Control of Paratuberculosis in Beef Cattle

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KEYWORDS

- Paratuberculosis
- Cattle
- Control
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PREVALENCE

Worldwide, paratuberculosis is less prevalent in beef cattle than in dairy cattle. For this reason, paratuberculosis is considered by some to be a “dairy cattle” disease. While the prevalence of paratuberculosis is less in beef cattle than in dairy cattle, paratuberculosis nevertheless occurs in beef cattle and is a major health and production problem in some herds. Awareness of paratuberculosis among beef cattle producers is generally lower than it is among dairy cattle producers. A study conducted by the National Animal Health Monitoring System (NAHMS) and published in 1997 revealed that nearly 70% of beef producers said they had never heard of paratuberculosis, while a similar study a year earlier showed that only 10% of dairy cattle producers had not heard of the disease.\(^1,2\) Compared to studies of dairy cattle, studies of the prevalence of paratuberculosis of beef cattle are much fewer in number. In the NAHMS study of beef cattle herds in the United States which used the serum enzyme-linked immunosorbent assay (ELISA), only 0.4% of animals had a positive test results.\(^1\) This compares with 2.5% of dairy cattle in a similar study 1 year previously.\(^2\) Among beef herds, 7.9% of herds had at least 1 positive test.\(^1\) This compares to 21.8% of dairy herds.\(^2\) The testing strategy used in this study was designed to identify herds with a prevalence of 10% or greater. In the author’s experience, the prevalence in most extensively reared beef cattle herds is less than 10%. Therefore, the true herd prevalence may have been underestimated in this study. Several smaller and less statistically valid surveys of beef cattle in the United States have been published in the past 20 years. Among these studies, the animal-level seroprevalence of paratuberculosis ranged from 3% to 9.6%, while the herd prevalence based on 1 or more seropositive animals ranged from 34% to 76%.\(^3-6\) There are several biases and potential sources of error in the studies, as most of the herds were self-selected and the seroprevalence was not corrected for test sensitivity and specificity. However, the studies suggest that paratuberculosis does in fact affect a substantial number of beef cattle in the United States. Two
Canadian studies reported an animal prevalence of 0.8% and 1.5% and a herd prevalence of 15.2% and 28.5% for beef cattle.\textsuperscript{7,8}

**ECONOMIC IMPACT**

The economic impact of paratuberculosis on beef cattle has not been accurately estimated. The low within-herd prevalence, along with the paucity of complete records for many beef herds, makes determining the economic impact of paratuberculosis in beef cattle challenging. Losses associated with death, the sale of underweight cattle, and the replacement costs associated with the disease are obvious. It could reasonably be assumed that a decrease in milk production occurs in beef cattle as it does in dairy cattle; therefore, the weight of calves produced by *Mycobacterium avium* subsp. *paratuberculosis* (MAP)–infected cows would likely be lighter. Other less obvious costs might include the potential loss of sales by purebred producers, the cost of litigation, the cost of the loss of very valuable genetic material, the loss of export markets and the loss of consumer confidence. Most of these costs are hidden or opportunity cost, not out-of-pocket losses. Therefore, the motivation to invest in control programs is low for many beef cattle producers. In fact, for most commercial beef cattle producers with low prevalence herds, there is little economic advantage in investing in paratuberculosis control as long as MAP is considered solely an animal pathogen.

**CONTROL STRATEGIES**

Two simple goals are foundational for the control of paratuberculosis in any infected herd of cattle, regardless of type: (1) minimize or eliminate the exposure of susceptible calves to the feces of infected cattle and (2) reduce the environmental contamination by eliminating animals that shed MAP. For uninfected herds, the only control measure needed is biosecurity: do not allow infected cattle to enter the property. These principles are so elegantly simple to articulate and so very difficult to execute consistently due to technological and logistical challenges and the resistance of many producers to accept stringent biosecurity practices.

