Prevalence and morphology of ectoparasites in goats from Tripura, India

P. Bhowmik[1]*, D. Borah[1], M. Kumar[2], P. Barman[3], B. Debnath[4], J. Roy[5] and D.K. Murasing[6]

[1]Department of Veterinary Parasitology, College of Veterinary Science, Khanapara, Assam Agricultural University, Guwahati, Assam, [2]Department of Veterinary Medicine, Bihar Veterinary College, Patna, Bihar. [3]Department of Animal Reproduction, Obstetrics and Gynaecology, [4]Department of Animal Nutrition, [5]Department of Veterinary Clinical Complex, College of Veterinary Science and Animal Husbandry, R.K.Nagar, Agartala, Tripura, [6]Department of Veterinary Gynaecology and Obstetrics, G.B.Pant University of Agriculture and Technology, Pantnagar, India.

*Corresponding author E-mail: pratikbhowmik17@gmail.com

Journal of Livestock Science (ISSN online 2277-6214) 16: 350-358
Received on 16/2/25; Accepted on 3/5/25; Published on 6/5/25
doi. 10.33259/JLivestSci.2025.350-358

Abstract

Goats are a vital part of the livestock industry and play a significant role in the socioeconomic lives of poor and marginalized farmers. This study provides baseline data on the prevalence of various ectoparasites in goats in Agartala, Tripura. A total of 478 goats of various ages and sexes were examined over one year to determine the prevalence and morphological identification of different ectoparasites. The results showed that the overall prevalence of ectoparasitic infestation was 82.42% (394/478). Among the ectoparasites, fleas had the highest prevalence at 78.45%, followed by ticks (71.96%), lice (36.61%), and mites (13.38%). Morphological analysis identified three species of fleas (*Ctenocephalides felis orientis, C. canis,* and *C. felis felis*), two species of ticks (*Haemaphysalis bispinosa* and *Rhipicephalus* (*Boophilus*) *microplus*), two species of lice (*Linognathus africanus* and *Damalinia* (*Bovicola*) *caprae*) and two species of mites (*Sarcoptes scabiei var. caprae* and *Demodex caprae*). The study also revealed that female goats and those older than one year had higher infestation rates. Though prevalence of ectoparasite was recorded throughout the year but highest prevalence was seen in monsoon (tick) and winter season (lice, flea, mite). As far as we are aware, this is the first study on the prevalence of various ectoparasites in goats in Agartala, Tripura. The data generated can help formulate effective control strategies against ectoparasites in goats in the study area and the entire state.

Keywords: Ectoparasite, Goat, Morphology, Prevalence, Tripura.

Introduction

Livestock is an important sector under agriculture in India which provides a significant contribution to the upliftment of the national economy. Among different livestock animals, goat referred as poor man's cow played a huge role to mankind in terms of meat, milk, skin, and pashmina. Ectoparasitism plays a crucial role in the economics of goat rearing by deteriorating animal health, reducing growth rate, and lowering production performance. Skin and associated structures serve as the ecological habitat for the ectoparasites by providing optimum microclimate for the successful completion of its life stages. Ectoparasites including lice, tick, mite and flea cause mechanical damage, irritation, inflammation, and hypersensitivity to the host animal and also act as a vector for transmitting diseases, such as babesiosis, theileriosis, ehrlichiosis, and anaplasmosis. Among different ticks, *Haemaphysalis*, *Hyalomma*, *Boophilus* and *Rhipicephalus* have been reported to transmit several of tick-borne diseases in goats (Anish et al.,2020; Begam et al.,2022). Lice infestation is one of the most common constraints in rearing of goat flocks all over the world (Besana & Pellar, 2020). *Damalinia caprae* and *Linognathus africanus* are the two most common lice that infest Indian goats (Ajith et al.,2017). Various species of flea *i.e Ctenocephalides felis orientis*, *C. canis*, C.felis, *C. felis strongylus* and *Pulex irritants* infests goat throughout the world. However, *Ctenocephalides felis felis* and *C. felis orientis* are the most prevalent goat fleas in India (Soundararajan et al.,2018 b). Mange is a contagious disease caused by *Sarcoptes scabiei* var. *caprae*, *Psoroptes caprae*, *P. cuniculi*, *Chorioptes caprae* and *Demodex caprae* in goats (Kumar *et.al*., 2015; Seid et al.,2016) resulting intense itching and scratching in the affected area accompanied by formation of crusts on the surface of skin which deteriorate the quality of hide and skin. Various workers reported that age and sex have a significant association with the prevalence of ectoparasites (Shabir *et al*.,2018 and Jariko et al. (2020). However, Yacob et al. (2008) stated that prevalence of ectoparasites was not affected by sex or age of the hosts. Although ectoparasites have a significant negative effect on goat farming, there is no information regarding their occurrence and distribution in Agartala, Tripura so far. This study is therefore aimed to explore the morphological characteristic and prevalence of ectoparasites during different season, and determining the magnitude of occurrence in relation to age and sex of the animals.

