

Methicillin-resistant *Staphylococcus aureus* in Bulk-tank Milk on U.S. Dairy Operations, 2007

Background

Methicillin-resistant *Staphylococcus aureus* (MRSA) first emerged in hospitals during the 1970s and has recently become a worldwide public health problem. It remains a major cause of hospital-acquired infections in humans. In addition, community-acquired MRSA has also become a major concern.¹ Currently, increasing evidence points to domestic animals—including food animals—as reservoirs and shedders of MRSA, and transmission between host species may be possible.² Over the past decade, a growing number of MRSA isolates have been reported in companion and food animals and in their human associates, including pet owners, farmers, and veterinary personnel. MRSA has been detected in dogs, cats, horses, pigs, sheep, goats, rabbits, chickens, exotic species, and milk from cows with mastitis.^{3,4}

Recent studies have shown genetic similarity between MRSA isolates from food animals—including dairy cows—to those in humans, suggesting transmission between the species.^{5,6} MRSA infections in dairy cattle have been ascribed to human-to-animal transfer, but the directionality of transmission is not always known.^{6,7}

Although *S. aureus* is a common mastitis pathogen and among the leading causes of foodborne bacterial infections,⁸ MRSA appears to be relatively rare in foods originating from animals, and there is little evidence to suggest that MRSA is common in milk. Two studies detected MRSA in less than 1 percent of meat, milk, and cheese samples.^{3,8} Pasteurization significantly reduces the risk of MRSA transmission via dairy products, and most reported instances of foodborne MRSA outbreaks have occurred through contamination by infected food handlers, rather than the food itself.^{9,10}

An analysis of 2,778 *S. aureus* isolates from milk samples submitted to diagnostic laboratories in Michigan from 1994 to 2000 showed no increased resistance of mastitis isolates to antimicrobials (including oxacillin) commonly used in dairy cattle.¹¹ Among 357 *S. aureus* isolates recovered from milk in North Carolina, antimicrobial resistance was uncommon, and resistance to oxacillin was not detected.¹²

Dairy 2007 study

In 2007, the U.S. Department of Agriculture's (USDA) National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study. The study was conducted in 17 of the Nation's major dairy States* representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows.

One objective of the study was to evaluate the occurrence of MRSA in bulk-tank milk from dairy operations. Operations with 30 or more cows that had completed the initial study questionnaire were eligible for bulk-tank milk sampling and testing for MRSA.

Sample collection and testing

To estimate the prevalence of mastitis pathogens and the occurrence of MRSA, a single bulk-tank-milk sample was collected from each of 542 participating operations. Samples were shipped overnight on ice to Quality Milk Production Services (QMPS) bacteriology laboratory for evaluation using routine testing methods.¹³ After the samples were cultured for the presence of mastitis pathogens, *S. aureus*-positive samples (n=218) were stored at -20°C for 4 weeks to 4 months, until further processing.

To detect MRSA in bulk-tank milk, phenotypic and genotypic methods were used. Phenotypic detection was based on plating of stored milk samples on a selective indicator media, CHROMagar™ MRSA.¹⁵ In a parallel assay, the thawed milk samples were plated on blood agar to obtain multiple staphylococcal-like colonies. Suspensions of these colonies, which might have contained mixtures of *S. aureus* strains and coagulase negative staphylococci, were used for subsequent genotypic detection of MRSA based on polymerase chain reaction using *S. aureus* and *mecA* specific primer sets.^{16,17} The *nuc* gene is specific for *S. aureus* while the *mecA* gene is responsible for conferring methicillin resistance. When *mecA* was identified in a colony suspension, efforts were made to identify individual *mecA* positive bacteria on the blood agar plates.

Results

Of the 218 milk samples that were originally *S. aureus*-positive, 190 were culture positive on blood agar after storage at -20°C; however, MRSA was not

* States/Regions:

- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

detected in these samples tested on CHROMagar. *MecA* was detected in nine colony suspensions from blood agar, twice in the absence of nuc and seven times in combination with nuc-positive. Detection of *mecA* in these samples can be due to the presence of methicillin-resistant *Staphylococcus* spp. other than *S. aureus*. In one study, methicillin resistance was found to be more common in nonaureus staphylococci from milk samples than in *S. aureus*.¹⁸ Through analysis of individual colonies from nine bulk-tank milk samples, methicillin-resistant *Staphylococcus* spp. (but not MRSA) were obtained from five samples. From the remaining four samples, no methicillin-resistant colonies were obtained.¹⁹

Conclusion

MRSA could not be detected in a nationally representative sample of bulk-tank milk from the NAHMS Dairy 2007 study using phenotypic and genotypic methods, suggesting that bulk-tank milk in the United States is not a common source of MRSA. However, in an extremely small number of bulk-tank samples (less than .02 percent), methicillin resistance was identified in *Staphylococcus* spp. other than *S. aureus*.

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