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Influences of season, parity, lactation, udder area, milk yield, and clinical symptoms on intramammary infection in dairy cows

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ABSTRACT

The aim of this study was to evaluate the influences of season, parity, lactation, udder area, milk yield, and clinical symptoms on bacterial intramammary infection (IMI) in dairy cows. A total of 2,106 mastitis pathogens in 12 species were isolated from 125 dairy farms distributed in 30 different cities in China, and the information about these factors was recorded at the same time. Mastitis pathogens were isolated from 63.43% of the milk samples, whereas *Streptococcus agalactiae* accounted for 38.61% of all pathogens, followed by *Str. dysgalactiae* (28.16%), *Staphylococcus aureus* (19.10%), *Escherichia coli* (6.90%), and other pathogens (7.23%). According to our investigation, IMI was more common in spring with the isolation rate of pathogens at 81.04%, and lowest in winter (52.34%). Cows were more likely to be infected by environmental pathogens (*E. coli* or *Str. uberis*) in summer, in rear quarters and in cows with higher daily milk yield or lower somatic cell count. In addition, *Str. dysgalactiae* exhibited a higher prevalence with increased parity. Different clinical symptoms of quarters with bacterial IMI were seen in this study, and mastitis pathogens were isolated from healthy quarters.
Key words: intramammary infection, pathogen, relationship, bovine mastitis

INTRODUCTION

Dairy cow mastitis is a serious disease associated with both high incidence (van den Borne et al., 2010) and economic losses (Holland et al., 2015), posing a major challenge to the dairy industry (Boboš et al., 2013; Leelahapongsathon et al., 2014). There are approximately 220 million dairy cattle worldwide. The incidence of clinical mastitis (**CM**) is estimated to range between 16 and 48 cases per 100 cows (Kvapilik et al., 2014), and the prevalence of subclinical mastitis (**SCM**) is reported to be 20 to 80% globally (Kivaria, 2006; Contreras and Rodríguez, 2011). Research has demonstrated a wide range in the cost of mastitis, ranging from $16.43 to $572.19 per cow (Holland et al., 2015). Beside the financial implications of mastitis, the importance of mastitis with respect to public health should not be overlooked (Bradley, 2002). Milk from cows with mastitis accidentally mixed into bulk milk enters the food chain and has the potential to transmit pathogenic organisms and antibiotic residues to humans (Hameed et al., 2007). In addition, the extensive use of antibiotics to both prevent and treat mastitis likely contributes to the rise in antimicrobial resistance in the management of human infectious diseases (Leblanc et al., 2006).

Mastitis is complex, developing as a result of the interaction between various factors associated with the host, specific pathogens, environment, and management (Demme and Abegaz, 2015; Rashad et al., 2016). Over 200 different organisms have been recorded to cause bovine mastitis (Blowey and Edmondson, 2010). However, IMI is mostly caused by a much smaller range of pathogens. A better understanding of the prevalence and distribution of the major mastitis pathogens is important for the dairy industry to help guide specific control measures (Piessens et al., 2011).

According to the data from National Bureau of Statistics of the People's Republic of China, approximately 15 million dairy cattle are present in China (Li et al., 2015). The incidence of mastitis was estimated to range between 16 and 75 cases per 100 cows. Annual losses associated with bovine mastitis were estimated to be 15 to 45 billion yuan, accounting for 38% of total direct costs related to dairy cattle health (Song and Yang, 2010; Memon, 2013). Although a great deal of research has been performed concerning various aspects of bovine mastitis in China, studies on the correlation between IMI and factors such as season, parity, lactation, and so on have not been reported. This study aimed to eluci-

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date the prevalence of mastitis pathogens, identify the relationship between IMI and these factors and SCC, test for pathogens in samples from healthy cows, and provide information that can be used in bovine mastitis control programs.

MATERIALS AND METHODS

Herds and Cows

Data from 125 dairy farms distributed in 30 different cities in China were included in this study (Figure 1). The cows were primarily major China Holstein (hybrid of Holstein and Yellow cattle), and were housed in either a free stall or a tie stall with straw, sawdust, or something others as bedding. Most farms used the bucket-type milking machines for milking cows twice daily and postmilking teat disinfection and selective dry cow therapy based on udder health status. The mean herd size of the study herds was 553 cows, with an average production of 5,862 kg of milk/cow per year.

Sampling and Processing

Before sampling, the first streams of milk were discarded, and teat ends were disinfected with cotton swabs soaked in 75% alcohol and allowed to dry. A total of 3,134 milk samples were collected from 3,072 dairy cattle and samples (n = 2,493) without evidence of CM were performed by Lanzhou Mastitis Test (**LMT**; scored at −, ± , +, ++, and +++, corresponding to negative, suspicious, weak positive, positive, and strong positive, respectively; Liu et al., 1983). The LMT is a diagnostic method of SCM, which is similar to the California Mastitis Test.

Samples of CM (n = 641), SCM (n = 1,808, LMT score at +, ++, or +++), and healthy cows (n = 685, LMT score at − or ±) were placed on ice and transported to the laboratory within 6 h of collection for bacteriological studies. Information regarding season, parity, lactation, udder area, milk yield, and clinical symptoms were recorded at the same time. Not all samples contain information as mentioned above because

Figure 1. Distribution of cities in China involved in this study.