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The association between *Mycobacterium avium* subsp. *paratuberculosis* fecal shedding or clinical Johne's disease and lactation performance on two Minnesota, USA dairy farms

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Abstract

Lactation performance of cows infected with *Mycobacterium avium* subsp. *paratuberculosis* (Map) was previously studied using only serum ELISA as a diagnostic method. This study evaluated on two dairy farms in Minnesota, USA the lactation performance (measures of health, production, reproduction, and survival) of cows shedding Map in feces before calving and of cows culled with clinical signs consistent with Johne's disease (JD) during the subsequent lactation. Fecal samples were collected from 1052 cows within 21 day before calving and tested for Map with bacterial culture. Producers' observed signs of clinical disease (milk fever, retained placenta, metritis, ketosis, displaced abomasum, lameness, mastitis, pneumonia, and JD) and production and reproduction data were recorded for each cow. The association between fecal shedding or clinical JD and lactation performance was evaluated. Logistic regression was used to evaluate the association with any clinical and subclinical diseases as the outcome. General linear model was used to evaluate the association with milk production, and survival analysis techniques were used to evaluate the association with days in the study before culling and days from calving to conception. In 84 cows (8% of 1052 cows) fecal samples were positive for Map (46% light, 26% moderate, and 28% heavy shedders). In

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multivariable analysis, light, moderate, and heavy fecal shedding cows produced on average 537, 1403, and 1534 kg, respectively, less milk per lactation and 1.4, 5.2, and 7.5 kg, respectively, less milk per day than fecal negative cows. Fecal culture positive cows were less likely to be bred and conceive. In the multivariable analysis the 56 cows culled with presumed JD produced approximately 1500 kg/lactation or 5 kg/day less than all other cows. The negative economic impact implied by decreased lactation performance in cows shedding Map or with clinical JD may motivate producers to implement programs to control Map infection and subsequent JD.

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1. Introduction

Johne's disease (JD), a chronic and progressive intestinal disease in ruminants caused by *Mycobacterium avium* subsp. *paratuberculosis* (Map), imposes large direct and indirect productivity losses on affected farms (Bennett et al., 1999; Chi et al., 2002). Production losses include reduced milk production, increased mortality, weight loss, premature culling, and reduced slaughter value (Chiodini et al., 1984).

Infection with Map in cattle can be categorized into four stages (Sweeney, 1996). In stage 1, cattle are infected though no clinical signs are observed and Map cannot be detected in feces. In cattle in stage 2, Map can be detected in feces though clinical signs of disease are not evident. Cattle may remain in these stages without developing clinical disease or may progress to clinical stages, typically after at least 2 years of infection. Fecal shedding of Map can be intermittent and its detection in culture is imperfect, especially when few organisms are shed in the feces (Merkal et al., 1968). Stage 3 cattle have observable clinical signs with weight loss and diarrhea, sometimes advancing to stage 4 with advanced clinical disease signs including lethargy, emaciation, and profuse diarrhea. Development of clinical signs is generally gradual and varies among individuals.

The scientific literature provides limited information about the impact of Map shedding in dairy cattle on lactation performance, including the attributable reduction of milk production and productive longevity in the herd due to clinical and subclinical JD. Buergelt and Duncan (1978) suggested that Map infected cows are removed from the herd earlier in life than their non-infected herdmates. Many cattle with JD are culled due to poor production even before a diagnosis of JD is confirmed, especially in freestall housing where an individual cow's manure consistency is less obvious than in tiestall housing (Rebhun, 1995). Although several studies have considered the effect of JD on culling rate (Hendrick et al., 2005; Tiwari et al., 2005), none have addressed the impact of subclinical JD or fecal shedding level on the survival of the cow in the herd.

Because of its economic importance, the impact of JD on milk production has been the most commonly evaluated. Most studies have shown that test-positive cows produce between 2 and 17% less milk than their negative herdmates (Abbas et al., 1983; Benedictus et al., 1987; Sweeney et al., 1994; Nordlund et al., 1996; Ott et al., 1999; Johnson-Ifeorulundu et al., 2001; Lombard et al., 2005), though the diagnostic test and the definition

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