

Epidemiology and Antibioqram Profiles of Respiratory Tract Infections in Goats

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ABSTRACT

Respiratory tract infections (RTIs) are the most common disease manifestations among goat population. In present study, the overall incidence of RTIs in goats of south Gujarat recorded was 27.75 % (126/454). The highest incidence of RTIs was recorded in goats aged below 6 months and in male goats. Non-descript and Surti breed of goats were clinically more susceptible to disease than other breeds. Seasonal peaks were observed in February and June. Clinically, infected goats exhibited elevated rectal temperature, heart rate, pulse rate, respiratory rate and capillary refill time, along with significant low saturation of peripheral oxygen (SpO₂). Bacteriological analysis identified *Staphylococcus* spp. as the most common pathogen, followed by *Streptococcus* spp., mixed infections (*Staphylococcus-Streptococcus* spp.), *Pseudomonas* spp., *Escherichia coli* and *Micrococcus* spp. Antibiotic sensitivity testing revealed that *Staphylococcus* spp. was highly sensitive to amikacin, streptomycin and penicillin. *Streptococcus* spp. responded well to streptomycin, ceftriaxone-tazobactam and penicillin, while mixed infections were sensitive to amoxiclav, moxifloxacin and ceftriaxone-tazobactam. *Pseudomonas* spp. was sensitive to amikacin and ceftriaxone-tazobactam, *Escherichia coli* to enrofloxacin, penicillin and moxifloxacin and *Micrococcus* spp. to oxytetracycline, enrofloxacin and ceftriaxone-tazobactam. These findings provide essential insights for effective diagnosis and targeted treatment of RTIs in goats.

Keywords: Antibioqram, Epidemiology, Goat, Respiratory tract infections.

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INTRODUCTION

Goat rearing is a common practice among landless labours and other underprivileged, indigent and backward groups in India. Respiratory tract infections of bacterial origin can occur as primary infections in otherwise healthy animals or as secondary infections following a reduction in immune resistance caused by various factors. Among these, pneumonia stands out as a critical concern, leading to considerable economic losses worldwide in the ruminant industry due to its detrimental effects on animal health and productivity (Yener *et al.*, 2009).

Goat diseases that affect the respiratory system can result in significant losses due to their high morbidity and mortality rates. In most infectious pneumopathies, a viral agent may be the primary invader, followed by attack of variety of bacteria, both Gram positive and Gram negative. Many microorganisms can contribute to the multifactorial respiratory illnesses that affect small ruminants (Lacasta *et al.*, 2008). Among them, bacterial infections have drawn interest because of their diverse range of clinical symptoms, intensity of the illness and resurgence of strains resistant to several chemotherapeutic treatments. Physical stressors such as abrupt weather changes, poor ventilation, wearing dense stockings and traveling often interact with predisposing factors, contributing to the development of respiratory tract infections (Momin *et al.*, 2014). Identification of bacterial etiology, the impact of antibiotics and its sensitivity are the important factors to be considered during therapeutic management of respiratory tract infections of bacterial origin. Thus, understanding the organisms causing the disease and its antibioqram can help with management, treatment and control, hence this study was undertaken.

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MATERIALS AND METHODS

Goats (126 out of 454) presented at Veterinary Clinical Complex, Veterinary College, Kamdhenu University, Navsari (Gujarat, India) with symptoms of nasal discharge, coughing, moist rales on auscultation, open mouth breathing or respiratory difficulty were considered for present study. Demographic data, viz., age, sex, breed etc. along with data of important risk factors were also collected from selected 61 animals. Further, physiological parameters like rectal temperature (°F), heart rate (bpm) pulse rate (/min), respiratory rate (/min), capillary refill time (sec) and saturation of peripheral oxygen (SpO₂) were also recorded. After

thorough clinical examination, nasal swabs were collected aseptically and subjected to cultural isolation, identification and antibiogram of bacterial isolates following standard procedures using disc diffusion technique of 11 antibiotics procured from HiMedia Lab, Mumbai, India.

RESULTS AND DISCUSSION

The overall hospital-based incidence of respiratory tract infection recorded under present study among goats was 27.75% (126/454). It was comparable to the reports of Dar *et al.* (2013) and Momin *et al.* (2014), but higher than the report of Chakraborty *et al.* (2014). It might be due to humid and cold temperate type of climate with frequent falls providing suitable environment for respiratory pathogens. Further, such adverse weather conditions when combined with viral and bacterial infections might lead to respiratory diseases (Scott, 2011). The South Gujarat falls under relatively high humid area (51-70%), which often predisposed the small ruminants to respiratory diseases.

