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Tick-borne diseases and their diagnosis in bovine animals

Amit Gupta*, Prernaa Sharma**

*Associate ProfessorDepartment of Life Sciences, Graphic Era Deemed to be University, Dehradun
**Research scholar, Department of Environmental Science, Graphic Era Hill University, Dehradun

ABSTRACT

India is predominately an agricultural land where the population (> 70 %) is dependent upon agricultural income. About 20.5 million people are dependent upon livestock for their livelihood. Farmers keep animals for the economical income from the milk, meat, wool, farming, and various agricultural operations. India is the number one milk, producer where cattle (199 million) and buffalos (105 million) are reared and most of which agonize from a multi-tick infestation. According to the pesticide consumption data, India comes 13 with the highest consumption and the external cost of pesticide are around $4-$19 per kg of the active ingredient and an annual expenditure of US$498 million has been calculated to treat tick- and tick-borne diseases. The economic loss due to tropical theileriosis in 2003 was estimated at around US$384 million and babesia infection mainly caused in cross-breed cattle and buffaloes cause economic mislaying or loss of around more than US$57.2 million which is very high for a developing country like India where marginal farmers cannot afford the treatment of their livestock. The diverse species of ticks are distributed in India due to favorable climatic conditions for the ticks to flourish in their population. Various tick species were reported from the various states of India and these ticks require a hot and humid climate for their survival to live.

Keywords: Ticks; cattle; buffaloes, disease; climate

INTRODUCTION

Ticks are the active vectors for ages they transmit a wide range of pathogens that cause some chronic and sometimes fatal diseases to the animal host. Infected ticks spread over hundreds of diseases that if remain untreated cause the death of the host. They are considered the reservoir of pathogens and there are many studies that confirm the presence of several microbial pathogens in different parts of the tick body. New technologies have revealed the presence of viruses, bacteria, protozoan, and fungi are the different microbial communities associated with tick-borne disease. These microbes may act as symbionts, transient commensals or pathogens **[1].** Since ticks are blood-feeding, they transmit these microbes from one stage to another stage of their life cycle and even female ticks can transmit these pathogenic microbes to their offspring. Economically important animals such as cattle are the most affected animal in terms of production loss and they are invaded by different tick-borne disease **[2, 3]** are in the sub-tropical country like India some of the common

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and important cattle diseases in India are-

Bovine Babesiosis (Fig.1)- *Bovine babesiosis* is a disease of cattle, tick-borne and transmitted by *Rhipicephalus* (a major tick vector). The principle strains of *Bovine babesiosis* are *Babesia bovis* and *Babesia bigemina*. Divergents of *Babesia* that infect cattle include *Babesia major, Babesia ovata, Babesia occultans, Babesia jakimovi* and the vector for these divergent i.e. *Ixodes ricinus*. *Babesia bovis* and *Babesia bogemina* are the two most extensively disseminated and showed their economic significance **[4, 5].** Transmission of *Babesia bovis* takes place by infected female tick engorgement occurs to the animal and is predominately observed in adult cattle. The main *Babesia bovis* symptoms of disease in cattle are high fever, parasitaemia (% age of infected RBCs) maximum blood profile (< 1%) and several neurological disorders were reported (i.e. incoordination, teeth grinding etc.).

In several studies, *Babesiosis bigemina* is found in the bovines and cattle in different parts of India including Punjab, Patna and Meghalaya. The successful treatment of *Bovine babesiosis* depends upon the early diagnosis of the disease and prompt administration of drugs into the cattle for better prevention **[4, 5].** This is difficult because there are wide ranges of cattle species involved in a single place. Protection depends upon premutation and continuous exposure to infected ticks to maintain protection which is mainly established through the inoculation process. Prevention of this disease i.e. *Babesiosis* is dependent upon tick elimination through regular dipping of cattle with *Acaridae* at regular intervals of two weeks or less, depending upon the local ecology of the vector **[6, 7].**

Fig.1. Symptoms of bovine Babesiosis
(Superficial lymph nodes and enlarged mandibular)