Control strategies available for beef cattle compared to dairy cattle are different. In order to try to understand the differences, it is important to consider the possible reasons why they exist. Obvious differences between beef and dairy cattle in most parts of the developed world include breed, environmental conditions, feeding practices, and calf-rearing practices. While there is no solid evidence that beef breeds are more, or less, susceptible than dairy breeds, there appear to be differences among beef breeds, at least when serologic prevalence is used as an estimate for MAP infection rate. A higher seroprevalence in Brahman compared to Angus cattle was reported within a moderately sized herd.\textsuperscript{9} Also, among crossbred cattle within the herd, the seroprevalence was positively correlated with the percentage of Brahman in the pedigree. There is substantial evidence of genetic variability to susceptibility to *Mycobacteria* among cattle. Therefore, it stands to reason that breed differences as well as individual genetic differences might exist. In purebred cattle in Texas, a greater seroprevalence was found in *Bos indicus* and *Bos indicus*–influence herds compared to *Bos taurus* herds.\textsuperscript{6} In all of these studies, seropositivity based on a serum ELISA was used to define prevalence. There was evidence of cross-reactivity from environmental mycobacteria in some of the *Bos indicus* herds in the studies.\textsuperscript{10} A possible alternative explanation of the high seroprevalence observed is that *Bos indicus* cattle may be more seroreactive to mycobacterial antigens whether they be MAP or other soil-borne *Mycobacteria*. A recent study has identified certain loci
associated with seroreactivity to MAP in Holstein cattle. This may explain differences in seroprevalence.

The environmental conditions under which most beef cattle are reared differ from those of dairy cattle. It should be noted that the environment of intensively reared beef cattle that are housed in winter, calved in sheds or barns, and held in close confinement may resemble dairy cattle more than it does that of extensively reared beef cattle. Here, the term “beef cattle” should be considered to mean extensively reared beef cattle. Extensively reared beef cow calf herds are fed stored forage less and are grazed more than the majority of dairy cattle in North America. Perhaps the most important difference between beef cattle and dairy cattle when considering the transmission and control of paratuberculosis involves calf-rearing practices. Almost all calves on modern dairies are separated from their dams within 24 hours of birth. Beef calves typically remain with their dams for 6 to 7 months. Consequently, the exposure of beef calves to the manure of mature cattle is much greater on most beef cattle operations than on most dairy cattle operations.

Cognizant of the differences between beef cattle and dairy cattle, we will now explore control practices aimed at reducing the transmission of paratuberculosis among beef cattle. Based on the biology of the organism, the pathogenesis of the disease, and observational and experimental data derived from dairy cattle, it is possible to suggest a number of control measures that should be effective at reducing the transmission of paratuberculosis among beef cattle. Regrettably, there is very little hard evidence that these methods are effective. We are left, therefore, with recommendations that make biological sense but are unproved and cannot be evaluated for cost-effectiveness.

Nursing Calves

Any control program for paratuberculosis in cattle should begin with calves, as they are the most susceptible sector of the population. The potential for control of paratuberculosis in beef herds is limited by the fact that separation of calves from mature cows is not practical. However, any practices that reduce the exposure of calves to the feces of cows is likely to help reduce the transmission of paratuberculosis. Reducing the exposure of calves to the feces of cows can be accomplished using strategies that reduce environmental contamination as well as contamination of feed and water sources. Specifically, the area where calves are born and nursed for the first few months of life can be enlarged. It is important to remember that the “effective” area, not the actual size of the pasture, is the key factor. For example, cattle that have access to a section of land, but have feed, water, and shelter in one corner of the pasture, do not effectively use the entire section. Both environmental contamination and feed contamination can be influenced by the manner in which hay is fed. Most experts now agree that hay from large bales is most effectively used when spread on the ground in amounts that can be consumed in a day or so. Hay rings tend to aggregate cattle and produce muddy areas around the ring during times of precipitation. This leads to mud and fecal contamination of the teats and udder. Researchers have found MAP on the udders of a high proportion of nonshedding beef cows infected in herds where poor sanitation practices were employed. Feeding hay on the side of a hill and moving the feeding area daily is more effective in reducing fecal contamination. Feeding more hay than cattle can consume in 24 hours leads to the transition of hay as feed to hay that cows lie on (eg, hay as bedding). When calves lie down and perhaps nibble on leftover hay that has been contaminated with the feces of mature cattle, the risk of fecal-oral transmission of pathogens increases. It is known that MAP can survive for many months in pond water. Therefore, pond water
could be a source of infection, especially for young calves during their more susceptible period. In a study of risk factors for paratuberculosis in beef cattle, having running streams as a water source reduced the risk of seropositivity in the herd.6

**Postweaning**

After weaning, beef calves are still susceptible to infection with MAP, although less so than are young calves. Weaned calves should be housed or pastured in areas free of the feces of mature cattle. Water and feed sources should also be free of fecal contamination. Because it is now known that some calves shed MAP before reaching maturity, in heavily infected herds the risk of calf-to-calf transmission should be minimized by avoiding overcrowding and optimizing sanitation practices. Ideally, young cattle should remain separated from the mature herd for as long as possible.

