PREVALENCE OF TICKS AND TICK BORNE INFECTIONS IN CATTLE AT DINAJPUR SADAR

A THESIS

BY

MANASI SAHA
MREGISTRATION NO.: 1005112
SEMESTER: SEPTEMBER'2011 – FEBRUARY'2012
SESSION: 2010-2011

MASTER OF SCIENCE (M. S.)

IN

PATHOLOGY

DEPARTMENT OF PATHOLOGY AND PARASITOLOGY
HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR

FEBRUARY 2012

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Submitted to the
Department of Pathology and Parasitology
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DEPARTMENT OF PATHOLOGY AND PARASITOLOGY
HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR

FEBRUARY 2012

DEDICATED TO

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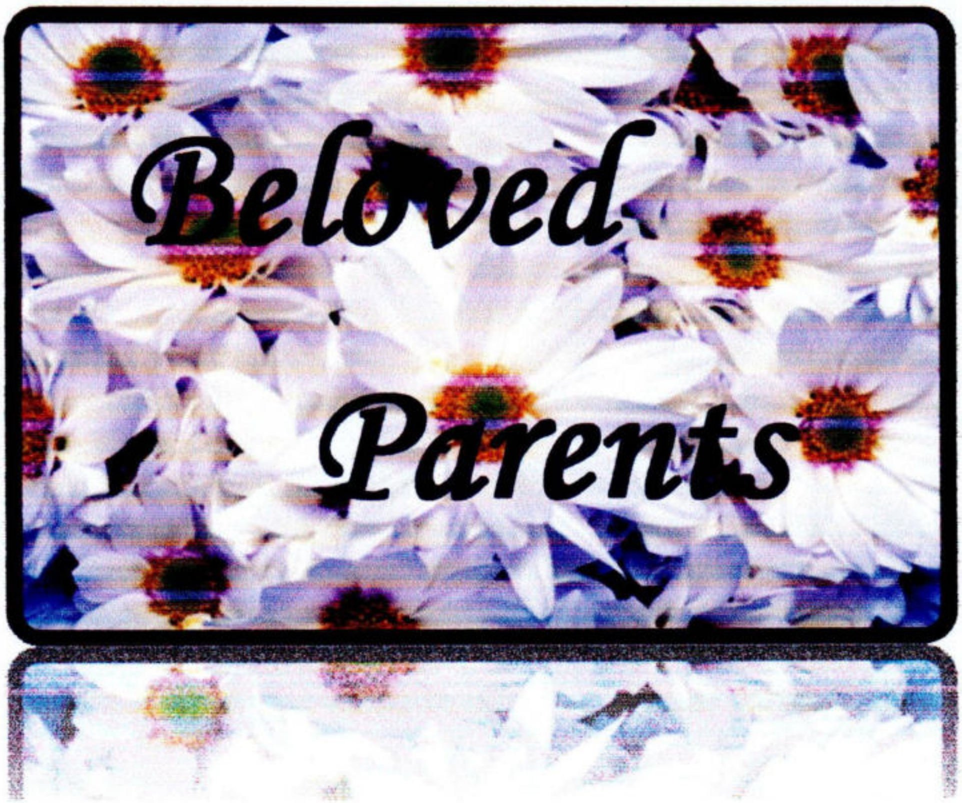

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ABSTRACT

Prevalence of ticks and tick borne infections in cattle was studied at Dinajpur Sadar area and the duration of the study was one year from January-December in 2011. A total of 240 cattle were examined for tick infestation. Among these animal, 119 (48.75%) cattle were found positive to tick infestation and 119 tick infested cattle were examined for tick borne infections. The effect of breed, season and sex was observed in cattle during the study. Clinical features of the tick borne infection in cattle were also examined. Distant and close inspection was done to locate tick in the animal body. Blood samples were taken from the tick infested cattle. Samples were examined by Giemsa's stained blood smear method. The highest tick infestation was found in the summer season (77.5%). Female cattle were more susceptible to tick infestation than male. Indigenous cattle (51.02%) were more prone to tick infestation than cross breed. The highest tick load found in the animal body was in ear, udder and perineal region. The overall prevalence of tick borne diseases was 70.58% where theileriosis (35.29%) and anaplasmosis (30.25%) were predominant. Tick-borne diseases were predominant in summer season followed by rainy and winter seasons. Female animals (77.45%) were more susceptible to tick borne infections than male (29.41%). Cross breed cattle (77.55%) were more prone to tick borne infections than indigenous cattle (38.09%). From the present study, it could be stated that breed and season were the important predictor of tick borne diseases. The major clinical signs were fever (up to 41°C), anemia, anorexia, depression, weakness, cessation of rumination, hemoglobinuria and an increase in respiratory and heart rate.