Anaplasmosis (yellow bag or yellow fever, Fig.2)
Anaplasmosis, tick vector-borne infectious blood disease of cattle and buffaloes caused by rickettsial parasites including *Anaplasma marginale* and *Anaplasma centrale*. *Anaplasma bovis*, *Anaplasma caudatum*, *Anaplasma phagocytophilum* are the other species that cause *Anaplasmosis* in cattle. Among 5, *Anaplasma marginale* is the most pathogenic and fatal and also most widely distributed. In cattle, *Anaplasma centrale* causes mild anaplasmosis and is used as an immunization agent whereas *Anaplasma bovis* causes acute anaplasmosis which is mainly related to stress. *Anaplasma phagocytophilum* is also identified in cattle but it is more effective in infecting human

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beings than cattle. This parasite infects red blood cells (RBCs) and causes severe anemia in bovines. The symptoms of this disease are Anemia, fever, weight loss, breathlessness, jaundice, uncoordinated movement, abortion and in some cases death of the cattle **[8, 9].**

In India, *Anaplasma marginale*, *Anaplasma central* and *Anaplasma bovis* are the most prevalent infectious species in cattle. The principle transmitter of anaplasmosis in India is *Rhipicephalus* (boophilus) microplus. The studies of anaplasmosis cover sixteen states including Karnataka, Haryana, Uttar Pradesh, Gujarat, Tamil Nadu, Punjab, Rajasthan where most studies were done and one study from North India (Jammu and Kashmir, Himachal Pradesh), South India (Andhra Pradesh, Kerala), eastern and western India (Maharashtra and west Bengal) each were done. Most cases of *anaplasmosis* increase during the late summer season because at this time vector population rises, so effective prevention of this disease is done by controlling the vector population during the summer time of the year. If necessary, the herd is injected with oxytetracycline every 3 to 4 weeks during peak times of summer. This may prevent an animal from clinical symptoms but an animal can become the carrier of a disease. Chlortetracycline can also be used to prevent *anaplasmosis* in the herd. A consistent proper amount of mineral intake can prevent *anaplasmosis* infection in cattle **[10, 11].**

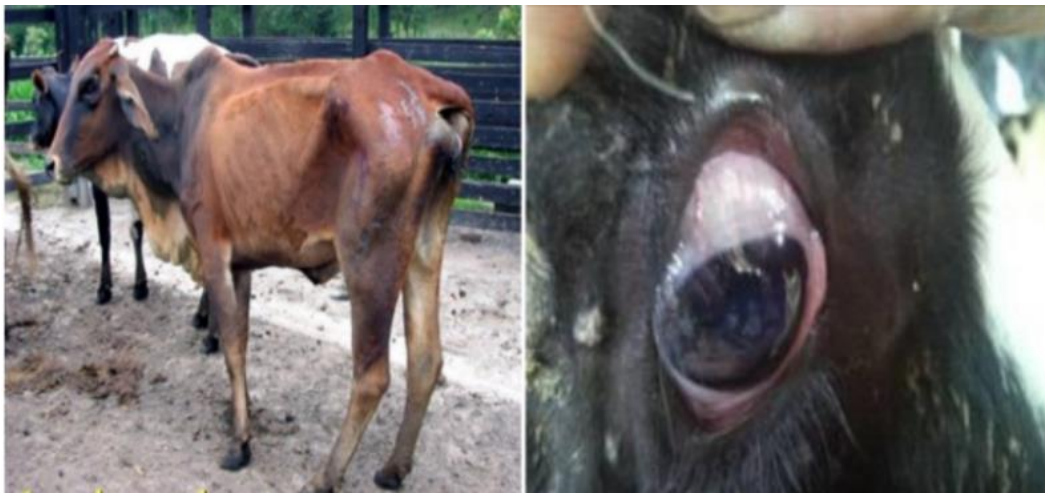

Fig.2. Symptoms of Anaplasmosis in cattle anemia with pale mucus membrane

Theileriosis

Theileriae is the intercellular protozoan parasite and it is most closely related to babesia, but it differs from *Babesia* in terms of development. *Theileria* develops first in the leucocytes and then infects the erythrocytes of the host. *Theileriosis* is the most infectious disease of cattle throughout the world. There are several *Theileria* species identified which infect cattle out of which *Theileria parva, Theileria orientalis, Theileria annulata* are the most important pathogens that cause East coast fever, Oriental theileriosis or *Theileria*-associated bovine anemia and *Tropical theileriosis* respectively. *Theileria annulata* is transmitted by the *Rhipicephalus* species, *Theileria orientalis* by *Haemaphysalis* species and *Theileria annulata* by *Hyalomma* species of ticks. Clinical symptoms such as fever, appetite, anemia, dyspnea, reduced milk yield, abortion, swollen subcutaneous lymph node, icterus, hemoglobinuria and soil licking are the suspicious signs of infection in cattle **[12, 13].**

