pork industry handbook

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Mycobacteriosis (Tuberculosis, TB)

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Introduction and History

Mycobacteriosis, formerly referred to as tuberculosis, is found in about 0.4% of all hogs slaughtered under federal inspection (based on USDA Food Safety and Inspection Service records for FY 1983). This probably accounts for a cost to the industry of $2.5 to 3 million annually.

Mycobacteriosis as it occurs in hogs today bears almost no resemblance to tuberculosis in cattle or in humans. The disease in pigs has no known effects on the health of the animal, and no evidence exists that it can be transmitted from pigs to man, either by direct contact or by eating pork products. However, in the absence of evidence that such transmission cannot occur, meat inspection regulations were formulated which call for special handling of carcasses in which evidence of mycobacteriosis is found. It is because of these regulations (see page 2) that economic losses occur. Since the disease in hogs is different in so many ways from tuberculosis in cattle, some have suggested that it always be called swine mycobacteriosis.

In the cattle and poultry industries, tuberculosis has been largely eliminated. Tuberculin testing of cattle, with subsequent slaughter of reactors (and in some cases depopulation of entire herds), has lowered the prevalence to about 0.0008% in slaughter cattle. The poultry industry, in a change to the maintenance of all-pullet flocks, essentially also has eliminated the disease. During a 10-year period in the 60's and early 70's, the rate of condemnation for tuberculosis in mature chickens dropped from 274 per 100,000 killed to about 50 per 100,000 killed and has remained low. Elimination of older birds has proved to be an effective control measure in this industry.

For a long time it was assumed that the elimination of tuberculosis in cattle and chickens would lead automatically to its elimination in swine. This has not been the case. Mycobacterial infections in swine remain a problem to pork producers today.

Etiology

Historically, the primary causative agents of swine mycobacteriosis have been those causing tuberculosis in animals with which swine have had contact. In the early part of this century, when both human and bovine tuberculosis were more prevalent, bacteria found in swine with mycobacteriosis often were shown to be either bovine TB (*Mycobacterium bovis*) or human TB (*Mycobacterium tuberculosis*) type. As early as 1925, however, *Mycobacterium avium*, the cause of tuberculosis in birds, began to appear more frequently in swine with mycobacteriosis. This trend has continued. Today, isolation from swine of mycobacteria organisms other than *M. avium* is uncommon. A few workers, in recent years, have reported the involvement of bovine TB organisms in mycobacteriosis of swine.

Corynebacterium equi occurs in swine in localized areas of infection which resemble tuberculosis even when examined through the microscope. The earliest reports of *C. equi* infection in pigs apparently were made during the 1930's, and isolation of the organism frequently has been reported since then. *Corynebacterium equi* is found more commonly in the soil of hog pens than elsewhere, and it occurs about as often in swine without mycobacteriosis as in swine with mycobacteriosis. The importance of *C. equi* infections to the swine industry is unknown.

In summary, although other bacteria can cause disease resembling swine mycobacteriosis, *M. avium* is responsible for nearly all reported cases.

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Characteristics

Pigs usually become infected by swallowing mycobacteria. When swallowed, *M. avium* penetrates the wall of the digestive tract (usually near the tonsils or in the small intestine) and is carried to lymph nodes in the area. Small areas of infection develop in these nodes, and the disease rarely goes beyond this initial site. For this reason, the health and condition of the pig remain unaffected in the majority of cases. Therefore, it is usually impossible to diagnose mycobacteriosis in pigs based on clinical signs.

Lesions in the lymph nodes are found, however, when pigs are slaughtered. Prior to 1972, tissues with these lesions were trimmed and discarded. In 1972, a regulation was adopted which called for cooking at 170°F. for 30 minutes of all carcasses found to have two isolated lesions of mycobacteriosis (for example, one near the small intestine, one near the tonsils). These carcasses are designated "passed-for-cooking," or PFC. As noted previously, this step was taken because it was thought that tissues of infected swine could be a potential source of infection for human beings, although no evidence of this exists. Carcasses processed in this manner lose most of their economic worth, and the additional labor required at slaughter causes an even greater economic loss. In addition, many processing plants have no facilities for cooking carcasses, so they must, therefore, be condemned.