Materials and Methods

The present study was conducted in a total of 478 goats of different age groups and sexes for a period of one calendar year covering all four seasons (Pre monsoon, monsoon, post monsoon, winter) from March, 2023 to February, 2024 in Agartala, Tripura. The study was carried out at goat breeding farm of College of Veterinary Science & Animal Husbandry (CVSc. & A.H.), R.K.Nagar, Tripura, different private unorganized farms, veterinary hospitals and dispensaries, village households as well as veterinary private clinics. Laboratory works were performed at the Veterinary Clinical Complex (VCC), CVSc. & A.H., R.K.Nagar, Tripura.

Collection and identification of Ticks, Lice and Flea

For collection of ticks, lice and flea ear, head, neck, back, abdominal regions, areas surrounding the eye and genitalia, inter-digital space and tail was thoroughly examined as these areas were previously identified as the common predilection sites of ectoparasitic infestation (Ajith et al.,2017; Gopalakrishnan et al.,2017). The lice and fleas were visualized using the hair separation and combing method (Lewis *et al.*1967) and were collected using a fine brush dipped in 70% alcohol (Giri et al., 2013). All the collected samples were then transferred to clean and labelled plastic vials writing the date, place of collection and preserved in 70% alcohol for preservation until further processing. Temporary and permanent slides of ectoparasites were prepared as per the procedures specified by Ajith et al. (2020), Soulsby (1982) and Cable (1963).

Identification of tick, flea and lice was done by microscopic observation (10x, 40x) under stereoscopic binocular microscope as per the keys and guidelines described by Sen and Fletcher (1962), Lewis (1967), Yamaguti et al. (1971), Joseph (1981), Soulsby (1982), Sebei et al. (2004), Geevarghese and Mishra (2011), Lawrence et al. (2014), Hii et al. (2015) and Alsaqabi (2019).

Collection and identification of mite

Skin scrapings were collected from suspected skin lesions following the method described by Sloss and Kemp (1978) for detection of mites. The scraping materials were then transferred to clean glass vials containing 70 % alcohol for preservation and processed as per procedure of Soulsby (1982). The

morphological identification of the mites was done under stereoscopic compound microscope using the keys of Sen and Fletcher (1962) and Soulsby (1982).

Statistical analysis

Prevalence data was expressed as the percentage. To test the significant association between the difference groups, *Chi square* test was performed. The statistical analysis was done at 1% probability level using the Statistical Package for the Social Sciences (SPSS), Version 25 software (SPSS Inc., Chicago, IL, USA).

Results

The overall prevalence of different ectoparasitic infestation in the present study was found to be 82.42% (394/478). Among different ectoparasites, infestation of flea was found to be the highest (78.45%) followed by ticks (71.96 %), lice (36.61%) and mite infestation (13.38%). Morphological identification of different ectoparasites were summarised in Table 1 & Fig 1-4. Present study also revealed that most of the goats were found to have mixed infestation of different ectoparasites which was presented in Table 2. Sex-wise, prevalence of lice, flea and mite was non-significantly higher in females (Lice:46.6%; Flea:80.8%; Mite:14.0) than male goats (Lice:35.5%; Flea:74.4%; Mite:12.2%). However, a significant association was observed between the prevalence of ticks (Female: 79.8%; Male: 58.88%) and the sex of the animal (Table 3). Age-wise, a significantly higher prevalence of ticks (87.97%), flea (88.31%) and mite (17.52%) was observed in goats aged more than 1 year age group (Table 3). However, the prevalence of lice (39.17%) was found non-significantly higher in goats aged more than 1 year age group. Seasonally, prevalence of tick (81.69%) and lice, flea, mite (48.97%; 88.77%; 22.44%) was found significantly higher in monsoon and winter season (Table 3).

