


Studies on theileriosis in goats from Karnataka, South India

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Abstract A study was conducted to determine the prevalence of theileriosis in goats from southern districts of Karnataka. Out of 47 goat blood samples examined by microscopy, 68.08% (32/47) were positive for *Theileria* spp. The parasitemia ranged from 1.0 to 1.8 and 0.1–0.9% in clinical and carrier animals respectively. Out of 325 ticks collected from goats, 92.6 (301) and 7.38 (24)% of the ticks were found to be *Haemaphysalis* and *Rhipicephalus* respectively. *Hemaphysalis kutchensis* (90.15%) was found to be the predominant species followed by *R. haemaphysaloides* (6.7%), *H. intermedia* (1.84%), *H. bispinosa* (0.61%) and *R. sanguineus* (0.61%). The present study indicated that caprine theileriosis is an endemic disease in Karnataka and suggested that *Haemaphysalis* and *Rhipicephalus* ticks may play a role in transmission of the disease.

Keywords Prevalence · Theileriosis · Ticks · Goats · Karnataka

Introduction

Theileriosis is a tick-borne haemoprotozoan disease caused by protozoan species belonging to the genus *Theileria*. These are obligatory intracellular parasites of the family Theileriidae that are known to infect wild and domestic ruminants in tropical and subtropical regions of the world (Dolan 1989). The disease being a major threat to livestock industry has become a constraint to goat production by causing economic losses in terms of high morbidity and mortality. The disease is also important due to its significance in the international trade of animals and animal products (Uilenberg 2001). In India *T. hirci* and *T. ovis* are the most prevalent species reported in small ruminants (Sisodia 1981; Kaufmann 1996).

However, there is no information on epidemiological aspects of the disease. Ixodid ticks being the vectors for theileriosis not only transmit the disease but also lower the production in animals by causing anaemia. In Karnataka state, no systematic studies have been conducted on theileriosis in goats. Hence, there is paucity of information on prevalence of caprine theileriosis especially regarding the causative agent and the vectors. Therefore, the present study was undertaken to record an overall prevalence of *Theileria* spp., and ticks involved in the transmission in goats.

Materials and methods

The study was carried out in seven southern interior districts of Karnataka namely Bengaluru Urban, Chikkaballapura, Chitradurga, Kolar, Ramanagar, Shivamogga and Tumkur during the period from March 2015 to February 2016 (Table 1).

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Table 1 Particulars of blood samples collected from goats from different districts

Sl. no.	Districts	No. of samples collected
1	Bengaluru urban	2
2	Chikkaballapura	4
3	Chitradurga	2
4	Kolar	12
5	Ramanagara	9
6	Shivamogga	8
7	Tumkur	10
	Total	47

A total of 47 goat blood samples were collected from both ailing and apparently healthy animals with tick infestation in EDTA coated vacutainers. The thin blood smears were prepared immediately, air dried, fixed in absolute methanol for 1 min and stained with diluted Giemsa stain (1:9) for 30 min. The slides were examined under oil immersion objective of the microscope (1000x) for the presence of *Theileria* organisms. Percentage of parasitemia was assessed by counting number of infected cells per 1000 RBC and infected cells were expressed as percentage (Yin et al. 2002). The haemoglobin levels were determined by automated haematology analyzer (Erba, Germany).

Ticks were collected manually from the same animals from different areas on the animal body like head, ears, axillae, abdomen and genital regions in well ventilated collection bottles. Ticks were cleared in liquid phenol (Carbolic acid) for four to 8 h and mounted in phenol balsam (1 part phenol + 1 part canada balsam). Ticks were observed under 10× and 40× of the stereo-zoom microscope and were identified as per the standard keys (Shariff 1928; Walker 1994; Geevarghese and Mishra 2011).

Results and discussion

During this study, out of 47 goat blood samples examined by microscopy, 32 (68.08%) samples were found positive for *Theileria* organisms in Giemsa stained blood smears. The specific identification is being carried out in a separate study.

The highest prevalence of *Theileria* spp., recorded during this present study is in contrast to the lower prevalence rates reported elsewhere viz., 20.8% of prevalence was recorded in local black breed goats infected with *T. hirci* from Duhok area in China (Zangana and Naqid 2011); 8.2 (21/256)% from Lahore (Naz et al. 2012); 1.54% from Black Sea region of Turkey (Aydin et al. 2013); 2.88%

from Turkey (Altay et al. 2007); 3.8% from Islamabad (Irshad et al. 2010) and 8.2% from Lahore district of Pakistan (Naz et al. 2012). The differences in the prevalence of theileriosis in different geographical areas could be due to variation in the geoclimatic conditions and availability of suitable vectors.

