Original Research Article
Prevalence of *E. coli* associated diarrhoea in goats in different areas of Chhattisgarh, India

ABSTRACT

Aims: The present study was conducted in four different districts of Chhattisgarh, *viz*. Durg, Raipur, Rajnandgaon and Dhamtari, to study the prevalence of *E. coli* associated diarrhoea in goats.

Study design: Field study.
Place and Duration of Study: Faecal samples from diarrhoeic goats were collected from 04 different districts of Chhattisgarh (Durg, Raipur, Rajnandgaon and Dhamtari) during June 2023 to May 2024.

Methodology: A total of 200 faecal samples were collected from diarrhoeic goats and screened for the presence of *E. coli*. The faecal samples were processed for microbiological isolation and identification of *E. coli* isolates based on the cultural, morphological and biochemical characteristics.

Results: The overall prevalence of *E. coli* associated diarrhoea in goats was 72% (n = 144/200). The study indicated a higher prevalence in Dhamtari (32.64%), while the least prevalence was recorded in Rajnandgaon (16.67%). Younger goats (57.64%) were more frequently affected as compared to adult ones (42.36%). The study also revealed a greater prevalence in female goats (61.11%) than male goats (38.89%). *E. coli* was more prevalent in diarrhoeic goats, during the summer season (45.83%), followed by rainy season (32.64%) and winter season (21.53%). Based on breed, the higher prevalence was observed in the Anjori breed (35.42%). Goats reared with poor hygienic conditions (54.86%) were more commonly affected than goats reared under moderate (34.03%) and good (11.11%) hygienic conditions.

Conclusion: The study concludes that *E. coli* associated diarrhoea is highly prevalent among goats, affecting 72% of those tested. Younger and female goats, particularly in Dhamtari and reared under poor hygiene, were most commonly affected. Seasonal variations also revealed a higher prevalence in summer season. Further studies are warranted in relation to the various serotypes and zoonotic potential of *E. coli* responsible for diarrhoea in goats. Possible variations in more diverse geographic zones need to be explored to propose an effective control and preventive protocol against *E. coli* associated diarrhoea in goats, which will eventually reduce the loss in terms of health and production in goats as well as the financial losses caused to the goat rearers.

Keywords: E. coli, diarrhoea, goat, prevalence

1. INTRODUCTION

Goats play a pivotal role in the economic and nutritional status of landless as well as small and marginal farmers in India. Among the significant diseases of goats, diarrhoea is generally regarded as one of the most frequent gut-related illness [1]. Diarrhoea has been most commonly reported to cause huge financial losses to goat rearers in terms of deterioration of health and reduced production, morbidity, mortality and increased expenses associated with the medication of the affected animals.

The most significant enteropathogens linked to diarrhoea in small ruminants include *Escherichia coli*, *Salmonella* spp., *Cryptosporidium,* rotavirus and PPR virus, either alone or in combination [2]. Among these bacterial pathogens, *E. coli* is considered to be the most common etiological agent associated with bacterial diarrhoea in several animal species as well as in humans [3]. *E. coli* is a gram-negative, rod-shaped and facultative anaerobe. This bacterium is a normal inhabitant of the gastrointestinal tract in animals, but various strains of *E. coli* possess certain virulence factors resulting in diarrhoea [4].

Many studies have been conducted earlier to record the prevalence of *E. coli* in diarrhoeic goats in several regions of India, but no such study has been carried out in the state of Chhattisgarh till date. Such studies may assist in planning better strategies for prevention and control of diseases for the area under the study. Therefore, the present study was performed with the objective to analyze the prevalence of *E. coli* associated diarrhoea in goats of Chhattisgarh based on area, age, sex, breed, season and the hygiene status.

2. METHODOLOGY

Four different districts of Chhattisgarh, *viz*. Durg, Dhamtari, Rajnandgaon and Raipur, were selected for the study. The study was conducted for a duration of one year, from June 2023 to May 2024. Goats with diarrhoea were randomly identified for collection of faecal samples from different areas across 04 districts during different seasons and details on age, sex, breed and hygiene status were recorded.

A total of 200 faecal samples were collected from diarrhoeic goats from Durg (n= 56), Dhamtari (n= 58), Rajnandgaon (n= 40) and Raipur (n= 46). Freshly passed faecal samples from diarrhoeic goats were collected aseptically in sterile plastic containers, taking care to avoid any external contamination. All faecal samples were transported to the laboratory under chilled conditions for microbiological isolation within 4 to 6 hours of collection.