Discussion

In the present study, we determined the prevalence of ectoparasitic infestation and their morphological identification in Agartala, Tripura. The overall prevalence of different ectoparasitic infestation in the present study was 82.42%. This suggested a high impact of different ectoparasites in goats in Agartala, Tripura. The higher prevalence of different ectoparasites in goats goes parallel with the findings of Tesfaye et al. (2012). The reason of higher infestation rates in the present study might due to the favourable climatic conditions, less awareness of farmers to the effects of ectoparasites and growing acaricidal resistance.

Present study revealed that out of 478 goats screened for ectoparasites, infestation of flea was found to be highest followed by ticks, lice and mite infestation. These findings correlate with that of with the findings of Nataraj et al. (2021). Higher prevalence of flea may be because of unscientific and unorganised rearing practice and association of goats with other flea-infested animals in households or grazing fields. Higher prevalence of ticks in the present study correlates with the findings of Soundararajan et al.(2018a) and Anish et al. (2020). However, Begum (2016) reported relatively lower prevalence of ticks in goats of Assam. Possible reasons of this variation in the prevalence per cent may be due to the geographical location and different management practices.

Among different ectoparasites, three species of fleas of the genus *Ctenocephalides i.e Ctenocephalides felis orientis* (60.26%), *C. canis* (32.53%) and *C. felis felis* (7.20%) were recorded in the present study. Earlier, similar species of flea in goat was also by Ashwini et al. (2016) in Karnataka, India. Two species of ticks namely *Haemaphysalis bispinosa* (89.24%) and *Rhipicephalus* (*Boophilus*) *microplus* (10.75%) were recorded in the present study which goes in parallel with the findings of Shruthi et al. (2017) and Anish et.al (2020) from Karnataka and Andhra Pradesh, India. Present study also revealed two different species of lice namely *Linognathus africanus* (62.28%) and *Damalinia* (*Bovicola*) *caprae* (37.71%). In-case of mite, *Sarcoptes scabiei* var. *caprae* (71.87%) and *Demodex caprae* (28.12%) was recorded in goats during the present study.

Most of the goats in the present study were found to have mixed infestation of different ectoparasites where mixed infestation of other ectoparasites with tick was highest. Earlier, mixed infections of ectoparasites were also reported by Shabir et al. (2018) and Ajith et al. (2020) in Ladakh and in the Upper Gangetic Plain and the Western Himalayas. The reason of most of the goats having mixed infestation with different ectoparasites might be because of frequent association of goats with

other domestic animals in the village conditions which enables them to get exposure to multiple ectoparasites.

Prevalence of different ectoparasites was significantly or non-significantly higher in females than male goats. Similar findings have been reported by Jariko et al. (2020). The reason of higher prevalence in females might be due to the hormonal influence and lower immune status of females during pregnancy or lactation. Another possibility of higher prevalence in females according to is that, high prolactin and progesterone hormone levels in females which make them more susceptible to any kind of infection (Borba et al.2018).

Table 1: Prevalence of various genera and species of ectoparasites in goat

Ectoparasites		No. of goats examined	No. of goats found positive	No. of goats found positive for different species	Prevalence (%)
Fleas	*Ctenocephalides felis orientis*	478	375 (78.45%)	226	60.26
	C.canis			122	32.53
	C.felis felis			27	7.20
Lice	*Linognathus africanus*		175 (36.61%)	109	62.28
	Damalinia(*Bovicola*)*caprae*			66	37.71
Ticks	*Haemaphysalis bispinosa*		344 (71.96%)	307	89.24
	Rhipicephalus (*Boophilus*)*microplus*			37	10.75
Mites	*Sarcoptes scabiei* var. *caprae*		64 (13.38%)	46	71.87
	Demodex caprae			18	28.12

