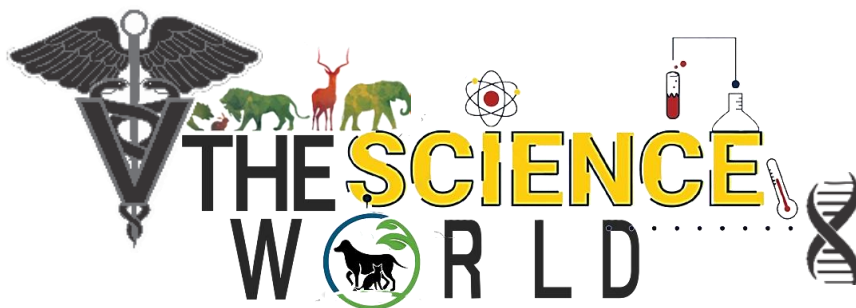




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Streptococcal Mastitis: An Overview of its Diagnosis and Control

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Abstract

Streptococcal mastitis remains a major threat to global dairy farming, causing severe economic losses through reduced milk yield and poor milk quality. This review provides a comprehensive overview of the diagnosis and control strategies for mastitis caused by key *Streptococcus* species. Accurate diagnosis has evolved from traditional culture techniques to advanced molecular methods, which offer rapid and precise pathogen identification. Control and prevention rely on robust herd management practices, and targeted dry cow therapy. Additionally, the rise of antimicrobial resistance highlights the urgent need for alternative therapies to mitigate the impact of streptococcal mastitis and ensure the sustainability of dairy production worldwide.

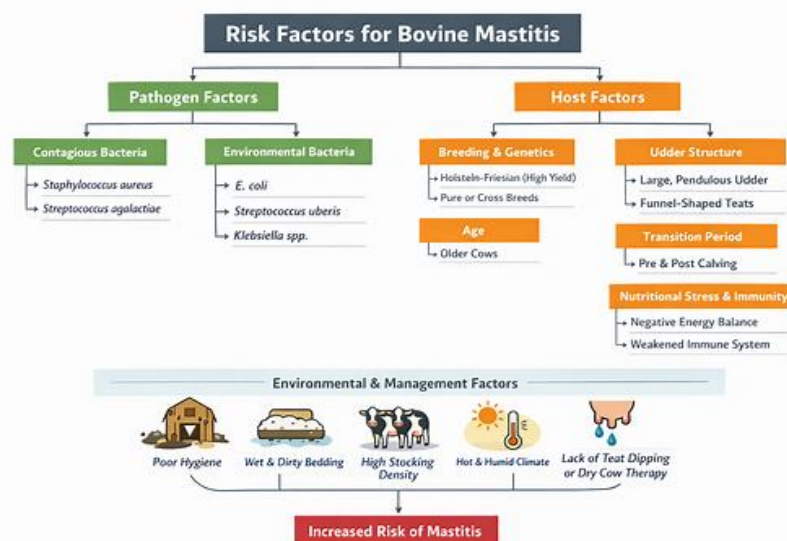
Key words: Mastitis, *Streptococcus* sp., Dairy production, Diagnosis, Control

Introduction

Mastitis is characterized by inflammation of the mammary gland parenchyma, which causes physical and chemical changes in milk and alters the glandular tissue. Depending on inflammatory severity, bovine mastitis is classified into clinical, subclinical, and chronic forms (Cheng et al., 2020). This disease inflicts substantial economic damage on the dairy sector by lowering milk yield and quality, raising treatment and veterinary costs, requiring milk disposal, increasing labor, and leading to premature culling (Erskine, 1992; Radostitis et al., 2007).



Epidemiology/Risk Factors



General characteristics of *Streptococcus* sp.

The genus *Streptococcus* represents one of the most significant bacterial pathogens, responsible for approximately 23%–50% of mastitis cases worldwide (Kabelitz et al., 2021). *S. agalactiae*, *S. dysagalactiae*, and *S. uberis* are the most common causative agent for bovine mastitis with varying global reports (Hassan et al 2023).