One gram of faecal sample was added to 9 ml of nutrient broth and incubated at 37°C for 24 hours as per standard procedure. A loopful of inoculation from nutrient broth was streaked on MacConkey agar and incubated for 24 hours at 37°C and checked for growth of pink coloured colonies, which were further streaked on Eosin methylene blue (EMB) agar and incubated for 24 hours at 37°C, on which a characteristic metallic sheen tentatively identified the isolate as *E. coli*. The colonies from the selective agar plates were then transferred to nutrient agar and incubated for 18–24 hours at 37°C to obtain pure colonies that were subjected to standard morphological and biochemical tests for confirmation.

3. RESULTS AND DISCUSSION

Diarrhoea is one of the major concerns in small ruminants, as it leads to loss of health and production and even death in severe cases. Pathogens like *E. coli* play a major role in causing diarrhoea among goats. Therefore, the present study was performed to investigate the prevalence of *E. coli* associated diarrhoea in different districts of Chhattisgarh.

Pink coloured colonies were selected from MacConkey agar plate and streaked on EMB agar for characteristic metallic green sheen producing colonies (Fig.1). Out of 200 faecal samples screened during the present study, a total of 144 presumptively positive *E. coli* isolates were obtained. The isolates showing cultural characteristics similar to *E. coli* were further confirmed by Gram's staining and different biochemical tests. Gram-negative isolates showing the IMViC pattern "+ + - -," negative results for the urease test and positive results for the TSI test were identified as *E. coli* isolates.

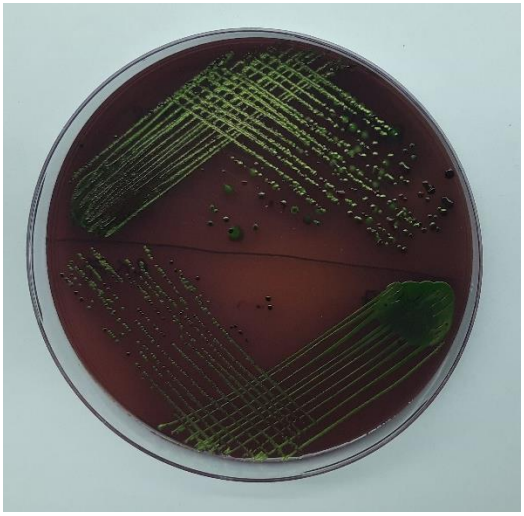

Fig.1: Growth of *E. coli* on EMB agar

The overall prevalence of *E. coli* was recorded to be 72% (144/200) in diarrhoeic goats (Fig. 2). The findings of the prevalence studies are shown in Table 1. In support of these observations, Yadav (2019) reported 75.93% prevalence rate of *E. coli* in diarrhoeic goats at university farm in Maharashtra [5]. Similarly, Banerjee *et al*. (2022) observed a higher prevalence of *E. coli* (100%) in diarrhoeic Black Bengal goats in West Bengal, India [6]. However, a much lower prevalence of *E. coli* (36.92%) in diarrhoeic sheep of southern region of Rajasthan was reported by Sharma *et al*. (2021) [7].

Table 1. Prevalence of *E. coli* associated diarrhoea in goats

Particulars	Category	No. of *E. coli* positive samples	Prevalence (%)
Area	Durg	41	28.47
	Dhamtari	47	32.64
	Rajnandgaon	24	16.67
	Raipur	32	22.22
Age	Young (<12 months)	83	57.64
	Adult (>12 months)	61	42.36
Sex	Female	88	61.11
	Male	56	38.89
Season	Rainy	47	32.64
	Summer	66	45.83
	Winter	31	21.53
Breed	Jamunapari	25	17.36
	Sirohi	32	22.22
	Osmanabadi	17	11.81
	Black Bengal	19	13.19
	Anjori	51	35.42
Hygiene status	Good	16	11.11
	Moderate	49	34.03
	Poor	79	54.86