Table 2. Single and mixed infestations of ectoparasites in goat

Name of Ectoparasites	Goats positive for single infestation (%)	Mixed infestation with either of the other 3 ectoparasites (%)
Ticks	41 (11.91%)	303 (88.08%)
Lice	27 (15.42%)	148 (84.57%)
Flea	54 (14.40%)	321 (85.60%)
Mite	38 (59.37%)	26 (40.62%)

Table 3. Prevalence of ectoparasites in goats according to sex, age and season

	goats examined	goats positive for ticks	goats positive for lice	goats positive for fleas	goats positive for mites
Sex					
Male	180	106	64	134	22
Female	298	238	111	241	42
Chi-square value		**24.47***	**0.14^{NS}**	**2.74^{NS}**	**0.34^{NS}**
Age					
< 1 Year	187	88	61	118	13
> 1 Year	291	256	114	257	51
Chi-square value		**94.46***	**2.11^{NS}**	**42.82***	**10.98***
Season					
Pre monsoon	127	92	46	96	14
Monsoon	142	116	42	101	11
Post monsoon	111	77	39	91	17
Winter	98	59	48	87	22
Chi-square value		**13.76***	**9.59***	**12.12***	**11.80***
Total	**478**	**344**	**175**	**375**	**64**

'*'Denotes statistically significant; 'NS' Denotes statistically non-significant

Fig. 1a. *Ctenocephalides canis*
The head is small with a strongly convex forehead.

Fig. 1b. *Ctenocephalides canis*
The first spine of the genal comb is shorter and half of the second spine

Fig. 1c. *Ctenocephalides felis orientis*
The head is twice as long as it is high, with an elongate and broadly rounded frons (Black arrow).

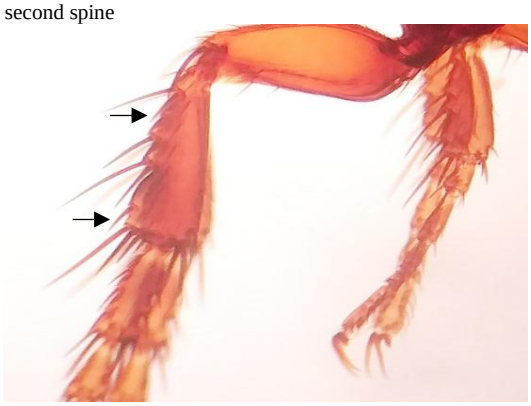

Fig. 1d. *Ctenocephalides felis orientis*
Hind tibiae has 7 dorsal notches with a single stout bristle in its 3rd and 6th notches. (Black arrows).

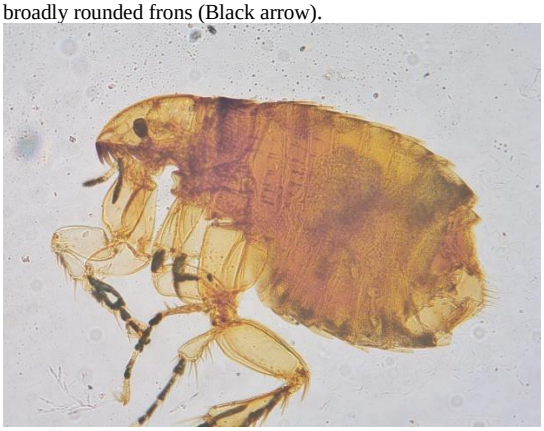

Fig. 1e. *Ctenocephalides felis felis*
Head is elongated and has an acutely angular frons

Fig. 2a. *Haemaphysalis bispinosa*
Festoons (Black arrow) and spiracle (Blue arrow)

