

## **Project: Brucellosis Vaccines for Livestock and Bison**

**Brief Description:** MSU will aid in eliminating the threat of brucellosis infections in livestock and wildlife through the development of effective new vaccines and delivery systems.

**Executive Summary:** The presence of *Brucella abortus* in the wildlife of Yellowstone National Park (YNP) poses a continuous threat to the livestock bordering YNP (Montana, Idaho, and Wyoming), as evident by recent outbreaks of brucellosis and the loss of brucellosis-free status (MT). The loss of livestock calves through abortion caused by infection with this microorganism and contamination of the human milk supply threatens the economic base of surrounding states. Continued exposure will compromise the multimillion dollar investments of these states to obtain their brucellosis-free status, thus, devastating the livestock market. These states have endured significant declines for cattle from this region because of these outbreaks. Aside from being problematic for livestock and wildlife, *B. abortus* also can be contracted by humans, causing an undulating fever and prolonged incapacitating fatigue, arthritis, and endocarditis.

To address this threat, adequate management measures need to be taken toward infection in the wildlife of YNP, or interventions need to be made to improve protection for at risk livestock. In either scenario, better brucellosis vaccines would be required. Unfortunately, there are no available wildlife or human vaccines, and the commercial livestock vaccines show poor or no efficacy in wildlife. Even revaccination of livestock with current vaccines has done little to improve herd immunity. Current funding has enabled MSU investigators to develop promising vaccines as well as to understand mechanisms of host protection against *B. abortus*. Three areas of intensive investigation are proposed: (1) develop an improved live *B. abortus* vaccine using a time-release technology to sustain longer immunization; (2) address the differences in innate immunity between bison versus cattle to aid in understanding *B. abortus* persistence; and (3) adapt innate immune modulators to help prevent *B. abortus* infections. These approaches will accelerate the development of methods to optimize livestock and bison immune responses to the brucellosis vaccine.

This request is to refine and simplify these vaccines for adaption to bison and livestock. Past research has already enabled the rapid development of a protective brucellosis vaccine in bison. Favorable results show the research feasibility; however, additional testing will be required to develop efficacious vaccines by optimizing dose and vaccine regimen.

**Congressional Action Needed:** An appropriation of \$500,000 is requested.

**Importance to Montana:** *B. abortus* is a communicable disease that has already affected Montana's livestock industry and will continue to pose future threats until improved vaccines are developed. Montana must regain its *Brucella*-free status to support the livestock industry. Furthermore, the presence of *Brucella abortus* in YNP poses a biosafety hazard to tourists that could impact the state's tourism industry, particularly, for southwestern Montana. Thus, efforts spearheaded by MSU are warranted, and the development of novel vaccines and study of livestock and bison immune responses will have a tremendously positive impact for Montana agriculture.

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## Brucellosis Vaccines for Livestock and Bison – Talking Points

- In this past year, Montana has lost its brucellosis-free status because of the recent outbreak of brucellosis in cattle from Carbon County. Loss of this status has compromised the ability of Montana beef producers to sell and transport their beef cattle. Dairy producers must increase the frequency of milk testing for brucellosis.
- Because of this outbreak, the reputation of Montana beef has been tainted, and all beef will be impacted. This has resulted in the devaluation of Montana beef.
- As long as there is free migration of infected bison or ungulates from YNP into Montana, a threat to maintaining our brucellosis-free status will continue.
- A new vaccine candidate for livestock that is >200-fold more protective in experimental animals than RB51 has been developed. A second mutation has been introduced to further cripple this live vaccine, and current studies are evaluating this vaccine's performance.
- A "sweet lick" vaccine is being developed to shut off live vaccine viability in the host as a means to regulate immunity induced to *B. abortus*.
- A DNA brucellosis vaccine (a composite of 65 different components) has been tested in bison yearlings and shown to protect 75% of the challenged bison. This composite vaccine is currently being modified to enhance its potency.
- A portion of the identified vaccine candidates is protective in a lethal brucellosis model.
- Studies are focused on understanding innate immunity in bison to eventually help identify suitable adjuvants that enhance vaccine responses in bison.
- Immune response genes not stimulated during bison brucellosis infections have been identified. These genes may account for lack of vaccine efficacy by conventional livestock vaccines.