



## Occurrence of gangrenous mastitis and its associated risk factors in dairy goats<sup>#</sup>

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### Abstract

*Gangrenous mastitis is one among the major economically important health constraint faced by goat farmers. Occurrence of gangrenous mastitis is a result of combination of host, agent and environmental factors. Alteration in any of the host, agent and environmental factors can lead to an increase in bacterial concentration and the expression of virulence factors resulting in gangrenous mastitis. The present study was conducted over a period of two years from September 2021 to September 2023. The study subjects included 30 goats affected with gangrenous mastitis, managed under semi-intensive and intensive system. The selected animals included Malabari, Jamnapari and Malabari crossbreds with age group ranging from one to eight years, parity number ranging from one to six and stage of lactation ranging from peri-parturient period, early lactation and late lactation. Information regarding the host associated and environmental risk factors were collected by a prepared proforma. Disease diagnosis was made based on clinical examination, examination of udder and milk changes. Epidemiological analysis revealed a higher occurrence of gangrenous mastitis in crossbred goats. The occurrence was also higher in the age group of 3-4 yrs, during periparturient period and in herd without proper management practices. Absence of herd and management practices like proper disinfection and isolation of animals to new shed during parturition significantly caused occurrence of gangrenous mastitis. Proper awareness regarding the epidemiological factors leading to gangrenous mastitis can help in future control strategies of caprine gangrenous mastitis.*

**Keywords:** Goat, gangrenous mastitis, epidemiology

India has 148.88 million of goat population and goats make up around nine per cent of the livestock GDP (DAHD, 2019). In India, a large population of small and marginal farmers, including landless agricultural labourers, primarily rely on raising goats. Since goat farming requires less capital investment, it is suitable for a large number of rural populations (Singh *et al.*, 2023). Mastitis is one of the significant conditions encountered in goat farming and among which gangrenous mastitis is the most serious one. Gangrenous mastitis is characterised by severe toxemic signs and can result in complete/ partial loss of mammary gland. Direct mortality is common from per acute gangrenous mastitis in sheep and goats (Contreras *et al.*, 2007). A combination of environmental, agent, and host variables leads to the evolution of gangrenous mastitis. Changes in these variables may increase the concentration of bacteria, which

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in turn lead to the expression of virulence factors. Hence this study was conducted with an objective of studying the occurrence of gangrenous mastitis and its associated host, environmental and managemental factors.

## Material and methods

### Study area

The study area included various parts of Wayanad district and Thamarassery taluk of Kozhikode district. Goats affected with gangrenous mastitis presented to Teaching Veterinary Clinical Complex, Pookode; Veterinary Ambulatory Clinic, Kakkavayal and also to nearby veterinary hospitals of Wayanad (Veterinary Dispensary, Thariyode and District Veterinary Centre, Kalpetta) formed the subjects of the study. The affected goats presented to TVCC, Pookode belonged to various places from Vythiri taluk like Thariyode, Vythiri, Muttill, Kaniyambetta and from Thamarassery taluk of Kozhikode district. Affected goats presented to Veterinary Ambulatory Clinic, Kakkavayal belonged to various places in Sulthan Bathery taluk like Ambalavayal, Meenagadi, Meppadi, and Chooralmala. The seasons prevailing in this area are divided into pre-monsoon (April to June), monsoon (July to September), post monsoon (October- December) and winter (December- March) (IMD, 2023).

### Study population

The study population included 30 goats managed under semi- intensive and intensive system. They belonged to Malabari, Jamnapari, and Malabari crossbreds with age group ranging from one to eight years, parity number ranging from one to six and stage of lactation ranging from peri-parturient period (three week before and after parturition), early lactation (less than 80 days), mid (80 – 140 days) and late lactation (over 140 days) (El-Tarabany *et*

*al.*, 2018). Different breeds in the study group were divided into high and low milk yielders (Hegde, N.G., 2020). The different teat end shapes included in the present study were conical and cylindrical shape, bottle end shape and short pencil shape.