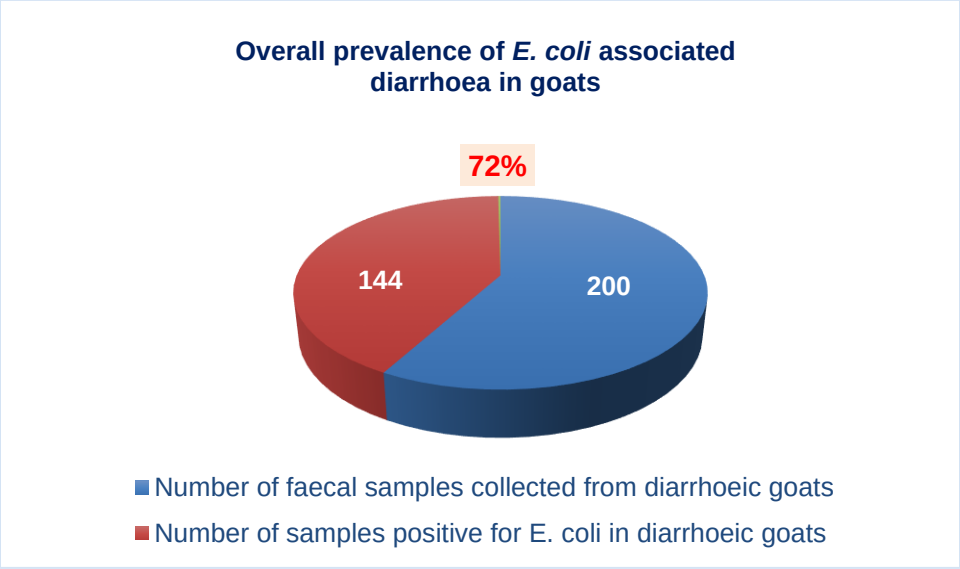

Fig. 2: Overall prevalence of *E. coli* associated diarrhoea in goats

A higher prevalence of *E. coli* was observed in the faecal samples from Dhamtari (32.64%), followed by Durg (28.47%), Raipur (22.22%) and least in Rajnandgaon (16.67%) (Fig.3). These differences in the rate of prevalence may be because of the sample size of the area and hygiene and managerial practices adopted at the farm premises and also on the climatic and geographical diversity of the animals examined [8].

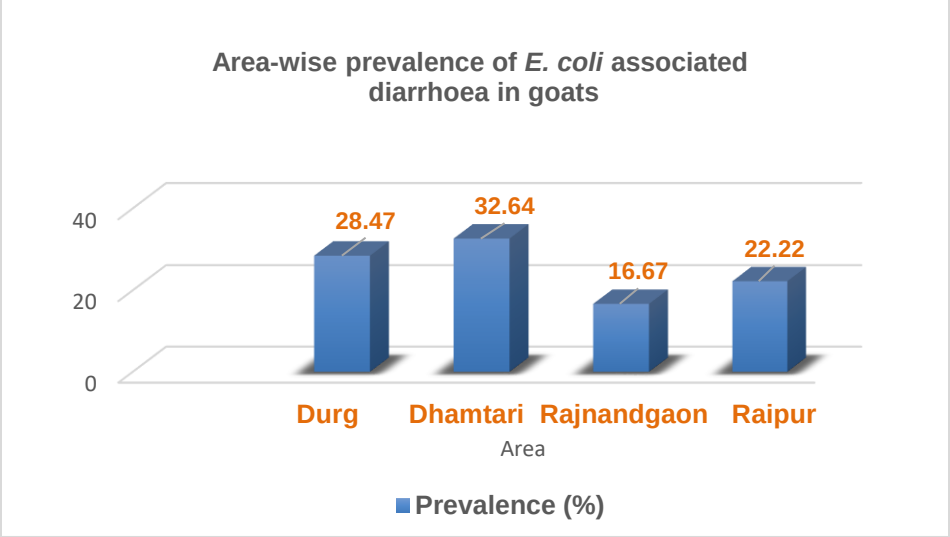

Fig. 3: Area-wise prevalence of *E. coli* associated diarrhoea in goats

E. coli was found to be the more common cause of diarrhoea in the age below 12 months (57.64%) (Fig.4). Owing to the dietary stress during weaning and an underdeveloped rumen in younger animals, the suppression of *E. coli* growth might be prevented [9]. The lower prevalence rate in the present study in adult goats was 42.36%, which is in accordance with the findings of Shabana *et al.* (2017) and Shrivastava *et al.* (2022) [2,10].

