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The seroprevalence of Johne's disease in Georgia beef and dairy cull cattle

Mel Pence, Charles Baldwin, C. Carter Black III

Abstract. Beef and dairy cattle serum samples, collected during 2000 at sale barns throughout Georgia, were obtained from the Georgia State Brucellosis Laboratory and were used to conduct a retrospective epidemiological study. Statistical samplings of 5,307 sera, from over 200,000 sera, were tested for antibodies to *Mycobacterium avium* ssp. *paratuberculosis*, (Johne's disease) using a commercial enzyme-linked immunosorbent assay test kit. An overall period seroprevalence in all classes of cattle tested was 4.73%. The period seroprevalence in dairy cattle was 9.58%, in beef cattle it was 3.95%, and in cattle of unknown breed it was 4.72%. It was concluded that the seroprevalence of Johne's disease in cull beef and dairy cattle in Georgia is economically significant.

Johne's disease is a chronic, progressive enteric disease of ruminants caused by *Mycobacterium avium* ssp. *paratuberculosis* infection.¹² Johne's disease causes major economic losses to the cattle industry.⁹ Calves may be infected in utero or as neonates. After a prolonged incubation period of 2–10 years, initial clinical signs may develop, including severe progressive diarrhea and gradual weight loss despite the persistence of a normal appetite.¹⁰ Typically, the infection develops in the ileum and gradually spreads to regional lymph nodes and other viscera. Over time, cattle become lethargic and emaciated, and in the terminal stages of disease, exhibit cachexia and severe watery diarrhea.¹⁰

No studies regarding the prevalence of Johne's disease in individual cows were available for the Georgia cattle industry. In a 1990 survey, the seroprevalence of Johne's disease in Florida was estimated to be 17.1% in dairy cattle and 8.6% in beef cattle.² Herd prevalence data are available from the National Animal Health Monitoring System (NAHMS) database. According to the data from the NAHMS Beef 1997 study, it was estimated that 7.9% of US beef herds had

1 or more enzyme-linked immunosorbent assay (ELISA)-positive cows.⁶ The NAHMS Dairy 1996 study estimated that 21.6% of all US dairies had 1 or more ELISA-positive cows in the herd.³ These herd prevalence studies clearly demonstrate that Johne's disease severely affects both the beef and the dairy industries.

The increasing prevalence of Johne's disease causes the beef and dairy industries and regulatory officials to struggle with how best to address this disease. Economic costs to the cattle industry include loss of genetic base, decreased production due to lowered milk production, decreased cull weight of breeding cattle, increased culling rates, decreased fertility, and increased costs of diagnostic testing. The NAHMS Dairy 1996 study estimated the average annual loss due to Johne's disease infection to be \$227 per cow in herds in which 10% of the cull cows had clinical signs of Johne's disease. Although the economic impact of Johne's disease on the national cattle industry has not been determined, estimates of losses in the dairy industry are approximately \$1.5 billion annually.^{8,12} These findings establish that Johne's disease is a significant problem for both the beef and dairy cattle industries.

A link between Johne's disease and Crohn's disease in humans has been proposed, but there is considerable controversy over whether sufficient conclusive scien-

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tific evidence is present to support the link at this time.⁴ If, however, consumers perceive it to be a problem or if it is proven that this link exists, the reduction of the prevalence, or the eradication of Johne's disease, or both, in cattle will be critical issues for our dairy and beef industries.

The results of risk analysis of Johne's disease show that the hazard to a cattle production unit is the transmission of disease from a Johne's disease-positive animal to a Johne's disease-negative animal. Most herd infections occur after the addition of a Johne's disease-positive animal to the herd (M. T. Collins, in Proceedings of AABP, 1998). *Mycobacterium avium* ssp., *paratuberculosis*, the causative microorganism of Johne's disease, is shed in feces, semen, colostrum, and milk, as well as transmitted in utero.⁷ Cattle are most commonly infected as neonatal calves or while in utero.¹¹ Consequently, the critical control points for Johne's disease infection are introduction of infected cattle and transmission from an infected dam to a non-infected calf (National Johne's Working Group Education Subcommittee: Johne's disease information packet, Oct 1998). Incoming, newly purchased cattle should originate from a Johne's disease-free herd. If that is not possible, then incoming cattle should be isolated from the herd until they test negative for Johne's disease before being commingled with the herd. Herd additions that do not originate from a Johne's disease-free herd should be confirmed culture-negative for Johne's disease on a yearly basis.