Prevalence of RTIs with Respect to Age, Sex, Breed, Season

The incidence of respiratory tract infection observed in different age groups is presented in Table 1. Among the suspected goats, the highest number of cases were observed in the age group below 6 months (27.87%), followed by those aged 1-2 years (26.23%) and 6-12 months (24.59%). The lowest incidence was found in goats above 2 years of age (21.31%). Higher prevalence in younger goats than the older were also reported by Scott (2011), Dohare *et al.* (2013), Kama *et al.* (2022) and Hota *et al.* (2024). Young goats are more susceptible, might be either because of immune-compromised state or higher stress inducing factors, *viz.* early weaning, the lack of maternal antibodies and their frequent freedom of movement, making them prone to respiratory infections.

The sex-wise significantly ($p < 0.01$) higher incidence was observed in male goats (77.06%, 47/61) compared to females (22.95%, 14/61). The findings suggest that sex influences the outcome being studied. Similar findings were also reported by Dohare *et al.* (2013) and Kama *et al.* (2022). Comparatively male population presented to VCC was higher than female population in this particular study. Moreover, males are raised for meat production, whereas females are kept for only milk utilization in South Gujarat region, hence, higher incidence was found in male goat. However, Momin *et al.* (2014), Singh *et al.* (2020) and Hota *et al.* (2024), observed higher incidence of female population.

The highest percentage of respiratory tract infection was found in non-descript breeds (52.46%) and the Surti breed (34.43%), followed by the Sirohi (9.84%) and Jamnapari (3.28%) breeds (Table 2). In South Gujarat region, goats are mainly reared by socio-economically backward class community mainly for milch and meat purpose and breeding strategies are mostly undefined leading to increase in population of

mix breeds. So, a greater number of animals with undefined breeds were presented during study period and it could lead to a significant rise in non-descript animals than other breeds.

The highest incidence was observed in February and June as compared to other months in the present study (Table 3), which concurred with the findings of Poonia and Malik (2012). The weakened immune system due to environmental stressors, dusty conditions and poor ventilation in barns increase susceptibility of goats towards respiratory pathogens. Besides, the south Gujarat has high humidity and around 40°-45°C temperature during summer season, which leads to the settlement of harmful environmental pathogens in respiratory tract resulting in respiratory diseases.

Table 1: Age wise incidence among the affected cases of respiratory tract infections in goats

Age	No. of goat affected	Percentage	χ^2 value
<6 month	17	27.87	
6-12 month	15	24.59	
1-2 year	16	26.23	0.578 ^{NS}
>2 year	13	21.31	
Total	61	--	

$p > 0.05$: Non-significant

Table 2: Breed wise incidence of respiratory tract infections in goats

Breeds	No. of goats affected	Percentage	χ^2 value
Non-descript	32	52.46	
Surti	21	34.43	
Sirohi	06	09.84	36.55 ^{**}
Jamnapari	02	03.28	

$**p \leq 0.01$, highly significant

Table 3: Month wise incidence of respiratory tract infections in goat

Months	No. of goat affected	Percentage	χ^2 value
January	03	04.92%	
February	12	19.67%	
March	04	06.56%	
April	10	16.39%	
May	09	14.75%	
June	11	18.03%	18.12 [*]
July	07	11.48%	
August	04	06.56%	
September	01	01.64%	
Total	61	--	

$*p \leq 0.05$, Significant

Physiological and Bacteriological Status of RTI Affected Goats

The rectal temperature (°F), heart rate (bpm), pulse rate (/min), respiratory rate (/min), capillary refill time (sec) in respiratory tract infected goats were significantly higher (103.24±0.15, 83.65±0.63, 88.69 ± 0.79, 35.91±0.78 and 02.36±0.09), whereas Saturation of peripheral oxygen (SpO₂) in blood was significantly lower (90.86±0.14) than the healthy control



goats (Table 4). Acute bacterial infection in respiratory tract leads to development of systemic inflammatory response syndrome which can cause variation in different physiological parameters (Chakraborty and Burns, 2023).

Among the 61 goats screened for respiratory involvement, five different types of bacteria were isolated either single or in combination (Table 5). It included *Staphylococcus* spp. (44.26%), *Streptococcus* spp. (31.15%), followed by mixed infection (8.20%), However, 1 goat sample (1.64%) didn't show any bacterial growth. The most prevalent species of bacteria found were *Staphylococcus* spp. Similar findings were noted by Rashid *et al.* (2013), Nair *et al.* (2023) and Chukwudi *et al.* (2024). *Staphylococcus* infection can damage both upper respiratory tract (nasal or throat infections) and lower respiratory tract (pneumonia) and it creates severe conditions where bacteria invade the lungs. Up to 30% of healthy individuals have *Staphylococcus aureus* in their upper respiratory tracts, despite the fact that this harmless colonization is often thought to predispose them to invasive illness (Shukla *et al.*, 2020). Lower respiratory infections caused by *Staphylococcus aureus* are substantially less prevalent but are linked to higher fatality rates, whereas skin and soft tissue infections are quite common (Klevens *et al.*, 2007).