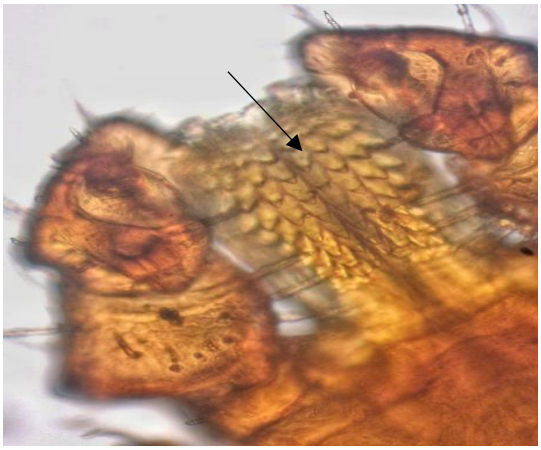

Fig. 2b. *Haemaphysalis bispinosa*
4/4 dental formula (Black arrow)

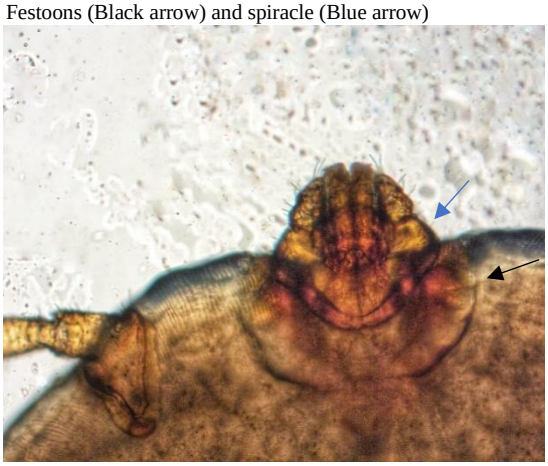

Fig. 2c. *Rhipicephalus* (*Boophilus*) *microplus*.
Hexagonal basis capitulum (Blue arrow) and eyes in scutum (Black arrows).

Fig. 2d. *Rhipicephalus* (*Boophilus*) *microplus*.
Festoons (Blue arrow) and spiracle comma shaped (Black arrow)

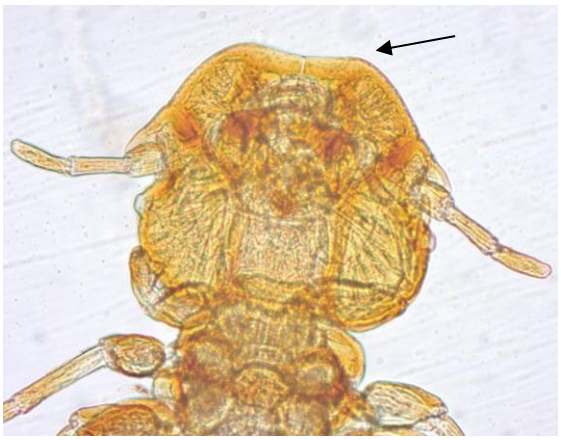

Fig. 3a. *Damalinia* (*Bovicola*) *caprae*.
Bluntly rounded and sub quadrangular head having anterior concavity (Black arrow).

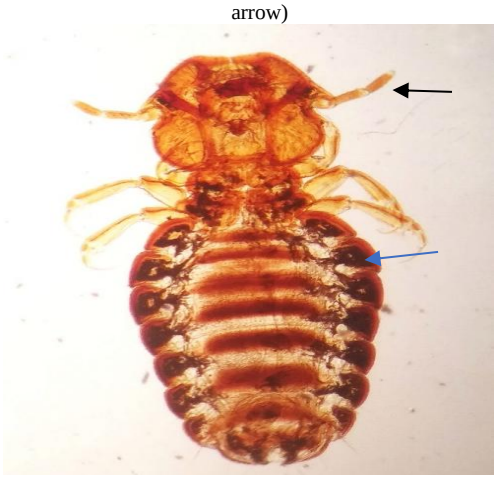

Fig. 3b. *Damalinia* (*Bovicola*) *caprae*.
Three segmented antennae (Black arrow) and abdominal spiracle (Blue arrow).

Fig. 3c. *Linognathus africanus*.
Three segmented legs with one claw each.