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INTRODUCTION

CHAPTER I

INTRODUCTION

Tropical, agro-based Bangladesh has 47.51 million livestock population of which 22.87 million are cattle (BBS, 2008). Livestock, the backbone of Bangladesh's agricultural economy is at risk of decline in production due to number of ecto and endo-parasites. Bangladesh is usually hot and humid except in winter and the climatic condition of Bangladesh is very conducive to a wide variety of parasites as well as ticks (Razzak and Shaikh, 1969).

Ectoparasitic infestation is one of the major veterinary problems affecting livestock industries in many parts of the world (Hourrigan, 1979). Ectoparasites including lice, ticks, mites etc. play an important role in the transmission of certain pathogens (Loomis, 1986). The ectoparasites are known to cause heavy economic losses to livestock industry due to their usual habit of blood sucking which adversely affects the economic production (Branscheid and Schroer, 1997). Among ecto-parasites, ticks have been recognized as the notorious threat (Niyonzema and Kiltz, 1986).

Ticks are recognized as the most voracious blood sucking arthropods, all instars of which such as larvae, nymphs and adults suck blood of infected animals and man. Ticks are harmful to hosts by themselves through causing constant irritation and blood sucking; around 0.05 ml in 24 hours. By causing injuries ticks may expose the skin to secondary bacterial infections. Further, they may cause tick toxicosis or tick paralysis. All these are in addition to the several etiologic agents mostly viral, rickettsial and protozoan organisms are transmitted by ticks either by transtadial, trans-ovarian or mechanical methods. A female tick can feed around 50 times more blood than its unengorged body weight, feed around 3.0 ml of blood during engorged period of 21-28 days and around 60% of the engorged blood is utilized for production of eggs. Ticks which usually attack animals are *Boophilus sp., Haemaphysalis sp., Rhipicephalus sp., Hyalomma sp., Amblyomma sp., Dermacentor sp.,* (Hoogstraal, 1956). Likewise, ticks belonging to the genera *Amblyomma, Hyalomma* and *Rhipicephalus* are considered as potential reservoir and vectors of human disease like Q-fever *(Coxiella burnetti),* Boutonnouse fever *(Rickettsia connorii),* Tularemia *(Bacterium tularans),* (Hoogstraal, 1956). It has been estimated that the average annual loss caused by cattle tick amounts to 4 percent of the gross value of cross bred or exotic breeds of cattle. Therefore, the economic effect in animals is considered very colossal (Barnett, 1974).

Haemoprotozoan diseases especially babesiosis, anaplasmosis, theileriosis are considered some of the major impediments in the health and productive performance of cattle (Rajput *et al.*, 2005). Tick-borne infections cause substantial losses to the livestock industry throughout the world (Ananda *et al.,* 2009) as they have got a serious economic impact due to obvious reason of death, decreased productivity, lowered working efficiency (Uilenberg, 1995), increased cost for control measures (Makala *et al.*, 2003) and limited introduction of genetically improved cattle in an area (Radostits *et al.*, 2000).

The situation of ticks and tick-borne infections in animals have been partially documented in Bangladesh by number of authors (Razzak and Shaikh, 1969; Ahmed, 1976; Banerjee *et al.,* 1983; Samad *et al.,* 1984; Kader, 1973; Rahman and Mondal, 1985) but those studies are fragmented and inconclusive.

Different studies have been conducted on various aspects of tick and tick borne infections prevalent in various parts of the country and abroad as well but not yet done in Dinajpur Sadar area. Duly considering the limitation of information on tick infestation of domestic animals in and around Dinajpur Sadar area and the importance of cattle wealth in the national economy, the present study was undertaken with the following objectives:

- To determine prevalence of tick infections in cattle.
- To determine different topographic areas of tick load in the cattle body.
- To determine prevalence of tick borne infections in cattle.

