continuous kicking movements) and death (Figures 1-4). The affected pigs often are the most thrifty and fastest growing animals in the group. In some pigs, the disease progresses so rapidly that they are found dead unexpectedly, without apparent symptoms that would provide an opportunity for the nervous signs to be observed.

Differential Diagnosis

Diarrhea resembling that in colibacillosis also can be caused by several viruses (rotavirus, TGE), by other bacteria (*Clostridium perfringens, Salmonella,* campylobacter-like organisms), and by parasites (coccidia, cryptosporidia). Nervous signs or sudden deaths in a pattern resembling edema disease also can be caused by viruses (pseudorabies, hemagglutinating encephalomyelitis virus, polioencephalomyelitis) or bacteria (Glasser's disease, bacterial meningitis, ear infection), by water deprivation (salt poisoning) or chemical toxins (arsenic, lead, mercury, insecticides, rodenticides), and in conditions such as porcine stress syndrome and mulberry heart disease. Therefore, veterinary consultation and a specific diagnosis should be obtained before treating, vaccinating, and/or changing management procedures in response to outbreaks of diarrhea, nervous signs, and/or sudden death.

Predisposing Factors

Neonatal enteric colibacillosis is a diarrhea caused by enterotoxigenic *E. coli* in pigs less than seven days old. A number of host and environmental factors affect the incidence of *E. coli*-caused diarrhea of newborn pigs. The stomach and intestine of pigs are quickly flooded with bacteria immediately after birth. Many of these are "harmless." However, if large numbers of enterotoxigenic *E. coli* are present, many pigs can be infected immediately after birth.

Newborn pigs have no antibodies at birth but receive them from the colostrum (first milk) of the sows. Colostrum has antibodies against many different microorganisms depending upon the sow's exposure or vaccination program. Frequently, gilts have had less exposure to the enterotoxigenic *E. coli* in the herd and consequently do not protect their pigs as well as sows do. If the pigs obtain colostrum (containing adequate levels of antibodies against the infecting strain) immediately after birth, and if they continue to suckle regularly (milk also contains antibodies, only in lower concentrations than in colostrum), the *E. coli* usually will be inhibited sufficiently to prevent clinical disease. However, all protection is relative, and infection with very large numbers of enterotoxigenic *E. coli* or anything that interferes with frequent suckling (such as lactation failure, injuries, or other infections) increases the probability of development of clinical colibacillosis.

Postweaning colibacillosis is triggered by the stress associated with weaning. These stress factors are: 1) loss of the protection afforded to the suckling pig by antibodies in milk; 2) change in diet to free-choice dry feed (contributes to irregular or depressed feed and water intake, followed by overeating with attendant "overload" and incomplete digestion); 3) social stress (loss of mothering, fighting with new pen mates, strange surroundings); 4) chilling; and 5) onset of a viral infection (rotavirus) that is probably present in all swine herds and which damages the lining of the small intestine. These stress factors predispose the young pig to the proliferation of *E. coli* in the small intestine. If the proliferating strain of *E. coli* produces enterotoxin, the result is postweaning diarrhea. If the proliferating strain of *E. coli* produces edema disease toxin, the result is edema disease.

It is important to understand that incidence of disease caused by pathogenic *E. coli* is greatly influenced by management of a herd and facilities. Large numbers of *E. coli* usually are present in the immediate environment whenever it is dirty and wet, the ventilation is poor, or the humidity is high. However, the most important source of infection is other young pigs with colibacillosis. Newborn pigs with *E. coli* diarrhea shed up to one billion *E. coli*/cc of the liquid feces.

Temperature is probably the most important of all the environmental influences on the well-being of young pigs. Young pigs are extremely sensitive to chilling, and this stressor lowers the resistance of pigs to infections including *E. coli.*

Pigs that develop colibacillosis must be treated promptly with antibacterial drugs shown to be effective against the enteropathogenic *E. coli* in the herd. Neonatal enteric colibacillosis (baby pig scours) is so acute that, even with proper treatment, death and performance losses make this a very costly disease. It is much more profitable to prevent these diseases than to be continuously treating affected pigs. The best possible results in the prevention of colibacillosis can be attained only by a complete program using all the good management practices available.