During 1979 to 1980, scientific studies were conducted to determine the temperature and the amount of time needed during processing to effectively eliminate mycobacteria. While kill rates of mycobacteria were not sufficient at 140°F. or less, 90% of the most heat resistant organisms were killed in four minutes or less at 150°F. When these organisms were incorporated into wieners processed at 150°F. for at least 10 minutes, and reaching a peak internal temperature of 155°F., 99.999% of them were killed. On the basis of these studies, the Food Safety and Inspection Service of the U.S. Department of Agriculture proposed a revised set of processing guidelines for PFC carcasses. Since most of the *M. avium* infected pigs are PFC, and very few actually are condemned, these new guidelines would virtually eliminate the mycobacteriosis problem for swine producers and packers. So far, however, these new guidelines have not been implemented, largely because of anticipated bad publicity to the government and to the pork industry.

As noted, the total loss to the swine industry in the United States annually is about $2.5 to 3 million. This is not a large figure by comparison to some other swine disease losses, but relatively few producers have infected herds, and it can, therefore, be financially devastating to those individuals affected.

Epidemiology

Because diagnosis of the disease in the living animal is usually impossible (see "Diagnosis"), figures for prevalence of the disease must be determined from findings of meat inspectors at slaughter. On this basis, the prevalence of lesions is about 0.4% of all hogs slaughtered each year under federal inspection. The infection rate may be higher since mycobacteria can be found in lymph nodes even if there is no visible evidence of their presence, and also because some infected sites are not detected by inspectors. On the other hand, since infection caused by organisms such as *C. equi* may be mistakenly diagnosed as being caused by *M. avium*, a higher infection rate than actually exists may be reported.

Chickens with tuberculosis are still found occasionally to be the source of infection for swine, but to a much lesser extent than was previously the case. Other parts of the environment of pigs may be more important.

Workers have reported that pig-to-pig transmission of mycobacteriosis may occur. This type of transmission probably is due largely to the presence of infected sites in the intestinal wall, with subsequent shedding of the mycobacteria in the feces. Mycobacterial infections of the lungs, mammary glands, and uterus also occur and may be a means of transmission. In the case of these infections, introduction of new breeding stock could be a means of introducing the disease into a herd; transmission from infected sows to their litters would cause the disease to be maintained within a herd.

Garbage feeding is another possible, although relatively rare, means for the spread of swine mycobacteriosis. For instance, improper handling of wastes from chickens before feeding to swine may lead to infection.

In recent years, work has shown that sawdust or wood shavings used for bedding may be a source of the disease in swine. *Mycobacterium avium* can often be found in samples of sawdust and wood shavings. The mycobacteria survive for long periods in stored wood shavings; they may even multiply there under proper conditions of moisture and temperature. This may explain the seasonal occurrence of mycobacteriosis in some herds. When conditions are favorable, the mycobacteria multiply and, thus, infection of pigs is easier. With a change of seasons, the conditions may become less favorable and the number of organisms in the wood shavings drops; the infection rate may drop with it.

The soil is another possible reservoir. Pathogenic mycobacteria may remain alive for more than four years in soil and litter contaminated by chickens with tuberculosis.

Wild animals, even those in captivity, seem to be highly resistant to natural infection with *M. avium.*. However, avian-type tuberculosis has been found in nearly 20% of field mice and wild brown rats trapped in poultry and pheasant pens known to house birds with tuberculosis. Attempts to transmit the infection to wild rats have been unsuccessful, and rats are, therefore, generally thought to be resistant.

Many species of wild birds have been shown to be infected. The infection has been transmitted to sparrows and pigeons caged or simply associating with domestic poultry. The prevalence of the infection in starlings may be as high as 5%.

Diagnosis

Sites of infection in pigs exposed to *M. avium* are usually found only in the lymph nodes of the digestive tract. The disease rarely spreads to other locations. For this reason, diagnosis of mycobacteriosis by physical examination of the live pig is usually impossible.

Site of infection detected by visual or microscopic examination, and the detection of mycobacteria in these infected sites, generally are reliable criteria for the diagnosis of swine mycobacteriosis. However, due to the existence of other microorganisms and conditions which may be confused with mycobacteriosis, an absolute diagnosis should be based only on the microscopic examination and on attempts to isolate and identify mycobacteria.

The tuberculin skin test is a diagnostic tool that has been applied to the study of swine mycobacteriosis. Recommendations on the amount of tuberculin to be used and the location where it should be applied have been variable. The recommended method now is the intradermal injection of 0.1 ml of the tuberculin (an extract of mycobacteria) in the dorsal surface of the ear with reactions recorded 48 hours later. Positive reactions are of variable size and intensity but usually include swelling and redness. Hemorrhage may occur at the injection site, and ulceration also may occur.

