Enteric Colibacillosis of Newborn Pigs

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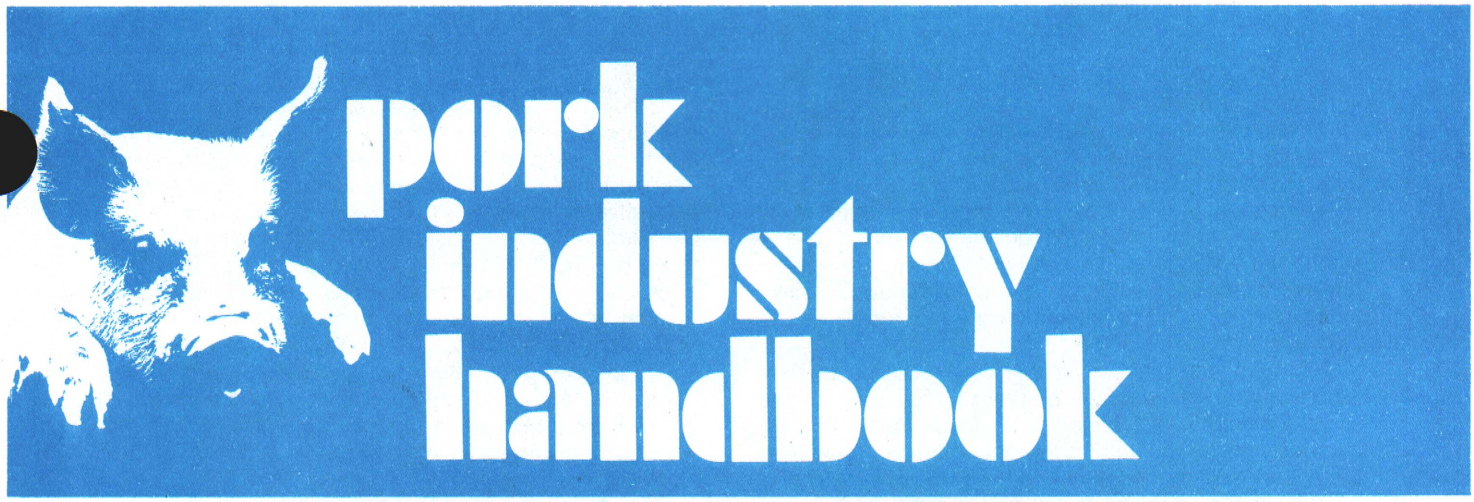

COOPERATIVE EXTENSION SERVICE • MICHIGAN STATE UNIVERSITY

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Names such as *E. coli* diarrhea or scours, baby pig scours, and colibacillosis are popularly used today to label an intestinal disorder of newborn swine characterized by large amounts of liquid feces. Research has shown that some strains of *Escherichia coli* bacteria can cause such intestinal disorders, but other bacteria and viruses can cause diseases with similar clinical signs. Within any herd, these different infectious agents may cause disorders concurrently or sequentially. This summary was prepared specifically to help the readers understand some of the current knowledge about *E. coli* infections.

It is often necessary to conduct laboratory tests to establish an accurate diagnosis. Properly collected specimens from carefully selected pigs are required for meaningful diagnostic efforts. Even then it may be difficult to establish the diagnosis for a particular episode of diarrhea. Too frequently, costly 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 TGE or rotavirus) or another microorganism that is completely unaffected by the drugs used.

Cause

E. coli 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 enteropathogenic, meaning that they produce disease by developing in the intestine without necessarily invading the other tissues of the body. Enteropathogenic *E. coli* are found throughout the world. There is probably at least one strain in each herd. It is important to understand that the incidence of disease caused by enteropathogenic *E. coli* is greatly influenced by the management of herd and facilities. Such strains of *E. coli* have the ability to propagate rapidly in the small intestine. Additionally, these strains produce toxins (enterotoxins) which cause massive fluid losses from the body. The amount of fluid and electrolytes in the small intestine soon exceeds the absorptive capacity of 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 are usually quite alkaline. The pigs usually are thirsty and continue to nurse until they become too weak and depressed to do so.

This fact sheet is directed primarily to neonatal enteric colibacillosis, which is diarrhea caused by enteropathogenic *E. coli* in pigs less than 7 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," but if large numbers of enteropathogenic *E. coli* are present, many pigs can be infected immediately after birth.