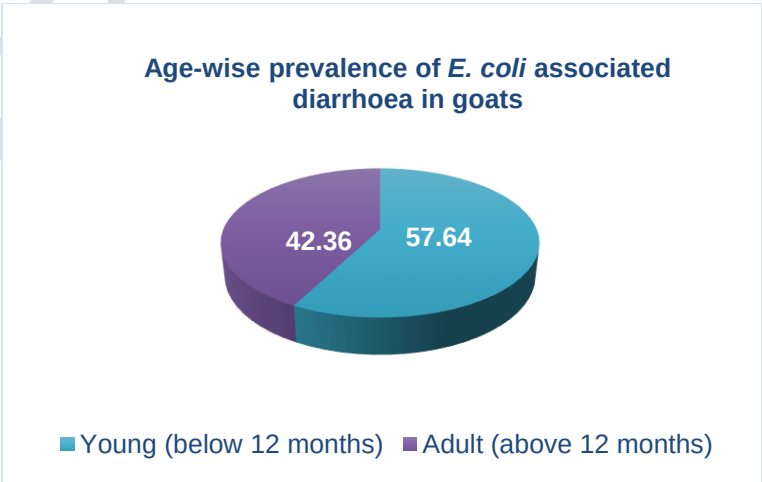

Fig. 4: Age-wise prevalence of *E. coli* associated diarrhoea in goats

The highest prevalence was recorded in female goats (61.11%) than male goats (38.89%) (Fig. 5), which is in agreement with the findings of Patel *et al.* (2017) and Sharma *et al.* (2020) [11,12]. The breeding policy of goat keepers may have led to such a higher prevalence, whereby they prefer to keep one male goat over 10 to 15 females. However, contrary to our findings, Azmat *et al.* (2024) recorded a higher prevalence of *E. coli* in male goats (31.25%) than female goats (13.64%) in Pakistan [13].

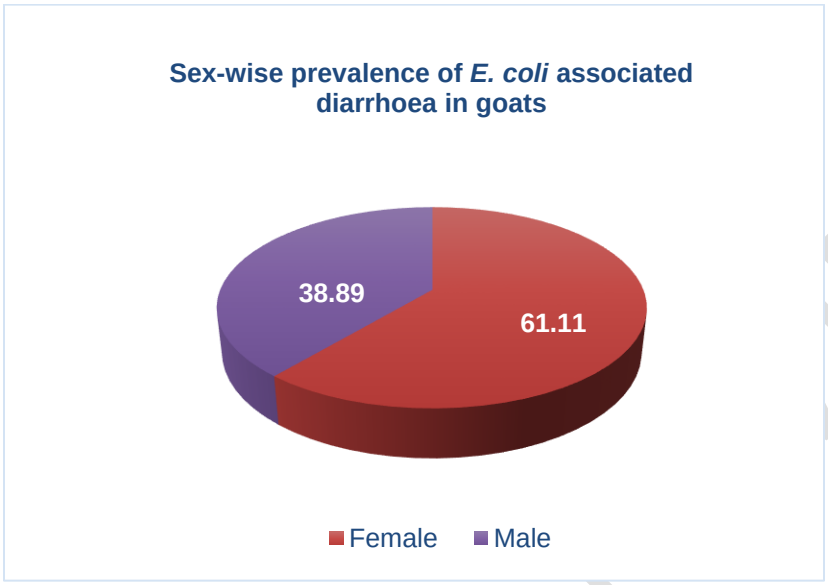

Fig. 5: Sex-wise prevalence of *E. coli* associated diarrhoea in goats

E. coli associated diarrhoea in goats was found to be more frequent in summer (45.83%) season in comparison to rainy (32.64%) and winter season (21.53%) (Fig. 6). These findings are in agreement with the findings of Abdou *et al.* (2021) and Gupta *et al.* (2024) [14,4]. Prahlad *et al.* (2018) suggested that during the summer season, warm ambient temperature encouraged the growth of *E. coli* and the increased movement of animals from pastures to housing during the summer, which might have led to stressful conditions in the animals [15]. However, El-Nady *et al.* (2023) documented a higher incidence of *E. coli* associated diarrhoea in kids during the winter season (56%) [16].