### Study design

A longitudinal study was conducted from September 2021- September 2023. All the animals were examined for gangrenous mastitis by clinical examination of the udder and milk

### Data collection

A data collection proforma was prepared for collecting information regarding the host associated risk factors such as age, breed, parity, stage of lactation, milk yield, teat end shape, teat injury. Environmental factors and management practices such as season, farming condition, floor type, proper disinfection, isolation of animal to new shed, and floor height. Disease diagnosis was made based on clinical examination, examination of udder and milk changes. Possible association of host and environmental factors with the occurrence of gangrenous mastitis was studied and analysed using Chi square test by SPSS version 24.0. The occurrence of gangrenous mastitis was the dependent variable and associated factors were the explanatory variables.

## Result and discussion

Among the 30 animals presented, clinical examination revealed systemic signs which ranged from mild, moderate and severe systemic signs (Abu Samra *et al.*, 1988) Udder of the affected goats appeared as cyanotic and cold (Fig.1a, 1b). Milk changed from serous to blood tinged secretion with fibrinous clots.



Fig.1a



Fig. 1b

Fig. 1a and 1b. Gangrenous mastitis affected goat and udder changes

### Host associated factors

The association between host associated factors and occurrence of gangrenous mastitis are shown in table 1. The Chi square analysis of risk factors revealed a significant association between the factors, age ( $\chi^2$  value = 7.40\*; P-value = 0.025), breed ( $\chi^2$  value = 7.80\*; P-value = 0.020) and stage of lactation ( $\chi^2$  value = 25.400\*\*; P-value <0.001). The occurrence was highest in the age group of three to four years (56.7 per cent) and lowest in the age group greater than four years (20%). Regarding the age-related factors, Foysal *et al.* (2020) and Suman *et al.* (2023) reported a higher incidence of clinical mastitis among goats aged between 3 and 4 years. Possible reasons for this increased incidence of mastitis with age may be that the older animal are under stress resulting from long time milk production, multiple numbers of parturitions and the weakened immunity (Zamin *et al.*, 2010). Other reason might be due to highest milk production during the 3 to 4 parities in lactating animals. In the present study, less occurrence of disease in greater than four-year-old animals might be due to the reduced number of presented animals in that age group.

Occurrence of gangrenous mastitis in goats was higher in the crossbred (56.7%) followed by Malabari (26.7%) and Jamnapari goats (16.7%). In agreement with present findings, Tufani *et al.* (2010) and Pratap *et al.* (2023) also reported that different breeds may experience caprine mastitis differently due to the difference in the

genetic resistance, sanitary management, and milking practices implemented.

Occurrence of gangrenous mastitis in goats was more during peri-parturient period with twenty-three animals (76.7% per cent), followed by four animals (13.3%) in mid and late lactation and three animals (10%) in early lactation. The present study is also in accordance with Suman *et al.* (2023), and Bergonier *et al.* (2003), who linked the increased occurrence of disease during the peri-parturient period to environmental contamination like poor hygiene practices and increased susceptibility to udder infections during the period.

Besides, the physiological stress on the animal might contribute to the flaring up of a persistent infection in the udder during the early stages of lactation. Limited epidemiological data are available from the previous research in the occurrence of caprine gangrenous mastitis. Hence most of the findings with available data were related with non-gangrenous caprine mastitis.

Among the other host associated risk factors, parity ( $\chi^2$  value = 3.867; P-value = 0.276), milk yield ( $\chi^2$  value = 0.533<sup>ns</sup>; P-value <0.001) and teat end shape ( $\chi^2$  value = 5.60; P-value = 0.061) (Fig 5a, 5b, 5c), teat injury ( $\chi^2$  value = 3.33; P-value = 0.068), had no significant association with the occurrence of gangrenous mastitis. Various authors have reported a significant association between these factors and occurrence of non-gangrenous mastitis.

**Table 1.** Occurrence of gangrenous mastitis based on host factors

Host factors	Category	No: of affected animal	Per cent	$\chi^2$ value	P-value
Age in yrs	1-2	7	23.3	7.40*	0.025
	3-4	17	56.7		
	>4	6	20.0		
Parity	1st parity	5	16.7	3.867 <sup>ns</sup>	0.276
	2 <sup>nd</sup>	6	20.0		
	3 <sup>rd</sup>	12	40.0		
	≥ 4 <sup>th</sup>	7	23.3		
Breed	Malabari	8	26.7	7.80*	0.020
	Crossbred	17	56.7		
	Jamnapari	5	16.7		
Stage of Lactation	Peri-parturient period (3wk before and after parturition)	23	76.7	25.400**	<0.001
	Early lactation (<2 month)	3	10		
	Mid and Late lactation (>2month)	4	13.3		
Milk Yield (Table 1a)	Low	13	43.3	0.533 <sup>ns</sup>	0.465
	High	17	56.7		
Teat end shape	Conical and cylindrical shaped	12	40.0	5.60 <sup>ns</sup>	0.061
	Bottle shaped teat	14	46.7		
	Short Pencil shaped	4	13.3		