Prevention

The three basic approaches to prevention are sanitation, good management practices and vaccination.

Sanitation. The purpose of a sanitation program is to reduce the number of pathogenic *E. coli.* Sanitary farrowing and nursery facilities as well as adequate ventilation are essential to reduce the number of pathogenic organisms and to prevent high humidity and damp or wet floors. Implement all-in, all-out facility management. Promptly removing or at least covering liquid feces with dry bedding or soil can help reduce the spread of bacteria from pigs with *E. coli* diarrhea. Modern mesh flooring reduces the exposure of pigs to feces.

In addition, if *E. coli* diarrhea is diagnosed, the affected pigs should be promptly treated with antibacterial drugs effective (either by laboratory tests or experience in that herd) against the particular strains present in the herd. This is an attempt to decrease the number of pathogenic *E. coli* that these pigs are shedding in the liquid feces. Treatment of pigs that already have edema disease often is ineffective. However, treatment of barn mates with antibacterial drugs may help prevent additional cases. It is important that antibacterial drugs not be used indiscriminately because *E. coli* often rapidly develop resistance to these drugs. Withholding feed temporarily, or feeding a diet high in fiber which temporarily reduces feed intake also may prevent the intestinal overgrowth of edema disease toxin producing *E. coli.* This method should be used in extreme cases only.

Management. The second approach is to use good management practices to maintain the "natural" resistance of the pigs at the highest possible level. Attention to the nutritional and general health status of the breeding herd helps insure the delivery of vigorous pigs and satisfactory lactation. Prompt suckling after birth, and frequent suckling thereafter, is necessary for the pigs to acquire the full benefits of the specific and nonspecific protective substances in the sow's colostrum and milk. Colostral antibodies must be swallowed every few hours to keep enough in the intestine to protect the pigs.

Chilling caused by drafts, wet or cold floors, or inadequate heaters must be avoided through the suckling and postweaning (nursery) periods. Chilling is one of the most severe stressors a young pig can encounter. Pigs should be warm enough to sleep soundly in a stretched-out position. Pigs in wet pens, or pens with inadequate heat, huddle, shiver, are restless, and continually moving to find a warmer spot in the group. Practices which minimize the stress of

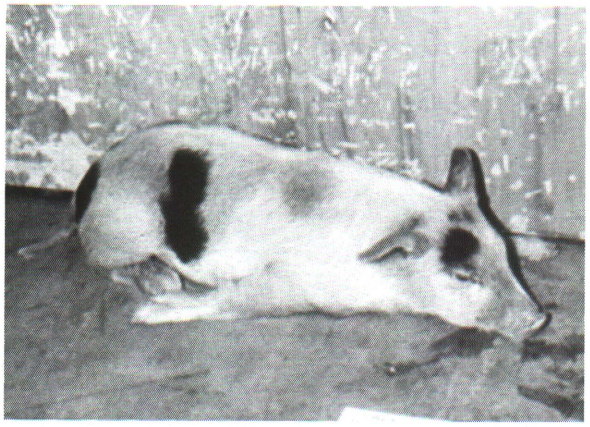

Figure 1. Pig with acute edema disease. The pig is lying on its sternum, unable to move.

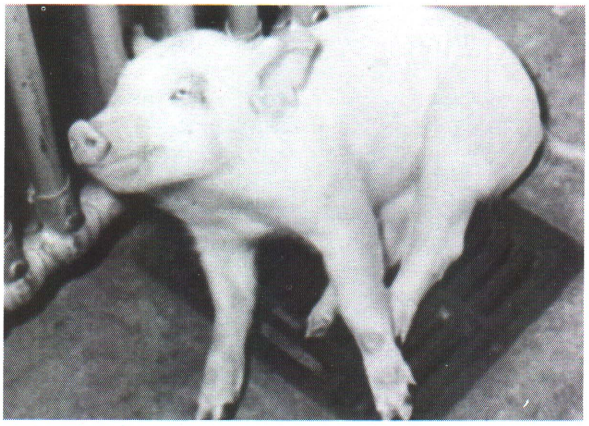

Figure 2. This pig with edema disease has swollen eyelids, and assumes a "dog-sitting" position.

