



ISSN Online: 2456-2912
NAAS Rating (2026): 4.61
IJVSAH 2026; 11(10): 85-88
www.veterinarypaper.com
Received: 09-08-2026
Accepted: 23-09-2026
Published: 07-10-2026

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Clinical mastitis in buffaloes: Bacterial etiology, antimicrobial susceptibility and associated milk loss in a hospital-based study

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DOI: <https://www.doi.org/10.22271/veterinary.2026.v11.i10b.3838>

ABSTRACT

Bovine mastitis is a multifactorial disease of major importance in dairy production because it affects udder health, milk production and the economic efficiency of dairy farming. The objectives were to study the hospital-based occurrence of mastitis in buffaloes over a three-month period, determine the bacterial etiology and antimicrobial susceptibility of bacterial isolates, and evaluate milk loss and associated economic loss per animal. There is a higher occurrence in buffaloes of fourth or higher parity (41%), followed by second and third parity (32%) and first lactation (27%). The bacterial-isolate *Streptococcus* spp. (60), *Staphylococcus* spp. (92), *Escherichia coli* (48), other bacteria (20) and *Klebsiella* spp. (20). Mixed infections were reported from most positive milk samples, and *Staphylococcus aureus* and *Streptococcus* species were identified in the study as the dominant pathogens. The antibiogram displayed sensitivity values of 35.60% for enrofloxacin, 12.90% for moxifloxacin, 25.70% for gentamicin, 31.70% for cefoperazone, 17.80% for ceftiofur, 25.70% for ceftriaxone, 19.80% for chloramphenicol, 12.90% for amoxicillin, 17.80% for amikacin and 9% for streptomycin. The study reported milk loss ranging from 1 to 10 kg per animal per day, with an average loss of 6 kg per animal per day and an estimated economic loss of ₹360 per animal per day. The study highlights the combined clinical, microbiological and production consequences of bovine mastitis in a veterinary hospital setting. No additional animal-level observations, statistical tests, prevalence estimates or calculations were introduced beyond the information contained in the study.

Keywords: Bovine mastitis, Buffalo, Bacterial etiology, Antimicrobial susceptibility, Milk loss, Economic loss, Hospital-based study

1. Introduction

Mastitis is an inflammatory disease of the mammary gland and is one of the major causes of economic loss in dairy production (Ibeagha-Awemu *et al.*, 2025) [1]. Its consequences include reduction in milk production, changes in milk quality, treatment expenditure and removal of unproductive animals from the herd (Yadav *et al.*, 2024a) [2]. The disease occurs in both clinical and subclinical forms; clinical mastitis is associated with visible abnormalities of milk or the udder, whereas subclinical mastitis may occur without obvious clinical changes (Fonseca *et al.*, 2025) [3].

The etiological spectrum of bovine mastitis is broad. Frequently encountered bacterial agents include *Staphylococcus aureus*, *Escherichia coli*, *Streptococcus* spp., *Klebsiella* spp. and other bacterial organisms (Zhang *et al.*, 2025) [4]. Recent literature also demonstrates that the relative contribution of mastitis-associated bacteria can vary between geographical areas and production systems, with environmental and opportunistic organisms contributing substantially in some dairy populations (Sizana *et al.*, 2026) [5].

Antimicrobial treatment remains an important component of mastitis management; however, antimicrobial resistance complicates treatment and has implications for animal health, food production and public health (Askari *et al.*, 2025) [6]. Studies of mastitis-associated bacteria have documented variable antimicrobial susceptibility profiles and the occurrence of multidrug-resistant isolates (Yadav *et al.*, 2024a; Yadav *et al.*, 2024b; Islam *et al.*, 2025; Sizana *et al.*, 2026) [7, 5, 2, 8]. Consequently, area-specific antimicrobial susceptibility information is relevant to rational mastitis management.

The economic consequences of mastitis extend beyond the immediate cost of treatment. Reduced milk yield, discarded milk, animal removal and other productivity losses can contribute substantially to the overall disease burden (Mumba *et al.*, 2026) [9]. Fetrow *et al.* (2000) [10] similarly emphasized the economic impor

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tance of mastitis in dairy systems. This study specifically addressed this production component by evaluating milk loss per buffalo and the corresponding economic loss.

Although larger epidemiological studies have evaluated mastitis occurrence and antimicrobial susceptibility in Haryana and other regions, hospital-based information can provide a practical description of the organisms recovered from clinically affected animals and the associated production loss.

2. Objectives

- To study the hospital-based occurrence of mastitis in buffaloes over a period of three months.
- To determine the bacterial etiology of mastitis and antimicrobial susceptibility of the bacterial isolates.
- To evaluate milk loss per animal and the associated economic loss due to mastitis.