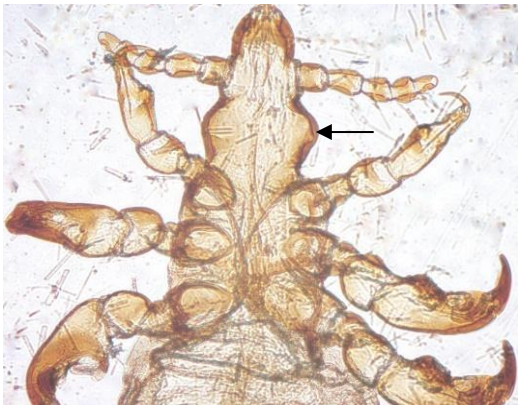

Fig. 3d. *Linognathus africanus*.
Head with prominent bulging and five segmented

Fig. 4a *Sarcoptes scabiei* var. *caprae*
Four pairs of short, stubby legs

Fig. 4b. *Demodex caprea*
Cigar shaped body with four pairs of legs

Age-wise, prevalence of different ectoparasites was significantly or non-significantly higher in goats more than 1 year age group. The worn-out immune system of older animals might increase the chance of more infestation of ectoparasites in the age group more than 1 year (Shuvo et al.,2021). However, the reason of low prevalence in less than 6 months of age group might be as the younger goats were least exposed to ectoparasite infested pasture and were kept in close proximity to households (Kusiluka et al.,1995).

Seasonally, a significant association was observed between ectoparasitic prevalence and the four different seasons. Tick prevalence was significantly ($p<0.01$) highest in monsoon season. The reason of high prevalence of ticks in monsoon might be because of favourable hot climate and ideal relative humidity which enhances the tick multiplication. However, Ajith et al.(2020) and Anish et al.(2020) reported higher prevalence of ticks in the pre-monsoon season. The prevalence of lice, fleas, and mites was significantly ($p<0.01$) higher in winter season. Many reasons can put forward to justify the reason of higher prevalence in winter. Huddling of animals together and less grooming during winter season favours the easy establishment of these ectoparasites in the body of goat. However, certain factors like hot and humid climate were unfavourable for lice propagation (Alilio, 2019) and increase inter-host transmission of mites during winter season might also responsible for higher infestation in winter. Similar findings were also reported by Iqbal et al. (2014), Rashmi and Saxena (2017). The present study implies that the climatic conditions required for infestation of lice, flea and mite are similar whereas a negative correlation of tick with lice, flea and mite was observed.

Conclusion

In conclusion, study highlights a high prevalence of ectoparasites in goats in Agartala, Tripura, identifying two species each of ticks (*Haemaphysalis bispinosa* and *Rhipicephalus* (*Boophilus*)

microplus), lice *(Linognathus africanus* and *Damalinia* (*Bovicola*) *caprae)*, and mites (*Sarcoptes scabiei* var. *caprae* and *Demodex caprae*), and three species of fleas (*Ctenocephalides felis orientis*, *C. canis* and *C. felis felis*). Female goats and those older than one year showed higher infestation rates. Ectoparasite prevalence was recorded throughout the year being highest in monsoon and winter. Effective control measures, including the use of ecto-parasiticides and health awareness programs, are crucial for managing the higher infestations of ectoparasites in the present study area. Further conventional and molecular studies are needed to understand the true epidemiological status and economic impact of ectoparasites in the region.

Acknowledgements

The authors would like to thank the Director of Animal Resource Development Department, Tripura and Principal, CVSc. & A.H., R.K.Nagar, Tripura for providing all necessary permissions and essential support to conduct the research work.

Declaration of interest: None.

References

1) Ajith Y, Dimri U, Gopalakrishnan A, Devi G, 2017. A study on prevalence and factors associated with ectoparasitism in goats of two agro-climatic regions in India. Journal of Parasitic Diseases, 41(3):739-746. doi.org/10.1007/s12639-017-0881-y.

2) Ajith Y, Dimri U, Madhesh E, Gopalakrishnan A, Verma MR, Samad HA, Reena KK, Chaudhary AK, Devi G, Bosco J, 2020. Influence of weather patterns and air quality on ecological population dynamics of ectoparasites in goats. International Journal of Biometeorology, 64(10): 1731-1742. doi.org/10.1007/s00484-020-01952-7.

3) Alilio P, 2019. The louse manifesto. The Pharos: 35.

4) Alsaqabi SM, 2019. Fine structure of Anoplura lice (*Linognathus*) infected goats by scanning electron microscope. International Journal of Science and Research 9(12): 1868-1875.