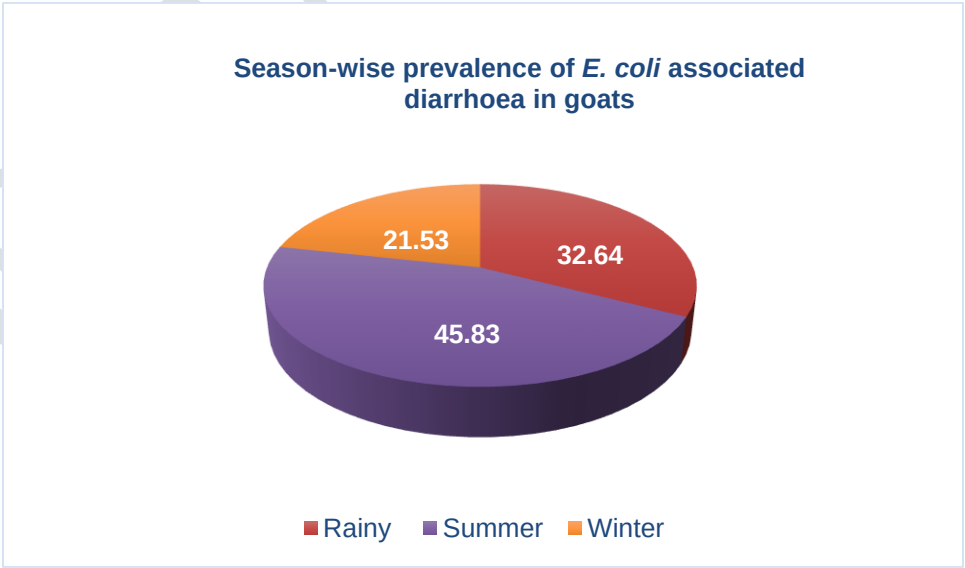

Fig. 6: Season-wise prevalence of *E. coli* associated diarrhoea in goats

The maximum prevalence of *E. coli* associated diarrhoea found in Anjori (35.42%) breeds, followed by Sirohi (22.22%), Jamunapari (17.36%), Black Bengal (13.19%) and Osmanabadi (11.81%) breeds of goat (Fig. 7). The greater frequency of *E. coli* associated diarrhoea in Anjori (a local breed of Chhattisgarh) goats may perhaps be due to the reason that this breed is most commonly reared and a larger population is found in the areas of Chhattisgarh. In conformity with the findings of this study, Ali *et al.* (2021) also recorded the similar observations in Bangladesh, where 18.80% Jamunapari and 14.26% Black Bengal goats were affected with diarrhoea [17]. On the contrary, Zaman *et al.* (2018) revealed no major association between the breed-wise prevalence of *E. coli* in goats of Bangladesh [8].