CHAPTER 2

REVIEW OF LITERATURE

CAPTER II

REVIEW OF LITERATURE

Prevalence and ecology of ticks and tick borne infections have been studied in great details in many countries of the world. Some relevant literatures are reviewed below:

2.1. Distribution of ticks

The identified ticks in Bangladesh are *Boophilus microplus, Haemophysalis bispinosa, Rhipicephalus sanguineus, R. evertsi, evertsi, Hyaloma anatolicum anatolicum, H. trancatum, Ambylomma variegatum, Aponoma gervaisi* and *Argas reflexus* (Rahman, 2011). 33.4 percent infestations of cattle with *B. microplus, H. bispinosa* and *H. anatolium* were recorded in Bangladesh (Razzak and Skaikh, 1969).

Only 2 tick species was found in the Andaman Island, India mainly *B. microplus* on cattle (Khan, 1986).

The distribution of hard ticks reported in Iran (Maghami, 1968; Mazlumi, 1968; Filopova *et al*., 1976; Hoogstraal and Wassef, 1979; Hoogstraal and Valdez, 1980; Robinson and Spradling, 2006; Aghighi *et al*., 2007).

The species of *Hyaloma dromedarii* distributed from North Africa to the south as far as Senegal, Mali, Chad, Sudan and Kenya; Canary Islands. Turkey (eastern), Palestine, Syria, Iraq, Saudi Arabia, Yemen, Oman, Armenia, Azerbaijan, Iran, Afghanistan, Pakistan, Kirghizia (Fergana Valley), Uzbekistan, Turkmenistan, Tajikistan, India and China (Xingjian) (Hoogstraal, 1956). The distribution of *Hyaloma marginatum* contains Morocco, Algeria, Tunisia, northwestern Libya; Portugal, Spain, France (extreme southern), Italy, former Yugoslavia (Bosnia, Herzegovina, Croatia, Macedonia, Montenegro and Serbia), Albania, Greece, Cyprus, Bulgaria, Romania, Moldova, Ukraine and Russia to the north as far as Rostov and Volgograd Oblasts; Turkey, Syria, Palestine, Egypt (Sinai), Iraq, Iran, Georgia, Armenia, Azerbaijan, Kazakhstan, Tutrkmenistan, Kirghizia, Uzbekistan, Tajikistan, Afghanistan, Pakistan, India, and China (Abadi *et al.*, 2010).

Hyalomma detritum was the most abundant and important species infesting cattle in Tunisia. *Hyalomma dromedarii and Hyalomma impeltatum* were collected on domestic ruminants in the arid and desertic zones (Rehman *et al.,* 2004).

Boophilus ticks are most prominent veterinary pests in numerous tropic and sub-tropic areas with an intensive cattle production (Uilenberg, 1992).

Boophilus microplus and *Haemophysalis bispinosa* were collected from domestic and wild animals of the Forest Mountains near the China and Burma borders (Dhanda and Ramachandra, 1964).

Rhipicephalus sanguineus, hard tick species originates from African savannas with >30 cm annual precipitation. It has been distributed worldwide and presently occurs from about 35°S to 50° N (Hoogstraal, 1956; Sonenshine, 1993).

Ixodide ricinus is the most common tick in many parts of Europe, occurring from northern Africa up to about 65° N and up to 60° E (Gray, 1991; Jaenson *et al.,* 1994). *Ixodide ricinus* has been found in significant numbers in several towns of the Czech Republic (Daniel and Cerny, 1990), England (Guy and Farquar, 1991), Austria (Sixl *et al.,* 1981) and Germany (Matuschka *et al.,* 1990; Kahl *et al.,* 1992; Bauch, 1993, Plate, 1993).

Amblyomma tick is one of the most abundant tick genera in Ethiopia and has been reported in many parts of the country with highest prevalence rate in Bedelle Etsay Kebede1985, Nekemte Belete Mekuria 1987, Hararghe Guliat Asrat, 1987, Asella Behailu Assefa 2004, Awassa Mehari Birhane 2004, Mizan Teferi Seid Belay 2004, and Jimma Yitbarek Getachew 2004 (Tamiru *et al.,* 2010).

H. bispinosa, was widely distributed in the forest of certain islands of Indonesia, Borneo, Singapore, Malaya and parts of Thailand (Hoogstraal and McCarthy, 1965). *H. bispinosa* was collected from subtropical regions with mild winter to temperate regions with extreme winter and tremendous number of *B. microplus* from Kathmundu valley. They commented that the latter tick prevailed in the area throughout the year (Hoogstraal *et al*., 1966).