5)Anish RK, Venu R, Rayulu VC, Jacob SS, Srilatha CH, Surya UNS, Pradeep BS, Prasad T, 2020. Prevalence and diversity of ixodid tick fauna in domestic animals of Andhra Pradesh state, India. Journal of Entomology and Zoology Studies, 8(5): 2346-235. doi.org/10.22271/j.ento.2020.v8.i5af.7825.

6) Ashwini MS, Puttalakshmamma GC, Mamatha GS, Chandranaik BM, Thimmareddy PM, D'Souza P E, 2016. Prevalence and morphological identification of fleas infesting small ruminants in Karnataka. Journal of Veterinary Parasitology, 30(2): 75-80.

7) Atteya M A, Ghobashy M A, Wahba A A, Abouelhassan E M, 2019. Evaluation of the Prevalence and Oxidative Status in Sheep infected with *Sarcoptes scabiei* in Ismailia Governorate, Egypt. Egyptian Veterinary Medical Society of Parasitology Journal, 15: 114-129.

8) Begam R, Talukdar S K, Sarmah P C, Bulbul K H, Kakati P, Tamuly S, Islam S, 2022. Molecular and microscopic detection of *Theileria luwenshuni* infection in goats in and around Guwahati of Assam, India. Biological Rhythm Research, 53(1): 18-25. doi.org/10.1080/09291016.2019.1621066.

9) Besana CM, Paller VGV 2020. Evaluation of Selected Slaughterhouses and Parasites of Slaughtered Livestock in Cotabato Province, Mindanao, Philippines. Journal of Livestock Science 11: 67-76 doi. 10.33259/JLivestSci.2020.67-76

10) Cable R M, 1963. An illustrated Laboratory Manual of Parasitology. (4th edn.). Allied Pacific Pvt. Ltd. Bombay, India.

11) Geevarghese G, Mishra A C, 2011. *Haemaphysalis* ticks of India. (1st Edn.). Elsevier London, 255.

12) Giri D K, Kashyap D K, Dewangan G, 2013. Caprine pediculosis-a prevalence study. Intas Polivet, 14(2): 269-271.

13) Gopalakrishnan A, Dimri U, Nandi A, Ajith Y, Joshi V, Jhambh R, Yatoo M I, 2017. Prevalence study on tick infestations of goat in lower Shivalik region of Uttarakhand. International Journal of Livestock Research, 7(7):158-165.

14) Hii S F, Lawrence A L, Cuttell L, Tynas R, Abd Rani P A M, Šlapeta J, Traub R J, 2015. Evidence for a specific host-endosymbiont relationship between '*Rickettsia* sp. genotype RF2125'and *Ctenocephalides felis orientis* infesting dogs in India. Parasites & vectors, 8(1): 1-9.

15) Iqbal A, Siddique F, Mahmood MS, Shamim A, Zafar T, Rasheed I, Saleem I, Ahmad W, 2014. Prevalence and impacts of ectoparasitic fauna infesting goats (*Capra hircus*) of district Toba