While mature cattle are the most resistant to infection with MAP, this resistance can be overcome by massive exposure. Therefore, in heavily infected herds, sanitation practices that reduce fecal contamination to food and water sources of mature cattle should be adopted. These practices should already have been in place for the cow-calf pairs and should be kept in place in the cow herd after weaning.

**Segregation and Culling**

An obvious strategy to help control transmission in beef herds is to immediately cull all clinical cases. Too often, a thin cow is placed in the corral, dewormed, and fed supplemental feed in an attempt to “put some weight on her.” Treatment sometimes leads to an extended stay on the ranch or farm while the slaughter withdrawal time is being observed. Frequently, the corral in which the sick cow is placed is the same corral used to hold weak and sick calves just after calving. In infected herds, any cattle with early signs of possible Johne’s disease (weight loss and diarrhea) should be isolated and tested or culled immediately. The isolation area (sick pen) should not be an area used to hold calves. It is frequently recommended that the last calf from any cow that develops clinical Johne’s disease should be culled. This recommendation is logical because transmission of paratuberculosis can occur in utero, through colostrum, through milk, and via the fecal-oral route, and the calf is in close contact with its dam during its most susceptible period in life. It stands to reason that the risk of dam-to-calf transmission should be much higher in a beef herd than in a dairy herd because beef calves remain with their dams longer. In 1 study, when herd of origin was not considered, a beef calf from a serologically positive cow was more likely to be serologically positive than was a calf from a serologically negative cow.12 However, when the herd of origin was factored in the statistical model in a similar study, a calf born to a seropositive dam was not at higher risk of being seropositive than was a calf from a seronegative dam.13 The findings in these studies suggest that the question of culling calves from infected cows is up for debate. At this time, however, it seems reasonable to cull the last calf from a clinically affected cow with Johne’s disease. This recommendation may gain additional credence as we learn more about the genetic susceptibility and resistance to paratuberculosis. Another recommended strategy for control of paratuberculosis in beef herds is to cull thin cows. Because thin beef cows are typically not reproductively efficient and tend not to wean heavy calves, there are other good reasons to cull them in addition to paratuberculosis.

The value of test-and-cull programs in dairy herds, compared to control programs without testing, has been debated for years. Testing and culling are probably more important in beef herds than in dairy herds. Infected cows cannot be separated from calves, and therefore retaining them in the herd increases the
potential for contamination of the environment and transmission of infection. In some situations it may be feasible to maintain 2 herds: 1 herd of test-positive cattle and 1 herd of test-negative cattle. The wisdom of this practice may depend upon the test used and the interpretation of this test to make decisions for segregation. All cattle that are fecal culture-positive are shedding MAP in feces, at least at the time of testing. Many cattle with a high positive ELISA result also are shedding. However, a smaller proportion of cattle with moderate and low positive ELISA results are shedding MAP due to the biology of the disease and the fact that at lower ELISA values, false-positive ELISAs are more frequent. Therefore, creating a herd of ELISA suspect, low-positive, and moderate-positive cows makes more sense than a herd of ELISA strong-positive or fecal culture-positive cows. Strong ELISA-positive and fecal culture-positive cattle can be collected for germ plasma (semen and embryos) with little risk of transmission to the offspring.

**BIOSECURITY**

Producers with infected herds should make every effort to keep their herds uninfected. Very few beef cattle are marketed with information about the paratuberculosis status of the animal or the herd. If information is not provided, buyers should ask sellers about the paratuberculosis status of their herd. Ideally, animals should be purchased only from very low-risk, test-negative herds participating in an official paratuberculosis control program. These herds, however, are not numerous. In some situations, in some areas and in some breeds, it is probably better to purchase cattle from a known infected herd with a good control program, good records, and a low prevalence than from a herd in which the paratuberculosis status is unknown or, perhaps more appropriately stated, “undisclosed.” For a more complete discussion on testing strategies, refer to the Diagnosis. Beef cattle producers should be particularly cautious when purchasing embryo transfer recipients and nurse cattle. These are frequently dairy or dairy cross animals. Because the prevalence of paratuberculosis is greater in dairy cattle, the risk of introducing the disease into a beef herd is greater when these cattle are added to the herd. Another potential break in biosecurity is the acquisition of colostrum, especially from dairy herds. High-quality, safe, and effective commercial dry colostrum substitutes are now available, obviating the need for frozen colostrum from other farms. The Voluntary Bovine Johne's Disease Control Program managed by USDA-APHIS was established in the 1990s to help producers control paratuberculosis in their herds. An excellent risk assessment tool is available online at http://www.aphis.usda.gov/animal_health/animal_diseases/johnes/downloads/johnes-umr.pdf.

**REFERENCES**