The *Theileria* organisms observed in the red blood cells of goats during this study were highly pleomorphic viz, rod forms (24%), pear forms (18%), dot forms (18%), nail forms (6%), comma forms (10%), oval forms (6%), parachute forms (4%), round forms (4%), semi comma forms (2%) and other forms (8%) (Fig. 1). Similar forms have been observed in *T. hirci* infected goats by Jianxun and Hong (1997) in West China. Guo et al. (2002) has reported ring forms (32.7%), parachute forms (29.2%), semi-comma forms (15.3%), oval forms (10.2%), nail forms (5.5%), rod forms (5.0%) and other forms (2.1%) in China. Aktas et al. (2005) has observed oval, round or dot forms in *T. hirci* infected goats from Iraq.

During this study, the symptoms like high fever (104–107 °F), severe anaemia, superficial enlargement of lymphnodes, and abortion in pregnant animals with heavy tick infestation were noticed in clinically infected goats.

The level of parasitemia during this study ranged between 1.0 and 1.8% in clinical and 0.1–0.9% in carrier animals. However, parasitemia of 3.2–3.7% has been recorded in goats from China (Guo et al. 2002). This could be attributed to the stage of the disease at which the blood smears were made because, high parasitemia will be seen in acute/clinical stage whereas, low parasitemia is a

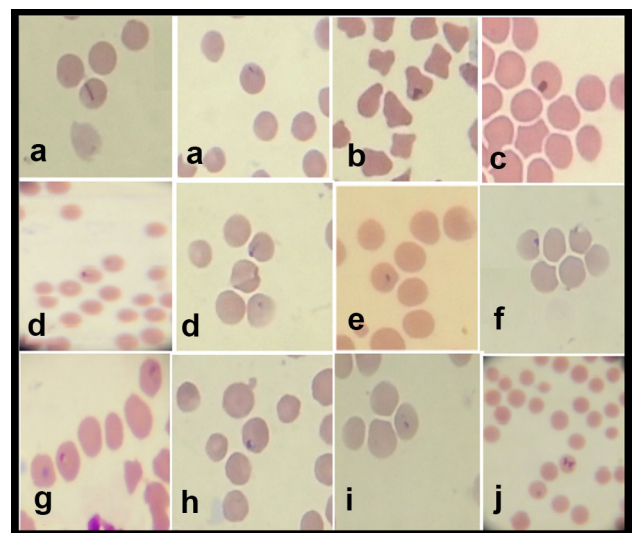


Fig. 1 Different morphological forms of *Theileria* organisms in Giemsa stained blood smears. **a** Rod form, **b** pear form, **c** dot form, **d** nail form, **e** comma form, **f** oval form, **g** parachute form, **h** round form, **i** semi comma form, **j** other forms

characteristic feature of carrier or chronic stage of the disease (Yin et al. 2008).

The haemoglobin levels of the ailing animals ranged from 2.8 to 5.6 gm/dl in the present study. This was in accordance with findings of Zangana and Naqid (2011) who reported decreased RBC count, Hb concentration, PCV and increased mean corpuscular volume with macrocytic and normochromic type of anaemia in local black breed goats in the Duhok area of Iraq. The change in the haematological values could probably be due to development of intravascular hemolysis or destruction of red cell by intra-erythrocytic stages of *Theileria* spp. (Barnett 1978).

In the present study, a total of 325 ticks were collected from both ailing and healthy animals. The majority of the ticks were found infesting the ears (>95%) (Fig. 2) and least number of ticks were found on abdomen, near eyelids, axillae, around perineum and other parts of the body. More number of ticks were collected during the period from March to May. Since, in southern districts the temperature was around 25 to 35° C with an average rainfall of 1068.8 mm per annum known to be conducive for development of ticks.

Out of 325 ticks collected from sheep 7.38 (24/325)% of ticks were *Rhipicephalus* spp., whereas 92.6 (301/325)% of ticks were *Haemaphysalis* spp. *Haemaphysalis kutchensis* (90.15%) (Fig. 3) was found to be the most predominant species followed by *R. haemaphysaloides* (6.7%) (Fig. 4), *H. intermedia* (1.84%), *H. bispinosa* (0.61%) and *R. sanguineus* (0.61%).