Members of this genus are Gram-positive cocci that may occur singly, in pairs, or in chains of variable length. Individual cells are typically less than 2 μm in diameter and exhibit either spherical or ovoid morphology. *Streptococcus* species are globally distributed, with many of veterinary relevance existing as commensals on the mucosal surfaces of the upper respiratory and lower urogenital tracts (Markey et al., 2013). They are facultative anaerobes, catalase-negative, oxidase-negative, and generally non-motile, except for certain enterococci. These organisms are fastidious, requiring enriched media supplemented with blood or serum to support growth (Markey et al., 2013).

Streptococcus uberis is typically α -hemolytic, exhibiting partial hemolysis, though non-hemolytic strains have also been reported. Studies indicate that the milk proteins α -casein and β -casein stimulate biofilm formation, enabling *S. uberis* to withstand environmental stress and enhance resistance to antibiotic treatment. The global Lancefield classification of *S. uberis* remains problematic, as different strains have been identified as Lancefield groups E, G, P, or U (Kabelitz et al., 2021).

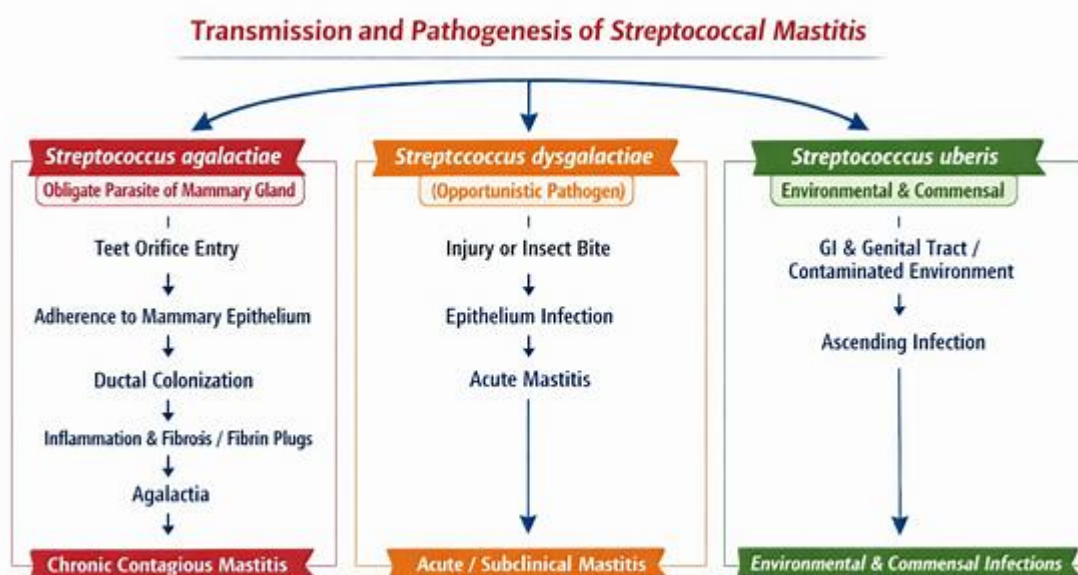
S. agalactiae is commonly found in the bovine gastrointestinal tract as well as in dairy farm environments. *S. agalactiae* is a major cause of subclinical mastitis and it belongs to



Lancefield group B and is generally β -hemolytic, although non-hemolytic strains have been documented; it is also CAMP-positive (Kabelitz et al., 2021).

In contrast, most strains of *S. dysgalactiae* are non-hemolytic, though α -hemolytic variants do occur. This species is classified within Lancefield group C (Kabelitz et al., 2021).

Pathogenesis and pathogenicity



(Markey et al. 2013)

Diagnosis

1. Clinical Signs

In general, mastitis presents with diverse, pathogen-specific symptoms that include abnormal milk characteristics such as clots, flakes, watery consistency, and changes in color, pH, odour, ion concentration, and somatic cell count (SCC) along with udder swelling and, less commonly, systemic signs like fever or anorexia.