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Indian bovines have been struggling with *theileriosis* disease and established as long-term victims for the past 4 decades. Studies revealed that most of the Indian states are dealing with this disease. *Tropical theileriosis* is common amongst Indian cattle. Infection was found in states Gujarat, Kerala, Uttar Pradesh, Punjab, Haryana, Maharashtra, Chhattisgarh, Karnataka, West Bengal, Odisha, except in Himalayan regions they were not found in a serological survey. Medicines for other cattle diseases are mostly available and not so costly but for theileriosis medicines are not available and the few available vaccines are very costly. Antiparasitic drugs are most widely used to treat the infection which helps in removing *T. annulata* from the lymph node of infected cattle but remains in the blood in very less number which makes the animal as a carrier. The carrier organism plays an important role in the transmission of disease via tick. It is difficult to observe infection in the carrier organism as the reports are always negative for infection. Understanding the infection life cycle of the pathogen should be determined along with clinical diagnosis **[12-14].**

Host immune response

It has been exemplified that non-identical vertebrate hosts of ticks have varying immune responses to tick bites and salivary components injection into the host during feeding. The researches on these tick salivary components are in great focus for several scientific research purposes. There are several pieces of research carried out on tick salivary biochemical compounds to the determination of specific antigens. One of the main goals of this research is to find out a validated and effective molecule for an anti-tick vaccine, which is specific to tick species. It has been difficult to understand the different immune responses of the host again tick bite and components and it is crucial to design and find a vaccine for human and animal use **[11-14].** Antitick immunity has been described earlier in many animals such as guinea pigs, cattle's and rabbits and the host previously exposed to tick acquire the capacity to deal with tick infestation by interfering with tick feeding and reproduction fecundity.

Diagnosis of tick-borne diseases [15, 16]

Diagnosis of the disease can be done by a single or combination of techniques to identify the disuses causing the pathogen. An accurate diagnosis is a prerequisite for effective disease management. Currently available and most widely used methods for the diagnostic of tick-borne disease (TBDs) are: blood smear microscopic examination, serological test and DNA-based PCR methods are adopted. Differentiation of these processes is shown in **Table 1.**

Table 1. Comparison of methods adopted for TBD detection in cattle.

Method	Sensitivity	Specificity	Cost	Thought put
PCR	++++	++++	++++	++++
Blood smear	+	+	+	++
IFAT	++	++	++	++
ELISA	+++	++	++	+++

Microscopic method

The blood smear microscopic method is the standard technique adopted for the routine examination of TBDs in cattle and other organisms. In this method, diagnosis of the disease is done based on clinical findings and microscope examination of blood and lymph node smear stained by Giemsa

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stain and observed under the microscope in oil emersion for the presence of macro schizonts in acute cases. This method is comparatively less time-consuming than all the other diagnostic methods and it is comparatively inexpensive also.

The smear method is associated with technical problems the drawbacks of this technique is that the accuracy of the examination depends upon the experience and training of the laboratory personnel. In this technique, it has low sensitivity and accuracy and even wrong diagnosis because it has low sensitivity in diagnosing carrier cattle. In the studies of hemolymph of boophilus for parasite Babesia infection there has been a lack of standardization in smear preparation by hemolymph results into a different thickness of the smear and affect the sensitivity of microscopic examination. The amount of blood used to make a smear is not standardized in most of the experiments, this observation of smear is not relevant for the microscopic examination.

Serological method

Many serological diagnostic methods are standardized for TBDs and are employed in epidemiological field studies. There are a number of limitations are associated with the serological assay which is associated with the antibodies stability, sensitivity, specificity, and objectifying the readings and results. These limitations are applicable to all the serological assays. For detection of theileriosis serological tests such as complement fixation test, immunofluorescent assay and enzyme linked immunosorbent assay any one of these technique is applied to analyze the level of circulating antibodies using either piroplasm or cultured macro schizonts as the antigen.

Cross reactivity with antibodies are administered against other *Theileria* species which limits the specificity of the immunofluorescent assay. Moreover, antibodies tend to vanish or withdraw in long term carrier host, whereas theileria piroplasm persist. Therefore, an animal with the negative serological reports can still infect ticks. This technique is unable to differentiate between recovered sterile, carrier and clinical case animal samples. The serological test is also not able to detect chronically infected animals.