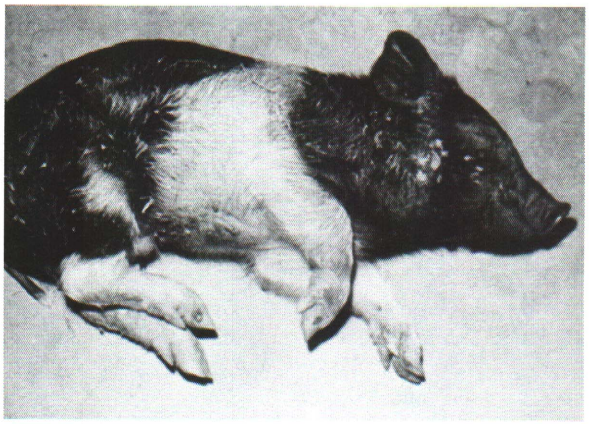

Figure 3. Edema disease. The pig has been down on its side for two days, making continuous paddling movements with its front legs.

Photos courtesy of Dr. Martin Bergeland, College of Veterinary Medicine, University of Minnesota.

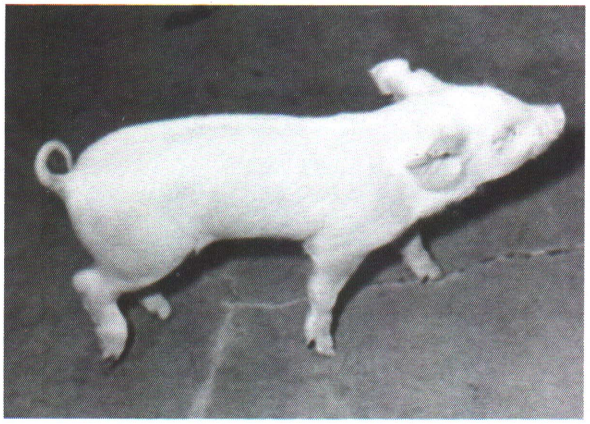

Figure 4. Pig with edema disease from a herd that had an outbreak of edema disease several days after weaning. This pig became sick 10 days later, after the initial outbreak had subsided. It is walking slowly in a circle, with the head elevated.

weaning (gradual feed changes using repeated feeding of many small meals during the day, feeding a high-quality prestarter to promote a gradual increase in the intake of solid food, allowing them to remain in the farrowing stall for a few days after weaning) are useful in reducing the incidence and severity of postweaning colibacillosis (diarrhea or edema disease).

Vaccination. The third approach to prevention is to increase resistance by vaccination. The pig can get specific protection against infectious diseases from its dam through the colostrum and milk. Vaccination of sows to increase the protective value of their colostrum and milk against pathogenic strains of *E. coli* has been practiced by many people.

Several companies produce vaccines containing the virulence factors (pili) enabling most strains of enterotoxigenic *E. coli* to heavily colonize the small intestine of newborn pigs. These vaccines are injected into gilts and sows late in gestation, and the dams respond by producing antibodies to these pili. These antibodies are transferred via the colostrum and milk to the pig's intestine. The antibody against pili prevents adhesion of the *E. coli* to the wall of the intestine. If the *E. coli* do not adhere, they cannot grow to produce enough toxins in the small intestine to cause diarrhea, dehydration and death.

Approximately 95 percent of the toxin-producing strains that affect newborn pigs produce one of the three specific pilus types: K88, K987P or K99. Many strains of both enterotoxigenic and nonenterotoxigenic *E. coli* also produce type one pili. The role of type one pili (if any) in the disease has not been defined and is currently a point of controversy among researchers.

Some vaccines contain heat-labile toxin antigen which is produced by some strains of enterotoxigenic *E. coli.* These antigens stimulate the sows to produce antibodies against heat-labile toxin and to transfer these to the intestines of the pigs. These antibodies could neutralize a limited amount of heat-labile toxin. Although prevention of colonization by pilus antibodies will prevent the formation of diarrhea-pro-

ducing amounts of heat-labile toxin, there is some evidence that the heat-labile antibodies also can be of value.