Rhipicephalus bursa and *Hyalomma marginatum marginatum* were the most common tick on domestic animal in Greece in 1983-86 (Papadopoulous *et al.,* 1996)

2.2. Ecological invegtigation

The >850 tick species known so far colonize highly diverse habitats, e.g. humid temperate and tropical forests, open grassland, deserts, continental cliff-site habitats and remote islands. Although many tick species primarily occur in natural habitats (Hoogstraal, 1981). Relative humidity and temperature had an influence on the behaviour and survival of various species of hard ticks (Lees, 1946; Feldman-Muhsam, 1947). Reproduction was independent of temperature but was optimal at 20-30°C (Hamel and Goethe, 1974).

A study on seasonal variation of larval population density of *B. microplus* was made in Jamaican pastures. Four months of heavy rainfall in August to

November preceded significant increases in the population in December to February. Rainfall above 15 cm/month contributed to maintaining low population densities, possibly by causing physical injury to larvae already on the vegetation (Rawlins, 1979).

The effects of temperature, humidity and climatic rhythms on the non-parasitic phase of ixodid ticks and their development was studied, and three types of life-cycle was recorded such as uninterrupted (homodynamic) cycles, e.g. in *B. microplus;* polyvoltine years, e.g. in *R. sanguineus;* and cycles extending over several years e.g. *A. americanum* (Balashov, 1989).

The percentage of infestation of ticks on cattle was maximum in summer and minimum in winter in Bangladesh (Razzak and Skaikh, 1969)

High altitude and low temperatures, delay the activity of ticks (Jouda *et al*., 2004, Sajid *et al*., 2009). Maximum tick activities in summer (June-July) reported in Iran (Mazlum, 1971; Yakhchali *et al.,* 2004; Yakhchali *et al*., 2006; Yakhchali *et al.,* 2007). The number of ticks was increased particularly after the rainy seasons with higher temperatures. Therefore, rainfall was considered as the most important climatic factor that influenced the seasonal variation in tick numbers in Iran (Rahbari, 1995, Yakhchali *et al.,* 2004; Yakhchali *et al*., 2006; Yakhchali *et al*., 2007). In Pakistan, high density of ticks were recorded in the month of August, Sep, and Oct, when the mean temperature was (27^0C) and relative humidity (84%) (Papadopoulous *et al.,* 1996)

The topographical and environmental conditions were affecting the distribution of *B. microplus* in Sind, Pakistan. *B. microplus* was collected from cattle from topographically sites and desert areas were found to be free from ticks. *B. microplus* was collected in cattle, those who pastured in irrigated or river delta regions. *B. microplus* appeared to favour humid temperate areas and reverine forest (Hussain and Kumar, 1936).

In Queensland, Australia, there was complete cessation of reproduction and disappearance of larvae for two months as well as failure of eggs to hatch for up to six months in the colder months of the year. This observation implies that in the topics, *Boophilus microplus* has a much greater annual reproductive capacity than in the temperate region, since there is a seasonal break in the reproductive cycle caused by large variations of rainfall and temperature (Snowball, 1957).

In Rhodesia and South Africa, where the humidity was high, *Boophilus decoloratus* was present all the year round. No marked seasonal variation in larval numbers, apart from a slight reduction in colder months of July and August was reported (Matthysse, 1958). *B. microplus,* the one host tick to engorge on cattle from 35 to 149 days after attachment as larvae and recorded two-three generation in a year in South Africa (Hoogstraal, 1956).

The adverse effects of rain have referred by dislodging larvae from their resting places and causing the excessive expenditure of energy in larvae regaining their favoured position on grass (Wilkinson and Wilson, 1959). At 26° C larvae of *B. decoloratus* died if the relative humidity fell below 70% (Londt and Whitehead, 1972).

A difference in relative abundance of lone star tick has noted in relation to vegetative cover and seasonal activity (Rogers, 1953).

H. bispinosa was collected from subtropical regions with mild winter to temperate regions with extreme winter and tremendous number of B. *microplus* from Kathmundu valley. B. *microplus* prevailed in the area throughout the year (Hoogstraal *et al.,* 1966).