The high prevalence of *Haemaphysalis* spp., compared to *Rhipicephalus* spp., during this study is in accordance with Neal et al. (1987) who had reported higher prevalence of *H. intermedia* followed by *R. haemaphysaloides* in *Theileria* infected sheep and goats from Chikkamagalur district of Karnataka during hot weather and monsoon



Fig. 2 Goats showing severe tick infestation in ears

season. Whereas Jagannath and Lokesh (1988) had reported *H. intermedia* (>70%) throughout the year in sheep (1164) and goats (372) from Kolar district of Karnataka and also reported severe tick infestation in ears. The attachment of ticks is dependent on the temperature and the thickness of the skin of the animals (Feldman and Borut 1983) because the temperature of the skin covering the body (35 °C) will be higher than the ear (25 °C) (Tukahirwa 1976) which facilitates easy acquirement of blood by ticks for their nourishment.

Latha et al. (2004) and Vathsala et al. (2008) had reported the highest prevalence of *H. bispinosa* followed by *R. haemaphysaloides*, *Hyalomma marginatum isaaci* and *H. anaticum anaticum* in healthy sheep and goats from Tamilnadu, Similarly Soundararajan et al. (2014) also reported highest prevalence of *H. bispinosa* (100%) followed by *H. m. isaaci* (7.29%), *R. haemaphysaloides* (3.13%) and *H. anaticum anaticum* (2.08%) in goats from Tamilnadu. The differences in prevalence rate of ticks in different geographical areas could be probably due to variation in the geoclimatic conditions because the climatic conditions are the major influential factors for the prevalence of ticks (Ahmed et al. 2007).

During the present study, the goats reared under intensive system of management were less infested with ticks compared to free range system which is in accordance with Soundararajan et al. (2014).

The present study concluded that the caprine theileriosis is an important endemic disease in Karnataka. *H. kutchensis* was found to be the most predominant tick followed by *R. haemaphysaloides*. The present study suggested that *H. kutchensis* may play an important role as a vector in transmission of *Theileria* spp. Hence, there is a need for considering the contributing formative factor of this tick in the epidemiology of theileriosis in Karnataka.

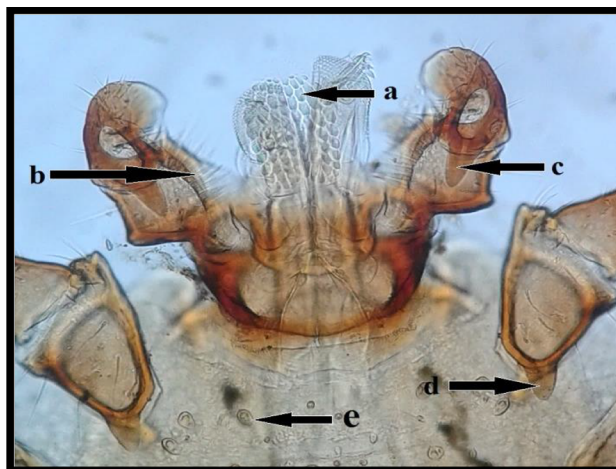


Fig. 3 Mouth parts of *Haemaphysalis kutchensis*. **a** Hypostome; **b** infra internal setae; **c** retro ventral spur; **d** coxal spur; **e** punctuations

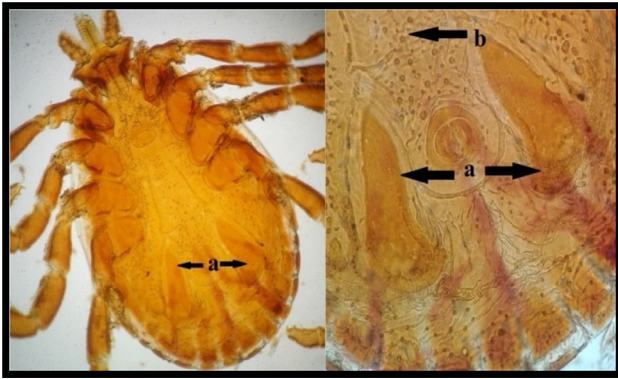


Fig. 4 Male *Rhipicephalus haemaphysaloides* tick. **a** Anal plates; **b** punctuations

However, further research work is needed to know the prevalence of ticks in other regions and their probable role as a vector in transmission of *Theileria* spp., in India.

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Compliance with ethical standards

Conflict of interest All the authors declare that there is no actual or potential conflict of interest.

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