Large numbers of *E. coli* are usually present in the immediate environment whenever it is dirty and wet, the

ventilation is poor, and the humidity is high. However, the most important source of infection is other young pigs with *E. coli* diarrhea. These pigs will shed up to 1 billion *E. coli*/cc of the liquid feces.

Temperature is probably the most important of all the environmental influences on the well-being of the pigs. It is also one of the easiest to control in modern farrowing facilities. Young pigs are extremely sensitive to chilling, and this stressor lowers the resistance of pigs to infections including *E. coli*.

Newborn pigs normally 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 what the sow has been exposed to or vaccinated with. Frequently, gilts have had less exposure to the enteropathogenic *E. coli* in the herd and consequently don't protect their pigs as well as sows do. If the pigs drink colostrum (containing adequate levels of antibodies against the infecting strain) immediately after birth, and if they continue to suckle regularly, the *E. coli* will usually be inhibited sufficiently to prevent the occurrence of clinical disease. However, all protection is relative, and infection with very large numbers of enteropathogenic *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.

Pigs that develop *E. coli*-caused diarrhea must be treated very promptly with antibacterial drugs which have been shown to be effective against the enteropathogenic *E. coli* in the herd. The disease is so acute in young pigs that, even with proper treatment, death and performance losses make this a very costly disease. It is much more profitable to prevent this disease than to be continuously treating affected pigs.

With this introduction, it should be obvious that the best possible results in the prevention of *E. coli*-caused diarrhea of baby pigs can be attained only by a complete program using all the good management practices available.

Prevention

There are three basic approaches to the prevention of *E. coli* scours. The first approach is a good sanitation program to reduce the number of enteropathogenic *E. coli*. Sanitary farrowing facilities and adequate ventilation are essential to reduce the number of pathogenic organisms and to prevent high humidity and damp or wet floors. Promptly covering the liquid stools 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 known to be effective (either by laboratory tests or experience in that herd) against the particular strains present in the herd. This, of course, is a treatment for the affected pigs, but it is also an attempt to decrease the number of enteropathogenic *E. coli* that these pigs are shedding in the liquid feces. It is important that the antibacterial drugs not be used indiscriminately because *E. coli* often rapidly develop resistance to these drugs.

The second approach is to use good management practices to maintain the "natural" resistance of the newborn pig 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. As previously mentioned, chilling caused by drafts, and wet or cold floors or inadequate heaters must be avoided because 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, and are restless, continually moving to find a warmer spot in the group.

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

One vaccination method currently being used successfully in numerous herds by veterinarians involves feeding cultures of *E. coli* to dams late in gestation. The vaccinated dams then protect their newborn pigs via antibodies in their colostrum and milk. The program must be custom-developed for each herd, partially because there are so many strains of *E. coli* that can cause scours of baby pigs. Antibodies produced against any one of these strains are not very effective against most of the other strains.

There are a number of precautions to follow. Only pure *E. coli* cultures isolated from the herd to be vaccinated should be used. The aim here is to avoid bacteria or viruses that are useless for vaccination, or even worse, feeding bacteria or viruses that could cause disease problems in the herd. This program has a number of rather detailed steps. Good results depend upon a good working relationship between a veterinarian and the producer.

Recently, several companies have introduced vaccines containing the virulence factors (pili) which enable most strains of enterotoxigenic *E. coli* to heavily colonize the small intestine. These vaccines are injected into gilts and sows late in gestation. The dams respond by producing antibodies to these pili, and these antibodies are transferred via the colostrum and milk to the pig's intestine. 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 large enough numbers to produce enough toxins in the small intestine to cause diarrhea, dehydration, and death. Approximately 95% 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 1 pili. The role of type 1 pili (if any) in the disease has not been defined and is currently a point of controversy among researchers.

Some of the vaccines contain heat-labile toxin antigen which is produced by some strains of enterotoxigenic *E. coli*. These antigens should 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-producing amounts of heat-labile toxin, there is some evidence that the heat-labile antibodies can be of value.

Many strains produce another type of enterotoxin called heat-stable enterotoxin. This toxin is not antigenic (sows will not produce antibody against it), and antibody directed against heat-labile toxin will not protect against diarrhea caused by strains that produce heat-stable toxin.