The reliability of the tuberculin test has been questioned, however. Apparently, false positive and false negative reactions occur, although some have had good success when using it to detect infected herds rather than infected individual animals. Other tests for diagnosis in the live animal have been reported, but none is currently in general use.

Generally speaking, diagnosis of the disease on a herd basis is important. This usually is accomplished by the discovery of infected sites in lymph nodes at slaughter. Once this has been confirmed, the producer should work with a veterinarian to determine potential sources of the infection which should be eliminated, and to alter management practice if appropriate (see "Prevention and Control").

Prevention and Control

Control of mycobacteriosis in swine is difficult because no adequate immunization product exists, and the preventive use of drugs or antibiotics in feeds is of unknown value.

Keeping the disease out of noninfected herds is a better objective than trying to eliminate the disease from infected herds. Therefore, it is important not to mix swine and poultry production on the same farm. Feeding uncooked garbage or other materials that might contain viable mycobacteriosis to pigs must be avoided. The purchase of breeding stock from known mycobacteriosis-free herds (ones in which no lesions of tuberculosis are found in slaughter pigs) should be practiced. However, transmission of mycobacteriosis from pig to pig is rare, and hence the breeding stock source is a lesser concern.

For the swine producer whose herd becomes infected with *M. avium*, there are few options for eliminating the disease.

First, producers may depopulate the herd and then repopulate with stock from mycobacteriosis-free herds. Little is known about effective procedures for decontamination of infected soil; it is known that mycobacteria can live in soil for at least four years. To avoid such problems, concrete lots should be used whenever possible. Concrete surfaces and equipment such as farrowing crates and feeders must be disinfected with a phenol-based disinfectant (such as Amphyl or a 2-3% cresylic acid solution). Quaternary ammonium disinfectants (such as Roccal) will not kill mycobacteria. If the source of infection (for example, soil) is not effectively decontaminated or if the new stock are not separated from it, the disease will recur.

Second, because lesions caused by *M. avium* usually regress and disappear with age, gilts, all of which are potentially infected, can be kept, to add to the herd size or to replace breeding animals. These pigs which could be passed for cooking or condemned at slaughter can continue to serve a useful function for the producer. Then when they are sold at the end of their usefulness as breeding animals, the lesions may have disappeared.

Third, if the source of the infection (such as infected bedding) can be found and eliminated, the producer may be able to wait out the approximate six-month period until all exposed pigs have been slaughtered.

This is obviously a disease which is better prevented than controlled. Efforts should be made to prevent all contact between hogs and wild birds. The potential for transmission of mycobacteriosis from infected wild birds to pigs is probably slight but nonetheless must be considered.

Hogs should not be housed in old poultry buildings unless these are constructed in such a way as to allow thorough cleaning (such as steam cleaning) and disinfection.

If at all possible, the use of woodshavings for bedding (especially in farrowing buildings) should be eliminated. Some producers have used woodshavings as bedding and experienced no problems, while others have been forced out of business due to slaughter losses from mycobacteriosis. If woodshavings must be used, they should be kept dry, both at the sawmill and on the farm, and wild birds should be kept away from storage areas.

The need for mandatory identification of hogs sent to slaughter is emphasized by this disease. Upon finding that there is a problem, a producer can send his hogs to slaughter through a market, thus forcing the packer (and actually other producers) to share the economic loss. The ability to trace hogs with mycobacteriosis to herd of origin would help solve the problem.

Summary

1. Swine mycobacteriosis causes an approximate $2.5 to 3 million annual loss to the pork production industry and is found in about 0.4% of all swine slaughtered under federal inspection.
2. Economic loss is not due to death or illness of pigs, but is from the loss of carcasses passed for cooking from mycobacteriosis-infected pigs.
3. The primary cause of swine mycobacteriosis is *M. avium*, which also causes tuberculosis in poultry.
4. The source of the infection for pigs may be infected poultry or other birds, uncooked garbage used as feed, the environment (soil, woodshavings), and possibly infected pigs.
5. A good test is not available for diagnosis of mycobacteriosis in the individual live pig. A confirmation of the occurrence of the disease in a herd is best achieved by observation of sites of infection in lymph nodes at slaughter and by examining these lesions microscopically and bacteriologically.
6. Since practical immunization and drug therapy are not available, the disease is best prevented by careful management of the pig's feed and its environment.