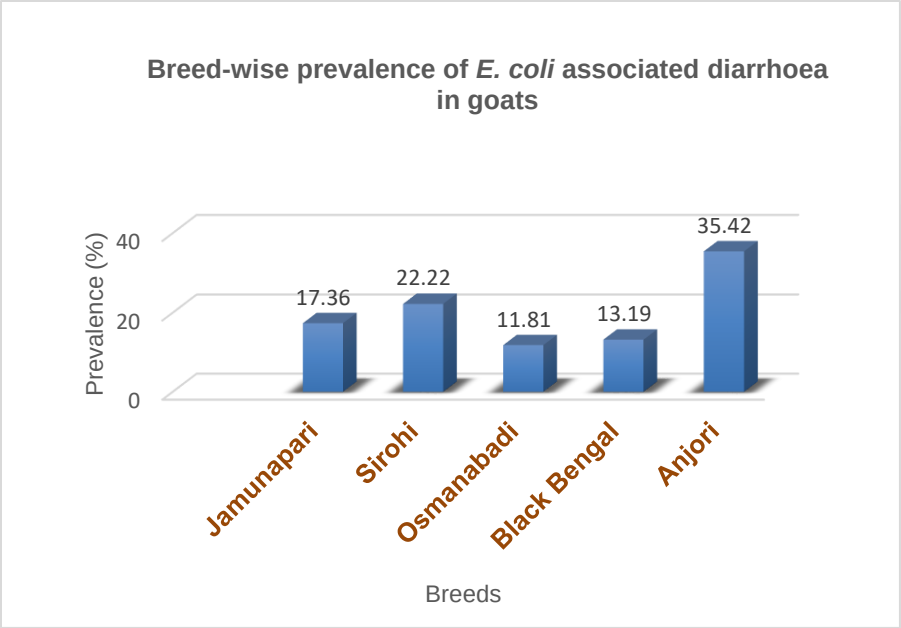

Fig. 7: Breed-wise prevalence of *E. coli* associated diarrhoea in goats

E. coli was more prevalent in the goats reared in poor hygienic conditions (54.86%) as compared to moderate hygiene (34.03%) and good hygienic status (11.11%) (Fig. 8). Similarly, Tarunpreet *et al.* (2019) revealed a higher prevalence of *E. coli* associated diarrhoea in the lambs housed under poor hygiene (86.53%) in comparison to the lambs maintained under good hygiene (68.75%) [18]. Poor hygiene in the premise predisposed the animals to infection and therefore it might be one of the supporting factors in the higher prevalence of *E. coli* associated diarrhoea in goats [19].

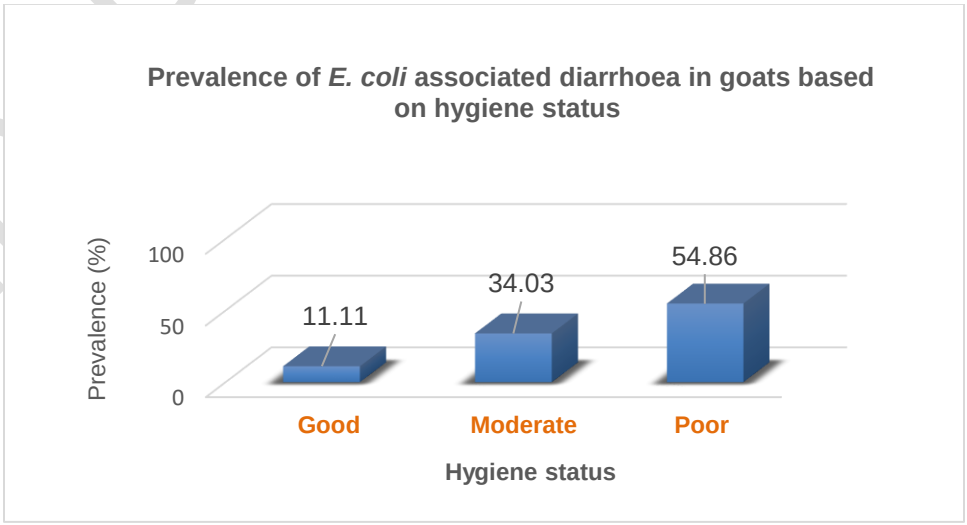

Fig. 8: prevalence of *E. coli* associated diarrhoea in goats based on hygiene status

4. CONCLUSION

Diarrhoea is regarded as a major gastrointestinal disorder frequently observed in goat rearing countries across the globe. Faecal samples were collected from 200 diarrhoeic goats from different areas, ages, sexes, breeds at different seasons and hygiene status in the Chhattisgarh. Microbiological examinations were performed to identify *E. coli*. Higher rates in female goats were observed than males. Anjori breed goats had the highest prevalence as compared to other breeds. Seasonal fluctuations were noteworthy, with a higher prevalence of *E. coli* associated diarrhoea observed in the summer season. In young animals, a greater number of cases of *E. coli* associated diarrhoea in goats reared under poor hygienic conditions suggested that practices involving sanitary measures may reduce the incidences in goats.

ETHICAL APPROVAL

The protocols established by the Institutional Ethics Committee were followed during the operations.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of manuscripts.