Although the commercial vaccines have been quite safe, there have been a few instances in which sows have aborted following vaccination. All *E. coli* organisms also 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 in certain sows.

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.

Colibacillosis in Older Pigs

The intestinal disorders characterized by yellow to white runny or smeary feces frequently observed in suckling pigs 10-35 days of age are often called white or milk scours. In contrast to those of newborn pigs with colibacillosis, these stools are usually neutral or acidic. These stools also have a different appearance from the pale yellow, watery, gassy feces of *E. coli* diarrhea of baby pigs. In many cases this syndrome is also called colibacillosis. Current research indicates that enteropathogenic *E. coli* can be present and occasionally play a significant role in the severity of the disease. However, research reports indicate that a virus (rotavirus) that is probably present in all swine herds destroys some of the epithelial cells that line the small intestine. (Although the rotavirus can affect newborn pigs, field investigations indicate that it rarely causes clinical disease in pigs less than a week of age if they're nursing healthy sows.) The resulting maldigestion and malabsorption are similar (although less severe) to those in TGE. Coccidia can also cause diarrhea in a similar way.

The diseases caused by these viruses are discussed in other fact sheets. The role of enteropathogenic *E. coli* in these cases is secondary to the damage caused by the virus. In some cases, *E. coli* may contribute to fluid losses. In other cases, it appears that the *E. coli* become closely associated with the damaged lining of the intestine and may enter the body or release toxins (endotoxins) that are absorbed into the body and cause shock and rather sudden death. Complete diagnostic procedures are indicated, but in the absence of the demonstration of a definite role for *E. coli* in the outbreak it is difficult to justify the administration of chemotherapeutic agents. In fact, it has been repeatedly observed they are ineffective in controlling "white" or "milk" scours.

Although enteropathogenic *E. coli* undoubtedly can and do contribute to postweaning scours, the precise role and significance is not well defined. As additional research is directed toward postweaning scours, it may well be found that there is a complex interaction of etiologic agents and factors among which *E. coli* may act only in a secondary role here as well.

If a complete diagnosis has been made that definitely incriminates enteropathogenic *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 against them. The selected drug should be given orally. Good sanitation and ventilation, avoiding overcrowding, and adequate heat as well as properly formulated feed and feeding practices are important management practices. At present, further proof is needed before a vaccination program directed at preventing colibacillosis of pigs over 10 days of age can be recommended.

Summary

Colibacillosis is a term often used loosely and consequently used both correctly and incorrectly. Careful diagnostic study of appropriately collected specimens from carefully selected pigs is required to render an accurate diagnosis. In addition to the detection of substantial numbers of enteropathogenic *E. coli*, the possible role and significance of other enteric pathogens must be evaluated in each outbreak of diarrhea.

Although many drugs are advertised for use in treating *E. coli* diarrhea of newborn pigs, most of these drugs have little effect in many herds since strains of *E. coli* have developed considerable resistance to them. Laboratory tests with the causative strain of *E. coli* 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 in the long run than treatment of large numbers of cases. There are three basic approaches to prevention. The first is a good sanitation program, including adequate ventilation to maintain dry farrowing pens and to keep the number of enteropathogenic *E. coli* as low as possible. 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 farrowing house must be operated to avoid stressful conditions for the sows (particularly overheating) and the pigs (particularly chilling). The third approach is to vaccinate the sows so that they can provide better protection for the pigs.

A vaccination program may be indicated where there is a high incidence of *E. coli* scours of newborn pigs. This may occur when a very pathogenic strain is introduced into a herd or when there are deficiencies in the management and farrowing facilities. Either a commercial vaccine containing the 3 pilus antigens—K88, K99, K987P, or the oral vaccination method using enterotoxigenic strains isolated from the herd can be used. The optimal benefits from vaccination can be achieved only when these deficiencies in the management and farrowing facilities 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. If *E. coli* are demonstrated to be an important cause of the problem, antibacterial drugs that are effective against the causative strains should be given orally.

Related Publications

PIH-47 Transmissible Gastroenteritis (TGE)
PIH-61 Rotaviral Diarrhea in Pigs
PIH-81 Swine Coccidiosis

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