

Project

Unraveling the genetic susceptibility to Johne's disease



Principal Investigators:

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National Dairy Research Strategy investment priorities targeted:

- Dairy cattle genetic improvement (disease resistance)
- Strategies to mitigate targeted infectious diseases (paratuberculosis)

PERIOD: 2018-2022

TOTAL BUDGET: \$1,019,988

Why this research is important:

Paratuberculosis, also known as Johne's disease, is a progressive, chronic inflammatory disease that affects the gastrointestinal tract of ruminants caused by infection with *Mycobacterium avium subspecies paratuberculosis* (MAP) and impacts animal health and dairy farm profitability. Johne's disease can result in financial losses for a farmer due to reduced milk production and increased risk of premature culling. Annual losses for the Canadian dairy sector due to Johne's disease has been estimated at \$90 million. Controlling Johne's disease is difficult due to unpredictable disease progression and weak sensitivity of diagnostic tests in some animals that may look healthy but can shed the bacterium and transmit the disease. There is increasing evidence of genetic resistance to the infection in cattle that could be exploited to complement other farm management strategies.

The researchers believe that through the discovery of genetic markers associated with Johne's disease susceptibility or resistance, more knowledge can be gained, and genetic improvement achieved to increase animals' genetic resistance and eliminate shedding animals transmitting the pathogen in a herd. A characterization of strain diversity in Canadian dairy herds could help provide insight into Johne's disease and contribute to develop diagnostic tools and vaccines for better disease management.

Research objectives:

- Identify genetic and epigenetic markers associated with Johne's disease resistance and susceptibility in cows using an extensive collection of high-quality phenotypes; and,
- Examine the prevalence of mixed genotype of MAP strains in paratuberculosis infections to determine if the nature of the strains could impact diagnostic tests or disease progression.

Project overview:

In previous research by Dr. Bissonnette and collaborators, techniques were developed to identify farms with different disease prevalence and create sampling approaches used to build an extensive data set required for genetic analysis. Preliminary genetic analysis on a small subset of animals using these data has already led to the identification of novel regions of the genome associated with resistance to Johne's disease.

Using repeated serum and fecal samples collected from over 3,150 cows during a longitudinal study, we determined with accuracy the development of paratuberculosis over time. This new research project will use these results, along with an additional diagnostic test to be performed on the same samples, to classify the animals as infected and infectious, infected and assumed resistant, or healthy. Genotyping of the cows using two proven genetic testing methods, Single nucleotide polymorphisms (SNP) panel and genotyping-by-sequencing, will help identify genetic markers and genes associated with susceptibility to Johne's disease. Epigenetic regulation of gene expression will also be profiled in infected and healthy animals. In addition, the genetic diversity of MAP strains from animals presenting different disease progression will be characterized using molecular tools. Analyses will be performed to define which factors, including the genotype of the strain and the existence of multiple strains, affect the performance of diagnostic tests and could explain disease progression.

Expected outcomes:

The identification of new genetic markers associated with Johne's disease to improve natural disease resistance through genetic selection and a strengthened understanding of the epidemiology and host-pathogen relationship will support the development of diagnostic tools and vaccines.

The participation of eight Canadian dairy farms will contribute to the successful completion of the project.

FUNDING PARTNERS:



In-kind contribution provided by:



NOTE: As per the research agreement, aside from providing financial support, the funders have no decision-making role in the design and conduct of the studies, data collection and analysis or interpretation of the data. Researchers maintain independence in conducting their studies, own their data, and report the outcomes regardless of the results. The decision to publish the findings rests solely with the researchers.