3. Materials and methods

3.1 Study design and source of data

The study was based on analysis of mastitis buffaloes reported at the Veterinary Clinical Complex, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, over a three-month period. Culture reports, antimicrobial susceptibility testing reports, and milk-loss information were used.

3.2 Bacterial etiology

Bacterial etiology was described from the culture reports available for mastitis-positive cases. It includes *Streptococcus* spp., *Staphylococcus* spp., *E. coli*, other bacteria and *Klebsiella* spp. Mixed infections (defined as the presence of more than one bacterium), were reported from most positive milk samples.

3.3 Antimicrobial susceptibility

Antimicrobial susceptibility was taken from cases and culture reports reported clinics by farmers. The antibiotics displayed were enrofloxacin, moxifloxacin, gentamicin, cefoperazone, ceftiofur, ceftriaxone, chloramphenicol, amoxicillin, amikacin and streptomycin.

3.4 Assessment of milk loss and economic loss

Milk yield before mastitis, milk yield after mastitis and milk loss per animal were presented using a box-and-whisker plot. There were milk-loss range of 1–10 kg/animal/day, an average loss of 6 kg/animal/day and an estimated economic loss of ₹360/animal/day.

4. Results

The study showed the highest occurrence of mastitis in buffaloes of fourth or higher parity (41%), followed by buffaloes in the second and third lactations (32%) and first lactation (27%). The study therefore identified higher parity as the category with the greatest reported occurrence within the hospital-based dataset.

Table 4.1. Parity-wise occurrence

Parity/lactation category	Occurrence reported in study
First lactation	27%
Second and third lactation	32%
Fourth or more	41%

The bacterial-isolate study showed *Staphylococcus* spp. as the largest category (92), followed by *Streptococcus* spp. (60), *E. coli* (48), other bacteria (20) and *Klebsiella* spp. (20). *Staphylococcus aureus* and *Streptococcus* species were the dominant pathogens. Mixed infections involving more than one bacterium were reported from most positive milk samples.

Table 4.2. Bacterial isolates

Bacterial category	Number
<i>Streptococcus</i> spp.	60
<i>Staphylococcus</i> spp.	92
<i>E. coli</i>	48
Other bacteria	20
<i>Klebsiella</i> spp.	20

Table 4.3. Antimicrobial susceptibility pattern

Antimicrobial	Sensitivity shown
Enrofloxacin	35.60%
Moxifloxacin	12.90%
Gentamicin	25.70%
Cefoperazone	31.70%
Ceftiofur	17.80%
Ceftriaxone	25.70%
Chloramphenicol	19.80%
Amoxicillin	12.90%
Amikacin	17.80%
Streptomycin	9%

Among the antibiotics the highest antimicrobial susceptibility value was for enrofloxacin (35.60%), followed by cefoperazone (31.70%) and gentamicin and ceftiofur (25.70% each). The lowest value shown was for streptomycin (9%). These values are presented exactly as reported and are not interpreted as resistance percentages.

4.4 Milk loss and economic loss

Parameter	Value reported
Milk yield before mastitis	13.23 kg/animal/day
Milk yield after mastitis	7.06 kg/animal/day
Milk loss/animal	6.16 kg/animal/day
Reported milk-loss range	1–10 kg/animal/day
Reported average milk loss	6 kg/animal/day
Reported economic loss	₹360/animal/day

Mastitis was associated with a marked reduction in milk production. The reported milk yield decreased from 13.23 kg/animal/day before mastitis to 7.06 kg/animal/day after mastitis, corresponding to a milk loss of 6.16 kg/animal/day. The reported milk-loss range was 1–10 kg/animal/day, with an average loss of 6 kg/animal/day. The estimated economic loss associated with reduced milk production was ₹360 per animal per day.

5. Discussion

5.1 Pattern of mastitis in relation to parity

The present hospital-based study showed the highest reported occurrence of mastitis in buffaloes of fourth or higher parity (41%). This finding is consistent with the general epidemiological importance of animal age or lactation history in mastitis occurrence. In a separate buffalo study from Haryana, Yadav *et al.* (2024b) [8] reported a significant effect of age on mastitis prevalence and noted the highest occurrence in the old-age group, followed by young and middle age groups. The same study also reported an association between lactation stage and mastitis occurrence. The agreement between the two studies supports the relevance of parity or age-related differences when describing mastitis in buffaloes, although the categories and study designs were not identical.

5.2 Bacterial profile

The predominance of *Staphylococcus* spp. and *Streptococcus* spp. in the present study is compatible with published observations that Gram-positive bacteria, particularly staphylococci and streptococci, are important mastitis pathogens. Yadav *et al.* (2024b) [8], studying buffalo milk in Haryana, reported Gram-positive bacteria in 54.16% of culture-positive samples and identified *Staphylococcus* spp. and *Streptococcus* spp. among the important isolates. The same study described *E. coli* and *Klebsiella* spp. among Gram-negative organisms. Similarly, Yadav *et al.* (2024a) [2] reported substantial contributions of both Gram-positive and Gram-negative bacteria among mastitis-positive samples from different districts of Haryana.