In-Vitro Antibiogram Pattern of Bacterial Isolates

The antibiotic sensitivity test was performed using nasal swab collected from all the suspected goats and results are

Table 4: Physiological parameters of respiratory tract affected goats and healthy control

Parameter	Healthy group-I (n=6)	Infected group-II (n=61)
Rectal temperature (°F)	101.88 ± 0.15	103.24 ± 0.15**
Heart rate (bpm)	77.00 ± 1.26	83.65 ± 0.63**
Pulse rate (/min)	77.17 ± 1.86	88.69 ± 0.79**
Respiratory rate (/min)	23.50 ± 0.42	35.91 ± 0.78**
Capillary refill time (sec)	01.16 ± 0.16	02.36 ± 0.09**
Saturation of peripheral oxygen (SpO ₂)	96.83 ± 0.30	90.86 ± 0.14**

**p ≤ 0.01, highly significant

Table 6: Antibiogram of goats affected with respiratory tract infections (n=60)

Antibiotics	Sensitive (%)	Intermediate (%)	Resistant (%)
Penicillin	51 (85.00%)	07 (11.67%)	02 (03.33%)
Moxifloxacin	49 (81.67%)	10 (16.67%)	01 (01.67%)
Streptomycin	48 (80.00%)	06 (10.00%)	06 (10.00%)
Amikacin	47 (78.33%)	09 (15.00%)	04 (06.67%)
Ceftriaxone + Tazobactam	46 (76.67%)	13 (21.67%)	01 (01.67%)
Gentamicin	41 (68.33%)	15 (25.00%)	04 (06.67%)
Amoxicillin + Sulbactam	39 (65.00%)	20 (33.33%)	01 (01.67%)
Enrofloxacin	37 (61.67%)	13 (21.67%)	10 (16.67%)
Ceftriaxone	36 (60.00%)	21 (35.00%)	03 (05.00%)
Amoxy-Clavulanic Acid	33 (55.00%)	11 (18.33%)	16 (26.67%)
Oxytetracycline	32 (53.33%)	15 (25.00%)	13 (21.67%)

presented in Table 6. The data revealed that the penicillin (85.00%), moxifloxacin (81.67%) and streptomycin (80.00%) were found most sensitive antibiotics in respiratory tract infection of goats followed by amikacin (78.33%), ceftriaxone + tazobactam (76.67%), gentamicin (68.33%), amoxicillin + sulbactam (65.00%), enrofloxacin (61.67%) and ceftriaxone (60.00%). Similar results were obtained by Mandal *et al.* (2019), Sahay *et al.* (2020) and Karande *et al.* (2021), while amoxicillin and clavulanic acid and oxytetracycline exhibited least sensitivity. Further, ceftriaxone demonstrated the highest intermediate sensitivity (35.00%), followed by amoxicillin + sulbactam (33.33%)

The antibiotics namely amoxicillin and clavulanic acid (26.67%), oxytetracycline (21.67%) and enrofloxacin (16.67%) were found most resistant in antibiogram of respiratory tract infection, which might be due to their common use as well as first choice of antibiotic in empirical treatment of respiratory tract infections. Similar findings were also reported by Murphy *et al.* (2018) and Khalifa *et al.* (2021). They suggested that the spread of antimicrobial resistance is a result of the indiscriminate use of antibiotics in the veterinary industry to control non-infectious diseases also. amoxicillin + sulbactam, moxifloxacin ceftriaxone + tazobactam and penicillin exhibited least resistance in comparison with other antibiotics as these antibiotics are higher class of antibiotic and have selective use in treating complicated cases only.

Table 5: Bacteria isolated from nasal swab samples of respiratory tract infections goats

Bacterial spp.	No. of isolates	Percentage
<i>Staphylococcus</i> spp.	27	44.26
<i>Streptococcus</i> spp.	19	31.15
<i>Streptococcus</i> spp. and <i>Staphylococcus</i> spp. (Mixed)	05	8.20
<i>Pseudomonas</i> spp.	04	6.56
<i>Escherichia coli</i>	03	4.92
<i>Micrococcus</i> spp.	02	3.28
Absence of any bacteria	01	1.64
Total	61	--

CONCLUSION

This study underscores the significant impact of RTIs in goats (27.75%, 126/454), with younger and male goats being more affected, particularly in non-descript and Surti breeds during February and June. *Staphylococcus* spp. was the most common pathogen. The penicillin and moxifloxacin were found to be the most effective antibiotics, while amoxicillin + clavulanic acid and oxytetracycline showed the highest resistance in the antibiogram of respiratory tract isolates of RTIs infected goats.

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