\*\*Significant at 0.01 level (p<0.01); ns non-significant (p>0.05)

\* Significant at 0.05 level (p<0.05)

Parity wise occurrence revealed highest occurrence in twelve animals (40%) with 3<sup>rd</sup> parity and lowest in five animals (16.7%) with first parity. Similar findings reported by Foyisal *et al.* (2020), that the higher prevalence of clinical mastitis was recorded between 3 to 4 parity (58.06%) in comparison to lower (26.67%) and higher parities which might be due to highest milk production during the 3 to 4 parities in lactating animals. As per Pratap *et al.* (2023) other possible reason might be that the teat canal may widen with age and parity, which increases the risk of infection from microorganisms entering the teat canal and increases susceptibility of the udder to infection. The chi square test revealed a non-significant association between parity and gangrenous mastitis which might be due to the unequal distribution of animals in the present study group.

**Table 1a.** Classification of milk yield of different breeds affected with gangrenous mastitis (Hegde, N.G. 2020)

Breeds	Milk yield / day	No: of affected animal	Per cent
Malabari	>300ml	4	50.0
	<300ml	4	50.0
	<b>Total</b>	<b>8</b>	<b>100</b>
Crossbred	>500ml	9	52.94
	<500ml	8	47.06
	<b>Total</b>	<b>17</b>	<b>100</b>
Jamnapari	≥1L/day	4	80.0
	<1L/day	1	20.0
	<b>Total</b>	<b>5</b>	<b>100</b>

Among the 30 animals, a total of 17 animals (56.7%) had high milk yield and a total of 13 animals (43.3%) had low milk yield (Table 1a). Megersa *et al.* (2010) and Altaf *et al.* (2020), reported that occurrence of mastitis was significantly higher in does with high milk production.

Occurrence of gangrenous mastitis was higher in fourteen animals (46.7per cent) with bottle shaped teat, followed by twelve animals (40%) with conical/ cylindrical

shape and least with four animals (13.3%) having pencil shaped and short teat (Fig. 2a, 2b, 2c). In the present study, occurrence was higher in bottle shaped and conical cylindrical shape when compared to the pencil shaped teat. In a study of risk factors of sub-clinical mastitis in goats by Akter *et al.* (2020), it was reported that the occurrence was significantly higher in goats with bottle shaped teats and conical or cylindrical teat shapes than short pencil shaped teats. Possible reason may be comparatively lower teat end to floor distance in conical/cylindrical and bottle shaped teat when compared to the pencil shaped teats.

Regarding teat injury, occurrence of gangrenous mastitis was found in ten animals (33.3%) with teat injury and 20 animals (66.7%) without teat injury. The present study was in agreement with the Radostits *et al.* (2006) who stated that the most common cause of mastitis is the bruising of breast tissue or teats from traumas, nursing, fly bites, or other lesions to the skin that act as a vital barrier to infection and mastitis is typically linked to poor hygiene practises. The other possible reasons may be that *Staphylococci* are major carriers in the mouth and nasopharynx of the nursing lamb, thus trauma can cause udder more susceptible for staphylococcal infection (Bergonier *et al.*, 2003).

#### Environmental factors and managemental factors

The association between environmental and managemental factors to the occurrence of gangrenous mastitis are shown in table 2. The Chi square analysis of risk factors revealed a significant association between the factors, farming condition ( $\chi^2$  value = 22.53\*\*; P-value = 0.001), season ( $\chi^2$  value = 7.867\*; P-value = 0.049), absence of herd and management practices like proper disinfection ( $\chi^2$  value = 16.13\*\*; P-value = <0.001) and isolation of animals to new shed during parturition ( $\chi^2$  value = 13.33\*\*; P-value = <0.001).