Polymerase Chain Reaction

This is an incipient method in the field of TBD diagnostics but this diagnostic technique is highly specific and sensitive in comparison to the other two methods and it has been verified by many authors **[15, 16].** PCR is a DNA based technique for the detection of TBD. This PCR technique include standard PCR, southern blotting, reverse line blot (RLB), RT-PCR and isothermal amplification methods. PCR methods are more reliable and the results are accurate but the cost of these methods is higher than the serological and microscopic method which limits their use in veterinary diagnostics in marginal countries.

The outcome of these studies provides fundamental information to explore and develop effective vaccines applicable in this field.

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REFERENCES

1. Boulanger N, Boyer P, Talagrand-Reboul E, Hansmann Y. Ticks and tick-borne diseases Tiques et maladies vectorielles à tiques. Med Mal Infect 2019; 49:87–97.
2. Dantas-Torres F, Chomel BB, Otranto D. Ticks and tick-borne diseases: a one health perspective. Trends Parasitol 2012; 28:37–46.
3. Brites-Neto J, Duarte KMR, Martins TF. Tick-borne infections in human and animal population worldwide. Vet World 2015; 8:301–15.
4. Ioannou I, Sandalakis V, Kassinis N, Chochlakis D, Papadopoulos B, Loukaides F, *et al*. Tick-borne bacteria in mouflons and their ectoparasites in Cyprus. J Wildl Dis 2011; 47:300–306.
5. Zintl A, Mulcahy G, Skerrett HE, Taylor SM, Gray JS. *Babesia divergens*, a bovine blood parasite of veterinary and zoonotic importance. Clinical microbiology reviews 2003;16(4):622–636.
6. Guerrero FD, Bendele KG, Davey RB, George JE. Detection of *Babesia bigemina* infection in strains of *Rhipicephalus* (*Boophilus*) microplus collected from outbreaks in south Texas. Veterinary parasitology 2007;145(1-2):156–163.
7. Aikawa M, Rabbege J, Uni S, Ristic M, Miller LH. Structural alteration of the membrane of erythrocytes infected with *Babesia bovis*. The American journal of tropical medicine and hygiene 1985; 34(1):45–49.
8. Ashuma SA, Singla LD, Kaur P, Bal M.S, Batth B.K, Juyal P.D. Prevalence and haemato-biochemical profile of *anaplasma marginale* infection in dairy animals of Punjab (India) Asian Pac J Trop Med 2013;6:139–144.
9. Prasanna PK, Sangwan AK. Comparative prevalence of subclinical bovine anaplasmosis under different cattle management systems in Haryana. Haryana Vet 2010; 49:1–5.
10. Atif FA, Khan S, Iqbal HJ, Roheen T. Prevalence of tick-borne diseases in Punjab, Pakistan and hematological profile of Anaplasma marginale infection in indigenous and crossbred cattle. Pak J Sci 2012; 64:11–15.
11. Futse J.E, Ueti MW, Knowles DP, Palmer GH. Transmission of *Anaplasma marginale* by *Boophilus microplus*: Retention of vector competence *Boophilus microplus*: Retention of vector competence. J Clin Mic 2003; 41:3829–3834.
12. Brahma J, Baishya BC, Phukan A, Mahato G, Deka DK, Goswami S. Prevalence of *Theileria orientalis* in crossbred cattle of Kamrup district of Assam. International Journal of Chemical Studies 2018; 6: 1791–94.
13. Farooq U, Tufani NA, Malik HU, Mir MS. Clinical and morpho-molecular epidemiology of bovine theileriosis in Kashmir, India. Indian Journal of Animal Research 2019; 53: 375–381.
14. Nene V, Morrison WI. Approaches to vaccination against *Theileria parva* and *Theileria annulata*. Parasite Immunology 2016; 38(12): 724–34.
15. Anupama R, Srinivasan SR, Parthiban M. Molecular studies on theileriosis and identification of *Theileria orientalis* in India using PCR. Indian Veterinary Journal 2015; 92: 9–11.
16. Anwar K. Epidemiology of tick-borne infection in ruminants in Peshawar. Journal of Advanced Parasitology 2018; 5: 6–10.