

Antimicrobial resistance and mastitis classification of pathogens in small ruminant mastitis

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Introduction

Mastitis is an important disease of small ruminants (SR) that results in substantial morbidity, mortality, and economic losses from treatment or loss of product. There is currently little information on SR mastitis pathogens or antimicrobial sensitivity in U.S. populations. This study 1) identifies breed, age, production use and stage of lactation of SR diagnosed with mastitis at a veterinary teaching hospital (VTH); 2) characterizes bacterial species and antimicrobial sensitivity in SR mastitis; and 3) classifies SR mastitis into peracute, acute, subclinical and chronic, and correlates with bacterial isolates.

Materials and methods

The UC Davis VTH medical records were searched using: keyword – mastitis and procedure – aerobic milk culture. We collected data from 84 cases of mastitis in goats (74) and sheep (10) between 2012 and 2022. Each case was evaluated for patient history, physical examination (PE) findings, milk cultures, pathologic diagnoses and short-term outcome. Cases were classified as follows: peracute – abnormal udder and severe systemic illness; acute – abnormal udder but no/minimal signs of systemic illness; subclinical – no physical abnormalities of the udder, but elevated California mastitis test (CMT); and chronic – presence of fibrous, non-productive tissue and/or udder abscessation. Data for antimicrobial sensitivity evaluation of milk bacterial isolates from SR were collected using the VTH's microbiology database. Statistics were mostly descriptive, reporting percentage and population proportions. Median age was calculated and a Kruskal-Wallis test used to assess age differences.

Results

The distribution of production use in goats was 65% (49/74) dairy, 8% (6/74) meat, 12% (9/74) pet, 7% (5/74) sanctuary, and 7% (5/74) unknown. Among the dairy goats, 78% (38/49) were milked, 20% (10/49) were nursing young and 2% (1/49) were dry. Among the meat goats, 67% (4/6) were nursing young, and 33% (2/6) were dry. Among pet goats 11% (1/9) were nursing young, and 89% (8/9) were dry. All sanctuary goats were dry. In sheep, 30% (3/10) were nursing young, 50% (5/10) were dry, and 20% (2/10) were of unknown lactation stage. The median dairy goat age (2y, range 1-10) was significantly less than of pet goats (6.5y, range 3-13, $P = 0.002$).

Staphylococci were the most common pathogen isolated from both sheep and goats. *S. aureus* comprised 85% (11/13) of Staphylococci from sheep and 33% (22/66) from goats. Coagulase negative staph (CNS) was more common than *S. aureus* in goats at 67% (44/66) of Staphylococci. Pasteurellaceae and coliforms were the second most common bacterial isolates in sheep and goats, respectively. Classification of clinical infections were peracute 35% (29/84), acute (43%, 37/84), subclinical (7%, 6/84), and chronic (12%, 10/84). The most common peracute pathogens were *S. aureus* (36%, 13/29) and *P. aeruginosa* (14%, 5/29). Most common isolates from monoculture acute mastitis cases were CNS (6/34, 18%), *S. aureus* (18%, 6/34) and *Mycoplasma* spp. (12%, 4/34). 12% (10/84) of clinical cases were co-infections and 17% (15/84) did not detect any organisms.

Analysis of antimicrobial sensitivity testing revealed that 18% (8/44) of CNS and 23% (5/22) of *S. aureus* were beta-lactamase positive. Seven percent and 2.3% of CNS were resistant to tetracycline and ceftiofur, respectively. All *Bacillus* spp. were multi-drug resistant, but were florfenicol- and tylosin- sensitive. All *E. coli* demonstrated multi-drug resistance, but all isolates had MIC < 4 for ceftiofur. All *P. aeruginosa* isolates demonstrated multi-drug resistance and were not sensitive to any drugs appropriate for extra label use in SR intended for food production.

Significance

Dairy goats more commonly present for mastitis than sheep or goats of other uses. A broad array of aerobic bacteria can result in SR mastitis including CNS, *S. aureus*, coliforms, Pasteurellaceae and *Mycoplasma* spp. *Mycoplasma* is likely underrepresented in this population and should routinely be cultured in cases of SR mastitis. Antimicrobial resistance as determined by MIC or expression of beta-lactamase is common in SR mastitis pathogens.