2.3. Prevalence of tick infestation

The highest prevalence (15%) of *Hyalomma* tick followed by *Boophilus* (12%), *Haemaphysalis* (5%) and *Rhipicephalus* (3%) reported in district Kasur, Pakistan (Durrani *et al.*, 2008).

A total of 1050 cattle, 700 buffaloes, 1400 each of sheep and goats and 250 camels were randomly selected and examined for the prevalence of tick infestation. The highest prevalence of tick infestation was found in cattle (75.1%) followed in order by goat (51.6%) and buffaloes (40.08%) in Pakistan (Sajid *et al.*, 2008).

A total number of 380 cattle were examined, of which 138 (36.31%) cattle were found to be infested in Chittagong District (Kabir *et al.*, 2011).

One hundred sixty five (165) cattle and three hundred twenty two (322) goats were randomly examined from different thanas of Chittagong. Among them, 108 cattle and 145 goats were positive for tick infestation. The overall percentage of infestation in cattle and goat were 65.45 and 44.4 respectively (Kamal *et al.,* 1996).

2.4. Pathogenic effects of ticks

Direct effects of ticks on cattle are tick worry, blood loss, damage to hides and skins of animals and introduction of toxins (Castro, 1997).

2.4.1. Tick worry

Tick worry is a generalized state of unease and irritability of cattle severely infested with ticks, often leading to serious loss of energy and weight. This negative effect on the growth of animals and their production is thought to be due to the effects of a toxin in the saliva of ticks (Hunter, 2004).

Moderate to heavy tick infestations can impact negatively on the growth and production of cattle. Infestations with *Rhipicephalus decoloratus* and *Rhipicephalus appendiculatus* were reported to cause weight losses of 1.5 g and 4.4 g, respectively (Norval *et al.*, 1988) while *Amblyomma* spp. resulted in losses of about 63 g (Stachurski *et al.*, 1993). Similarly, milk production was reduced by 9 g per engorging *Rhipicephalus appendiculatus* female in indigenous Sanga cattle (Norval *et al.*, 1997)

2.4.2. Anaemia

Anaemia is an inevitable consequence of heavy infestation by any blood-feeding parasite, and cattle deaths attributable to anaemia as a result of tick infestation are common (Jonsson, 2006). Engorging ixodid females will increase their weight by 100–200 times but the actual amount of blood ingested is much greater than this, as blood meal is concentrated and fluid excreted in saliva (Kemp *et al.*, 1982). The anaemia caused by heavy tick infestation results in loss of condition in cattle causing a reduction in meat production and milk yield (Gates and Wescott, 2000).

2.4.3 Wounds and myiasis

The mouthparts of ticks puncture the skins during feeding, causing damage to the hide, the damage taking the form of small rounded areas of necrosis, which is often followed by secondary fly attack resulting in serious skin infection (Gracey *et al.*, 1999). Ticks with longer mouthparts such as *Amblyomma* and *Hyalomma* cause more extensive damage than those with shorter mouthparts such as *Boophilus* and *Rhipicephalus*. The involvement of host reactions leading to tissue damage may be dependent upon recruitment of inflammatory responses characterized by dermal cell infiltrates which form the lesions (Mattioli *et al.*, 2000). Tick wounds may become infested by screw worms or other agents of myiasis, and are also associated with the spread of bovine dermatophilosis caused by *Dermatophilus congolensis* (Kahn, 2006).

2.4.4. Toxicoses

Tick saliva contains toxins which have a specific pathogenic effect. The toxins affect not only the attachment site but also the entire organs of the host. Some ticks produce neurotropic toxins which induce tick paralysis that is characterized by an acute ascending flaccid motor paralysis (Kahn, 2006). Examples are paralysis caused by the feeding of *Dermacentor andersoni*, Australian tick paralysis caused by *Ixodes holocylus*, and tick toxicosis caused by *Rhipicephalus* species (Drummond, 1983). Females of the species *Hyalomma truncatum* produce a dermotropic (epitheliotropic) toxin which causes sweating sickness in calves and some adult cattle (Kahn, 2006).

