

Johne's disease in beef cattle: Correlation of serum ELISA and fecal PCR results from clinical cases and herd surveillance

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Introduction

Johne's disease is caused by *Mycobacterium avium* ssp. paratuberculosis (MAP) and can be a costly and frustrating disease in beef herds. Clinical Johne's disease in cattle arises years after inoculation as diarrhea and progressive weight loss. Prior to reaching clinical status, subclinically infected cattle can shed bacteria into their environment, leading to continued spread of the disease within herds. The duration of subclinical infection is highly variable, and the humoral immune response and the amount of fecal shedding of MAP can vary greatly between individuals and throughout the year. Currently available diagnostic tests (serum ELISA, fecal PCR, fecal culture) each have significant limitations. Assays may differ in their utility depending on whether they are used to confirm clinical cases of Johne's disease or to screen healthy cattle for potential infection.

Materials and methods

Data for this study was compiled from two sources: 1) a retrospective search of all bovine case submissions with paired fecal PCR and serology for MAP to the Iowa State University Veterinary Diagnostic Laboratory (ISU-VDL) from 2015-2020, and 2) a funded project that covered the cost of MAP serum ELISA testing in beef herds that were actively performing herd surveillance via pooled fecal PCR testing at the ISU-VDL during 2016-2020. Results from both clinically suspect and surveillance testing of beef animals were included in this data analysis; samples with strong evidence for potential false positives due to contamination were excluded from the analysis. Serum ELISA results were stratified based on S/P ratio, and PCR results were stratified based on Ct value.

Results

A total of 5,115 paired samples were analyzed; overall positivity rate as determined by a positive on 1 or both tests was low (2.47%). The probability of a fecal PCR positive increased as the serum ELISA S/P ratio increased. Conversely, the probability of a serum ELISA positive increased as the fecal PCR Ct value decreased. Eighty out of 98 cattle (81.6%) with serum S/P ratios over 1.2 were positive by fecal PCR at the time of testing. However, when this group was limited to non-surveillance (i.e. clinical) samples only, 47 out of 50 cattle (94.0%) with S/P > 1.2 were positive by fecal PCR. In samples submitted for surveillance testing, 97.4% of serum samples were negative; only 2 positive and 7 suspect fecal PCR results were detected in seronegative cows. Cattle with low-positive and suspect (S/P 0.45-1.2) serum ELISA results were rarely positive by fecal PCR, indicating that

the vast majority of these cattle were not shedding detectable levels of MAP at the time of testing. Follow up testing on several of these cattle was available, and results were highly variable; some had increasing antibody levels and eventual PCR positive feces, others became seronegative and remained negative on fecal PCR.

Significance

Our results indicate that when compared to fecal PCR, serum ELISA testing remains a cost-effective and useful test in beef cow-calf operations to help identify a subset of higher-risk cattle in the herd. Depending on the goals of the herd, this may allow resources (e.g., fecal PCR testing) and husbandry practices devoted to controlling Johne's disease (calving area size, neonatal calf management, pasture selection, retention of breeding stock) to be focused on the highest risk cattle rather than spread over the entire herd. Future studies are needed to assess the variability of antibody dynamics over time in individual cattle through serial testing, and to investigate potential biomarkers that may allow earlier and/or more accurate detection of infected cattle.