In future, Johne's disease may become a candidate for an eradication program in individual states due to the economic costs to the state's cattle industry and potential zoonotic implications. The first step in preparing for such a program is to evaluate disease prevalence.

The prevalence of Johne's disease in Georgia was estimated using serum samples obtained from cull cows and bulls obtained from the Georgia Department of Agriculture Brucellosis Laboratory. The Georgia Department of Agriculture obtained serum from the entire population of cull cows and bulls (approximately 200,000) from June 1999 through June 2000 at sale barns throughout Georgia. These samples were identified by sex, market where collected, and most were identified by cattle type (dairy or beef) and age. The serum was collected in boxes of 40 or fewer samples, boxes were selected randomly and a Johne's disease ELISA^a test was run on each fifth serum sample from the randomly selected boxes. The random sampling of the 5,307 serum samples, representing approximately 200,000 cull cattle samples, resulted in a greater than 99% confidence level of identifying a 0.5% or greater period seroprevalence.^b These 5,307 samples were then sent via state courier from the Georgia State Brucel-

Table 1. Results of Johne's disease ELISA by breed type.

Breed	Beef	Dairy	Unknown	Total
Total tested	3,950	637	720	5,307
ELISA positive	156	61	34	251
ELISA negative	3,794	576	686	5,056
Period prevalence	3.95%	9.58%	4.72%	4.73%

losis Laboratory in Atlanta, Georgia, to the Veterinary Diagnostic and Investigational Laboratory in Tifton, Georgia, where a Johne's disease ELISA test was performed on the serum samples following the procedures and protocol recommended by the manufacturer.

A total of 251 of the sera tested positive for antibodies against *M. paratuberculosis*; 5,056 samples were negative for a total period prevalence of 4.73%. When the results were categorized by breed (dairy/beef/unknown), 61 dairy animals were positive and 576 negative for a dairy period prevalence of 9.58%; 156 beef animals were positive and 3,794 negative for a beef period prevalence of 3.95%; and 34 unknown type animals were positive and 686 negative for an unknown type period prevalence of 4.72%. (See Table 1).

The ability to identify a truly positive *M. avium* ssp., *paratuberculosis* bovine is limited because latent infections occur, and serum antibodies are not significantly increased to result in a positive ELISA until late in the disease process. Estimates of the sensitivity of the commercial test used range from 11% in early sub-clinical infections to over 90% in the terminal stages of disease with an average sensitivity of about 50%.^{1,5} If the majority of the sampled cattle were culled because of lack of production and reproductive failure and not due to clinical Johne's disease, then the sensitivity of the ELISA in this serosurvey could be assumed to be low. However, when generalizing to the Georgia cattle population, one might anticipate that the true prevalence in the study population may be higher than that in the general cattle population because clinically affected cattle is more likely to be culled. An estimate of the test sensitivity at 50% might be considered appropriate in this test cattle population. In 2000, the Georgia cattle industry consisted of 620,000 beef cows and 90,000 dairy cows. With 3.95% of the beef cattle and 9.58% of the dairy cattle affected by Johne's disease, at least 24,490 beef cattle and 8,622 dairy cattle were infected with Johne's disease in Georgia in 2000. Using an average sensitivity of 50% for the ELISA test,^{1,5} these figures would double, suggesting that 48,980 beef cattle and 17,244 dairy cattle in Georgia were infected during 2000.

The estimated losses due to Johne's disease (lost production, loss of genetics, and decreased slaughter value) were \$75–\$100 per adult beef cow in the herd.²

Using the seroprevalence figures developed in the survey (24,490–48,980 beef cattle were infected with Johne's in Georgia during 2000), it was found that Johne's infection cost Georgia beef producers \$1,836,750–\$4,898,000 during 2000. Losses caused by Johne's disease in dairy cattle are estimated at \$40–\$227 per cow³. Using the seroprevalence figures developed in the survey (8,622–17,244 dairy cattle in Georgia during 2000), it was found that Johne's infection cost Georgia dairy producers \$344,880–\$3,914,388 during 2000. Therefore, using the most conservative estimates of period prevalence and financial losses, it was found that Johne's disease cost the Georgia beef and dairy industries \$2,181,630 during 2000. Using the higher estimates of period prevalence and economic impact of Johne's disease, it was found that the Georgia beef and dairy industries lost \$8,812,388 in 2000.

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Sources and manufacturers

- a. HerdChek® M. pt. *Mycobacterium paratuberculosis* Antibody Test Kit, IDEXX, Westbrook, ME.
- b. Epi Info. Department of Health and Human Services, Centers for Disease Control and Prevention, Atlanta, GA.

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