Occurrence of gangrenous mastitis was more in household rearings (93.3%) than organised farms

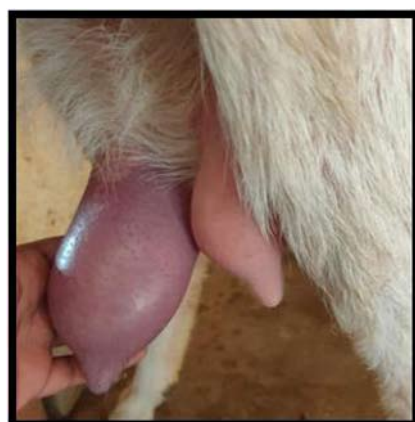


Fig 2a



Fig 2b



Fig 2c

**Fig. 2.** Different teat end shapes- a. Conical and cylindrical shape, b. Bottle shaped, c. Short pencil shaped

**Table 2.** Occurrence of gangrenous mastitis based on environmental factors

Environmental and management factors	Category	No: of affected animal	Per cent	$\chi^2$ value	P-value
Farming condition	Organized Farm Household	2 28	6.7 93.3	22.53**	0.001
Season	Pre-monsoon Monsoon Post monsoon Winter	14 4 6 6	46.7 13.3 20.0 20.0	7.867*	0.049
Raised floor with standard height	Present	18	40	1.20 <sup>ns</sup>	0.273
	Absent	12	60		
Isolation of animal to new shed	Present	5	16.7	13.33**	<0.001
	Absent	25	83.3		
Time of starting of treatment on same day of clinical signs	Present	12	60	1.20 <sup>ns</sup>	0.273
	Absent	18	40		
Proper Disinfection	Present	4	3.3	16.13**	<0.001
	Absent	26	66.7		

\*\* Significant at 0.01 level ( $p < 0.01$ ); ns non-significant ( $p > 0.05$ )

\* Significant at 0.05 level ( $p < 0.05$ )

(6.7%). Similar findings were reported by Mahlangu *et al.* (2018) and Razi *et al.* (2012) wherein they reported a higher prevalence of mastitis in goats residing in houses i.e. unorganized sector. The probable reason for higher occurrence of mastitis in unorganized sector might be due to poor hygiene management, lack of awareness about milking methods and general environmental conditions of rearing goats.

Occurrence of gangrenous mastitis was more in pre-monsoon (46.7%) followed by post-monsoon (20%), winter (20%) and monsoon (13.3%). Similar findings were reported by Koop *et al.* (2016) and the possible reason may be that stress occurred due to the climate change during the pre-monsoon period might have contributed to the higher occurrence of disease.

Absence of herd and management practices like proper disinfection and isolation of animals to new shed during parturition significantly ( $P < 0.001$ ) caused occurrence of gangrenous mastitis. Similar findings found in a prevalence study of sub-clinical mastitis by Zamin *et al.* (2010) reported that mastitis prevalence was higher where sanitary condition was poor. Majority of owners reported that they did not resort to shifting in a separate pen after kidding and in most of the households, farmers were separating animals into the earthen floor sheds only.

In the present study, other environmental factors like floor height ( $\chi^2$  value = 1.20; P-value = 0.273) had no significant association with the occurrence of disease.

In case of floor type, all the 30 animals were reared on slattered wood floor type and none was reported as reared on concrete floor. Possible reason for the occurrence of disease even in the slattered floor may be due to the lack of proper disinfection of the floor and underneath area.

## Conclusion

The present study recorded occurrence of caprine gangrenous mastitis over a two-year period from September 2021- September 2023. Epidemiological data regarding host, environmental and management practices were studied. The Chi square analysis of host associated risk factors revealed a significant association between age, breed and stage of lactation. The Chi square analysis of environmental and management risk factors revealed a significant association between farming condition, season, absence of herd and management practices like proper disinfection and isolation of animals to new shed during parturition. Epidemiological analysis revealed more occurrence of gangrenous mastitis in crossbred goats, in the age group of 3-4 yrs, common during periparturient period and in herd without proper management practices. In caprine gangrenous mastitis, a huge knowledge gap exists in research works and only limited data are available. Hence most of the findings with available data were related with non -gangrenous caprine mastitis. More extensive research work is needed in assessing the various epidemiological factors leading to gangrenous mastitis. This study would give proper awareness regarding epidemiological factors leading to the occurrence of gangrenous mastitis.

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## Conflict of interest

The authors declare that there is no conflict of interest.

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