The dominance of staphylococci in the present study also has relevance to contemporary mastitis literature. Islam *et al.* (2025) [7] described *S. aureus* as an important bovine mastitis pathogen and highlighted the role of antimicrobial resistance and virulence-associated characteristics in persistent intramammary infection. However, the present study did not contain molecular characterization or virulence-gene data; therefore, no such conclusions are drawn.

The observation of mixed infections in most positive milk samples is also important when interpreting the bacterial findings. Mixed bacterial involvement means that the clinical and therapeutic context cannot necessarily be reduced to a single organism.

5.3 Antimicrobial susceptibility

The Antimicrobial susceptibility study showed the highest reported susceptibility for enrofloxacin (35.60%), with lower values for the other antibiotics displayed. This pattern differs from the results of the broader buffalo study of Yadav *et al.* (2024b) [8], in which chloramphenicol was reported as the most sensitive antibiotic overall, followed by enrofloxacin, amikacin, levofloxacin, moxifloxacin and gentamicin. The difference illustrates the importance of local and study-specific antimicrobial susceptibility data rather than assuming a uniform susceptibility profile across buffalo populations. Yadav *et al.* (2024a) [2] similarly reported variation in susceptibility across Haryana and identified gentamicin as the most sensitive antibiotic in that study, while penicillin showed high resistance.

Recent studies further emphasize the variability of antimicrobial resistance among mastitis pathogens. Islam *et al.* (2025) [7] reported substantial resistance among *S. aureus* isolates and identified multidrug-resistant isolates as well as the *mecA* gene in a subset of isolates. Sizana *et al.* (2026) [5] also reported antimicrobial resistance among mastitis-associated bacteria and emphasized the need for improved hygiene and antimicrobial stewardship. The present study, however, provides susceptibility percentages rather than a molecular resistance profile; consequently, the findings should be interpreted as an antibiogram description rather than evidence of specific resistance genes or mechanisms.

5.4 Milk production loss and economic implications

The production-loss component is a major strength of the study because it connects mastitis with a directly relevant farm-output measure. The study reported milk loss of 1–10 kg per animal per day, an average loss of 6 kg per animal per day and an estimated economic loss of ₹360 per animal per day. This is consistent with the broader literature describing reduced milk yield as a major pathway through which mastitis generates economic loss. Yadav *et al.* (2024a) [2] identified decreased milk production and treatment costs as major economic consequences of mastitis, while Mumba *et al.* (2026) [9] demonstrated that mastitis-related economic burden can involve both direct health expenditures and indirect productivity losses such as discarded milk and animal removal.

The milk-loss findings also have practical relevance in a hospital setting because animals presented for clinical disease may have already experienced a substantial decline in productive performance. Fetrow *et al.* (2000) [10] emphasized the economic dimension of mastitis management, supporting the inclusion of production loss when con-

sidering the importance of the disease. In the present study, the reported ₹360 per animal per day loss provides a simple production-based economic indicator from the hospital dataset; no additional cost components were estimated because they were not provided in the study.

5.5 Relationship between the present findings and published literature

Taken together, the study data and the published studies showed 3 main common findings: mastitis affects productive performance; bacterial etiology is heterogeneous but commonly includes staphylococci, streptococci and enteric Gram-negative organisms; and antimicrobial susceptibility varies among bacterial populations and geographical settings. The present hospital-based study adds a specific clinical perspective by combining bacterial findings, an antibiogram and quantified milk loss in buffaloes.

7. Conclusion

Bovine clinical mastitis in the hospital-based buffalo study was associated with a higher reported occurrence in animals of fourth or higher parity, predominance of *Staphylococcus* spp. and *Streptococcus* spp., frequent mixed bacterial involvement, variable antimicrobial susceptibility and substantial milk production loss. The study reported an average milk loss of 6 kg per animal per day and an economic loss of ₹360 per animal per day. The findings support the clinical and economic importance of mastitis in buffaloes and the value of combining bacteriological investigation, antimicrobial susceptibility testing and production-loss assessment.

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How to cite this article: Sindhu N, Mor R, Aruna, Kumar A, Sukhbir, Sharma M, et al. Clinical mastitis in buffaloes: Bacterial etiology, antimicrobial susceptibility and associated milk loss in a hospital-based study. *International Journal of Veterinary Sciences and Animal Husbandry*. 2026;11(10):85-88. doi: <https://www.doi.org/10.22271/veterinary.2026.v11.i10b.3838>

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