REFERENCES

1. Islam K, Ahad A, Barua M, Islam A, Chakma S, Dorji C., Uddin MA, Islam S, Ahasan ASML. Isolation and epidemiology of multidrug resistant *Escherichia coli* from goats in Cox's Bazar, Bangladesh. J. Adv. Vet. Anim. Research. 2016;3(2):166-172.
2. Shabana I, Bouqellah II, Zaraket, H. Investigation of viral and bacterial enteropathogens of diarrhoeic sheep and goats in Medina, Saudi Arabia. Trop. Biomed., 2017;34(4):944-955.
3. Turkyilmaz S, Eskiizmirliler S, Tunaligil S, Bozdogan B. Identification, characterization and molecular epidemiology of *Escherichia coli* isolated from lamb and goat kids with diarrhoea. Acta Vet. Brno., 2014;82(4):357–362.
4. Gupta RK, Niyogi D, Joshi RK, Yadav V, Jaiswal V, Shrivastava DP, Singh SV, Jaiswal S, Singh J, Alam K. Prevalence and phylogenetic analysis of *E. coli* in diarrhoeic goats in eastern plain zone of Uttar Pradesh. Indian J. Anim. Research. 2024.DOI: 10.18805/IJAR.B-5179.
5. Yadav MM. High level of antimicrobial-resistant pathogenic *Escherichia coli* in diarrheic goats reared under semi-intensive system of management at university farm, Maharashtra. Int. J. Chem. Stud., 2019;7(6):62-67.
6. Banerjee J, Bhattacharyya D, Habib M, Chaudhary S, Biswas S, Maji C, Nanda PK, Das, AK, Dandapat P, Samanta I, Lorenzo JM, Dutt T, Bandyopadhyay S. Antimicrobial resistance pattern, clustering mechanisms and correlation matrix of drug-resistant *Escherichia coli* in Black Bengal goats in West Bengal, India. Antibiotics. 2022;11:1344.
7. Sharma RK, Singh G, Purohit K, Kumar D, Sharma MK, Arora S, Limbat R. Microbiological studies on diarrhoeic sheep in Southern Rajasthan. Pharma Innovation, 2021;10(8): 969-972.
8. Zaman S, Ahad A, Sarker MS. Isolation and identification of buccal and intestinal bacteria in goats in Chittagong, Bangladesh. Int. J. Adv. Res. Biol. Sci., 2018;5(4):64-71.
9. Hussein, H.S. and Bollinger, L.M. 2005. Prevalence of Shiga toxin–producing *Escherichia coli* in beef cattle. J. Food Prot., 68(10): 2224-2241.
10. Shrivastava S, Mishra KK, Shrivastava N, Walwadkar KK, Singh AK, Risheen GD. Prevalence of caprine diarrhea due to *Escherichia coli* in the Vindhya region (Rewa) of Madhya Pradesh. Pharma Innovation, 2022;11(3S):1694-1698.
11. Patel H, Kalyani IH, Bariya A, Dodiya V, Sakhare P, Sharma, K. Isolation, characterization, serotyping and antibiogram studies of *E. coli* collected from diarrhoeic neonatal kids. Int. J. Microbiol. Res., 2017;9(2):854-856.
12. Sharma SK, Manat N, Joshi M. Prevalence of colibacillosis in goat kids in Udaipur district of Rajasthan. Ind. J. Vet. Sci. Biotech., 2020;16(2,3,&4):98-100.

13. Azmat M, Khan JA, Ijaz M, Ashraf K, Naseer O. Molecular epidemiology of enteric pathogens associated with diarrheal disease in goat kids. Pakistan J. Zool., 2024;2024:1-8.
14. Abdou NEMI, Majeed QAH, El-Azazy OME, Tahrani LMA, Al-Azemi MS, Alajmi A. Risk factors of diarrhoea in small ruminants in Kuwait. Iran J Vet Res. 2021;22(2):146-149.
15. Prahlad U, Awati, B., Ramesh, BK, Patil NA, Rao PKJ, Tikare V, Mallinath KC, Kharate A, Suryakanth P, Paramesh NB, Revappayya M. Influence of age, sex and season on the occurrence of *Escherichia coli* O157: H7 in sheep and goats of Hyderabad-Karnataka Region, India. Int. J. Curr. Microbiol. Appl. Sci., 2018;7(06):2896-2904.
16. El-Nady HH, Eissa MI, Abou-Zeid NZ, Abd-Elfatah EB, Shehata AA, Fawzi EM. Colibacillosis in lambs and kids in Egypt: Prevalence, serogroups, antibiogram profile, virulence genes distribution and antimicrobial resistance genes. Open Vet. J., 2023;13(9):1106-1115.
17. Ali ME, Sujan KM, Rasel IH, Islam MK. Prevalence of diarrhea of goats and their concurrent blood profile in northwest region of Bangladesh. Asian J. Med. Biol. Res., 2021;7(1):6-11.
18. Tarunpreet, Sharma SK, Singh AP, Goklaney D. Prevalence of colibacillosis disease and clinico-haemato biochemical changes in lambs in southern part of Rajasthan. Vet. Practitioner., 2019;20(1):95-99.
19. Jafari A, Aslani MM, Bouzari, S. *Escherichia coli*: a brief review of diarrheagenic pathotypes and their role in diarrheal diseases in Iran. Iran. J. Microbiol., 2012;4(3):102-117.