2. California Mastitis Test (CMT)

The CMT reagent is mixed with the individual quarters milk sample that has been collected in the mastitis paddle in approximately equal proportion of the milk sample. Then, after the mixture was swirled in rotary motion, the result is then read within 10–15 s as negative, trace, + 1, +2, and +3 (Hassan et al 2023).

3. Conventional Culture Based method of detection of streptococci

A 10- μ L loopful of each milk sample was streaked onto 5% sheep blood agar and incubated aerobically at 37°C for 24 to 48 hours (Harjanti et al. 2018). Following incubation, plates were examined for colony morphology, hemolytic characteristics, and Gram stain reaction (Markey



et al. 2013). Typical streptococcal colonies—characterized as small (~1 mm at 48 hours), translucent if beta-hemolytic, and appearing as Gram-positive cocci in chains—were presumptively selected. These isolates were sub-cultured onto nutrient agar and Edwards medium, then incubated aerobically at 37°C for 24 to 48 hours to obtain pure cultures.

Biochemical Identification

Presumptive *Streptococcus* isolates were confirmed using key biochemical assays. Isolates were initially screened for negative catalase and oxidase reactions (Markey et al. 2013). Eleven definitive tests were selected for species-level differentiation (e.g., *Streptococcus uberis* and Group B streptococci):

- CAMP reaction (Hogan et al. 1999)
- Esculin hydrolysis (McDonald and McDonald 1976)
- Sodium hippurate hydrolysis (Baron et al. 1994a)
- Arginine hydrolysis (Baron et al. 1994b)
- Carbohydrate fermentation (inulin, mannitol, raffinose, salicin, and sorbitol)
- Growth tolerance tests (at 45°C and in 6.5% NaCl)
- Lancefield serogrouping (Markey et al. 2013)

Identification using commercial kits: Nowadays, Identification using commercial kits such as the rapid ID 32 STREP system (bioMérieux). highly automated identification system the new VITEK gram positive and negative identification cards provide stable and decisive result of bacteria identification [Funke et al. 2005, Wallet et al. 2005, Crowley et al. 2012]. (Markey et al. 2013)

4. Genotypic characterization

Molecular techniques including polymerase chain reaction (PCR), gene sequencing, and typing allow quick and exact detection of harmful bacteria like *Streptococcus uberis*, *Streptococcus agalactiae*, and *Streptococcus dysgalactiae*. These genetic assays offer better sensitivity and specificity than standard culture methods. Scientists use PCR to spot specific genes and tools like pulsed-field gel electrophoresis (PFGE) and multilocus sequence typing (MLST) to map out how different bacterial strains spread and relate to one another (Khan et al. 2003).



Treatment and Control

Five-point plan introduced by National Institute for Research in Dairying (NIRD) since 1960s is effective in controlling contagious mastitis pathogens [Breen et al. 2019]. The five points are:

- i) Identify and treat clinical cases – using antibiotic therapy: The main strategy to treat mastitis is by the use of antibiotics, such as penicillin, ampicillin, tetracycline, gentamicin, etc., which can be given by intra-mammary infusion, intramuscular or intravenous injections
- ii) Post milking teat disinfection
- iii) Dry cow therapy (DCT) –Dry cow therapy (DCT) is highly effective for controlling and inhibiting mastitis progression. The dry period is the ideal time for treatment because zero milk production eliminates antibiotic food-chain contamination risks, though post-calving caution remains necessary. Third-generation cephalosporins (like ceftiofur) and fluoroquinolones are the preferred drugs for treating both Gram-positive and Gram-negative infections.
- iv) Cull chronic cases
- v) Routine maintenance of milking machine

Conclusion

Streptococcal mastitis remains a critical economic and welfare challenge within the dairy industry. Accurate diagnosis combines somatic cell counts with precise laboratory tests like PCR and bacterial culture. Controlling transmission depends on the isolation of infected cows and strict milking hygiene, use of proper teat disinfectants and environmental control measures. Mitigation is achieved through targeted antibiotic treatments during lactation and strategic dry cow therapies. Integrated, proactive management is ultimately essential for eliminating persistent infections and preserving herd longevity.

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