Although the commercial vaccines have been quite safe, there have been instances in which sows have aborted following vaccination. All *E. coli* organisms contain an entirely different type of toxin called endotoxin; and under certain conditions, it appears that enough endotoxin has been present in the vaccine to cause abortion.

To achieve optimal benefits from any vaccination program against *E. coli* scours of baby pigs, it is still essential to keep the level of pathogenic *E. coli* as low as possible through good management, to insure that pigs suckle promptly and frequently, and to avoid chilling, injuries, and other disease problems.

The vaccines which protect against *E. coli* scours of newborn pigs are not effective against postweaning colibacillosis (diarrhea or edema disease). Recently, some companies have marketed inactivated oral vaccines which are fed to the piglets during the preweaning and postweaning periods to protect against postweaning colibacillosis. There is much less known about the mechanisms of action and effectiveness of these vaccines. Reports of their use in the field suggest that although they may be useful in some situations, they are not consistently effective in preventing postweaning diarrhea or edema disease. Control of postweaning colibacillosis depends primarily on stress management, hygiene, and, where warranted, the use of antibacterial drugs. Good results depend upon a good working relationship between a swine veterinary practitioner and the producer.

If a diagnosis has been made that indicates pathogenic *E. coli* as having a significant role in an outbreak of diarrhea in pigs over a week of age, the incriminated strains of *E. coli* should be tested to determine which antibacterial drugs are effective. The selected drug should be given orally. At present, further proof is needed before a vaccination program directed at preventing colibacillosis of pigs over ten days of age can be recommended.

Some pigs are genetically resistant (recessive) to colonization and disease caused by some pilus types (K88 and f107) of *E.Coli*. This is an active area of research which may lead to marker assisted selection of breeding stock as a practical prevention strategy within the next few years.

Summary

Colibacillosis is a term often used loosely and, consequently, many times incorrectly. Careful diagnostic study of appropriate specimens from selected pigs is required to render an accurate diagnosis. In addition to the detection of substantial numbers of pathogenic *E. coli*, the possible role and significance of other enteric pathogens must be evaluated in each outbreak of diarrhea, sudden death loss, or nervous signs.

Although many drugs are advertised for use in treating *E. coli* diarrhea of pigs, most of these drugs have little effect in many herds because strains of *E. coli* have developed resistance to these drugs. Laboratory tests or experience in the herd are necessary to make accurate recommendations about the particular antibacterial drug to use for treatment.

Prevention of *E. coli* diarrhea of newborn pigs is more economical than treatment of large numbers of cases. There are three basic approaches to prevention. The first is a good sanitation program including all-in, all-out management. The careful design of facilities with only a few farrowing crates per room can be very helpful in making a sanitation program work. The second approach is to establish a good nutritional and health program for the breeding herd to insure the birth of vigorous pigs and a good milk supply. The third approach is to vaccinate the sows so they provide better immune protection for the pigs through the colostrum and milk.

A vaccination program may be indicated where there is a high incidence of *E. coli* scours of newborn pigs. This may occur either when a highly pathogenic strain is introduced into a herd or when there are deficiencies in the management and farrowing facilities. The optimal benefits from vaccination can be achieved only when these deficiencies are corrected.

Diarrhea in pigs over a week of age should not be assumed to be caused by *E. coli*, but a careful diagnosis should be made. *E. coli* are demonstrated to be an important cause of the problem, antibacterial drugs effective against the causative strains should be given orally. Vaccines are not recommended for control of postweaning diarrhea or edema disease.

Additional management information can be found in the following fact sheets.

PIH-46, Care of the Sow During Farrowing and Lactation
PIH-60, Mechanical Ventilation of Swine Buildings
PIH-111, Management and Nutrition of the Newly Weaned Pigs
PIH-120, Non-mechanical Ventilation of MOF Swine Buildings

MICHIGAN STATE UNIVERSITY EXTENSION

MSU is an Affirmative-Action/Equal-Opportunity Institution. Extension programs and materials are available to all without regard to race, color, national origin, sex, disability, age or religion. ■ Issued in furtherance of Extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Gail L. Imig, extension director, Michigan State University, E. Lansing, MI 48824.

Rev. 4:95-1:5M-KMF-KE, 35¢, single copy free to Michigan residents