Tek Singh, Punjab Pakistan. Global Veterinaria 12(2):158-164. 10.5829/idosi.gv.2014.12.02.8286.
16) Jariko AA, Leghari RA, Gadahi JA, Memon MUR, Khaskheli AA, Koondhar MQ, Jariko RA, Jariko MA, 2020. Prevalence of tick infestation in goats reared under semi-intensive system. Pure and Applied Biology, 9(1): 1177-1183. doi.org/10.19045/bspab.2020.90123.
17) Joseph SA,1981. Studies on the bionomics of *Ctenocephalides felis orientis* (Jordan)1925. Cherion, 5 (2): 73-77.
18) Kumar M, Roy J, Singh MN, Sharma CS, Monsang SW,2015. Comparative efficacy of keetguard (herbal acaricide) amitraz and deltamethrin against *Sarcoptes scabiei* in black Bengal goats. Indian Society for Veterinary Medicine, 35(1):62-64.
19) Lewis R E,1967. The fleas (Siphonaptera) of Egypt. An illustrated and annotated key. Journal of Parasitology, 53(4): 863-885.
20) Lawrence A L, Brown G K, Peters B, Spielman D S, Morin-Adeline V, Šlapeta J, 2014. High phylogenetic diversity of the cat flea (*Ctenocephalides felis*) at two mitochondrial DNA markers. Medical and Veterinary Entomology, 28(3): 330-336. doi.org/10.1111/mve.12051.
21) Nataraj N, Muthuraman K, Ayyanar E, Ashokkumar M, Kumar A, Srinivasan L, Devaraju P, 2021. Ectoparasite diversity in pets and livestock from Puducherry, India. International Journal of Acarology, 47(7): 628-632.
22) Neog R, Borkakoty M R, Lahkar B C, 1992. Mange mite infestation in goats in Assam. Indian Veterinary Journal, 69(10): 891-893.
23) Rashmi A, Saxena AK, 2017. Population levels of phthirapteran ectoparasites on the goats in Rampur (UP). Journal of Parasitic Diseases, 41(3):778-781. DOI 10.1007/s12639-017-0888-4.
24) Sebei P J, McCrindle C M E, Green E D, Turner M L, 2004. Use of scanning electron microscopy to confirm the identity of lice infesting communally grazed goat herds. Onderstepoort Journal of Veterinary Research,71(2): 87-92.
25) Seid K, Amare S, Tolossa Y H, 2016. Mange mites of sheep and goats in selected sites of Eastern Amhara region, Ethiopia. Journal of Parasitic Diseases,40(1): 132-137.
26) Sen SK, Fletcher TB, 1962. Veterinary entomology and acarology for India. (1st edn.). ICAR, New Delhi.
27) Shabir M, Yatoo MI, Kanwar MS, Kubrevi SS, Dar R, Angmo K, 2018. Ectoparasite prevalence in Pashmina goats in Changthang: A pastoralnomadic area of Ladakh. Indian Journal of Animal Science, 88(3): 281-284.
28) Shruthi R, Thimmareddy PM, Mamatha GS, Chandranaik BM, Puttalakshmamma GC, 2017. Studies on theileriosis in goats from Karnataka, South India. Journal of Parasitic Diseases, 41(4): 1082-1085. DOI 10.1007/s12639-017-0937-z.
29) Shuvo SM, Siddiqui TR, Hoque MR, Begum N, Paul DR, Alim MA, Alam MZ, Dey AR, 2021. The prevalence and potential factors associated with ecto-parasitic infestations in Black Bengal Goats in Mymensingh, Bangladesh. Bangladesh Journal of Veterinary Medicine, 19(2):93-105.
30) Sloss M W, Kemp RL,1978. Veterinary Clinical Parasitology. (5th edn.). Iowa State Univ. Press, Ames, Iowa, U.S.A.
31) Soundararajan C, Nagarajan K, Muthukrishnan S, Prakash M A, 2018a. Tick infestation on sheep, goat, horse and wild hare in Tamil Nadu. Journal of Parasitic Diseases, 42(1): 127-129. doi: 10.1007/s12639-018-0977-z.
32) Soundararajan C, Nagarajan K, Prakash M A, 2018b. Occurrence of flea infestation on goats under stall fed condition and its control. Journal of Parasitic Diseases, 42(3): 444-448. doi.org/10.1007/s12639-018-1006-y.
33) Soulsby EJL,1982. Helminths, Arthropods and Protozoa of Domesticated Animals, 7th Edn., English Language Book Society, Bailliere, Tindall, London.
34) Tesfaye D, Assefa M, Demissie T, Taye M, 2012. "Ectoparasites of small ruminants presented at Bahir Dar Veterinary Clinic, Northwest Ethiopia," African Journal of Agricultural Research, 7:4669–4674
35) Yamaguti N, Tipton V J, Keegan H L, Toshioka S,1971. Ticks of Japan, Korea, and the Ryukyu islands. Brigham Young University Science Bulletin Biological Series, 15(1): 1.
36) Yacob HT, Yalew TA, Dinka AA,2008. Part I: ectoparasite prevalences in sheep and in goats in and around Wolaita soddo, Southern Ethiopia. Revue de MédecineVétérinaire,159(8-9):450-454.