2.5. Tick-borne diseases

Theileria and *Babesia* species are tick-borne haemoprotozoan parasites of vertebrates that have a major impact on livestock production, mainly cattle and small ruminants, in tropical and subtropical areas (Mehlhorn and Schein, 1984). Bovine babesiosis is a tick-borne disease caused by infection with intra-erythrocytic Apicomplexa protozoan parasites from the genus *Babesia* that are distributed worldwide (McCrosker, 1981). Theileriosisis observed in South Europe, East Africa, Middle and South Asia, Middle East and affects approximately 250 million cattle (Uilenberg, 1981; Young, 1981; Dolan, 1989). The distribution of *Babesia* followed the distribution of the tick vector. The babesial tick infection rate was related to the vector abundance which, in turn, was regulated by climate. *Bos indicus* (zebu) cattle, because of tick resistance, were less likely to be infected by the vector. Factors involved in the epidemiology and transmission of anaplasmosis were not well defined (Guglielmone, 1995). 12.5% mortality rate and estimate 250000 pounds economic losses per annum was detected due to bovine babesiosis in northern Ierland (Taylor, 1983). 6-13% mortality rate in cattle was recorded due to bovine babesiosis in Serbia, Yugoslavia (Petrovic, 1958).

2.5.1. Vector

Boophilus annulatus is the principal vector of *B. bovis* and *B. bigemina* in Northern Africa (Ndi *et al*., 1991; Sahibi *et al*., 1998; Bouattour *et al.*, 1999), the Middle East (Pipano, 1997), Turkey (Sayin *et al.,* 1996), some areas of southern Europe (Caeiro, 1999) and is mentioned as the vector in southern areas of the former USSR. *Babesia divergens* is transmitted almost exclusively by *Ixodes ricinus* in northern Europe (Friedhoff, 1988). In Portugal, there are at least three classes of ticks identified that are competent for transmission of *B. bovis* and *B. bigemina: Ixodes ricinus, Rhipicephalus bursa* and *Rhipicephalus (Boophilus) annulatus* (Caeiro, 1999). The tick vector for the *Babesia spp.* for the South America was *B. microplus. B. microplus* and many different haematophagous diptera species were considered vectors of *A. marginale* (Nari, 1995).The transmission of *B. bigemina, B. argentine* and *A. marginale* by the cattle tick *B. microplus,* in case of *Babesia sp*. by transovarian route and by stage to stage method of transmission for *Anaplasma marginale* was reported (Callow, 1976). *Boophilus microplus*, particularly males, can transfer among cattle in close proximity and this can lead to a much shortened prepatent period (6–12 days) for *B. bigemina* (Callow and Hoyte, 1961; Callow, 1979), but it is usually 12–18 days after tick attachment (Callow, 1984). As *B. bovis* does not persist in an infective form in the ticks beyond the larval stage (Mahoney and Mirre, 1979).*Theileria annulata* is transmitted by *Hyalomma* *spp.* ticks (Warnecke, 1978; Robinson, 1982; Dumanli, 1983; Gautam and Dhar, 1983). Cattle with subclinical infection in endemic regions become carrier of piroplasm and these animals are sources of infection for ticks (Neitz, 1957; Brown, 1990).

2.5.2. Season

The seasonal prevalence of *Babesia* spp. commenced in spring and reached a peak in June, whereas the prevalence of *Theileria* spp. reached a main peak in July and a somewhat lower peak in September. The results from tick preparations corresponded with the prevalence of clinical disease in domestic animals (Warnecke, 1978). Highest prevalence rate of *Babasia bigemina* and *Anaplasma marginale* was recorded in cattle during summer months followed by Autumn (August and October) in Queensland, Australia (Roger, 1971).

2.5.3. Prevalance

Different blood protozoa such as *Babesia bigemina, Theileria annulata, Theileria mutans* and rickettsia like *Anaplasma marginale, Anaplasma centrale* have been reported in animals of Bangladesh (Samad and Gautam, 1984). Among haemoprotozoan diseases, babesiosis and anaplasmosis are the more prevalent in different areas of Bangladesh where Samad *et al.* (1989) recorded the highest 14.53% babesiosis and Chowdhury *et al.* (2006) recorded 70% anaplasmosis in Sirajgong district. Talukdar *et al*. (2001) also documented higher prevalence (33%) of anaplasmosis in Baghabari Milk Shed Area, Sirajgong. Siddiki *et al*. (2010) recorded lower prevalence of haemoprotozoan diseases in Red Chittagong Cattle in compared to crossbred cattle in some areas of Chittagong district.

In USSR, 18.03% sub-clinical prevalence of *Babesia* infection was recorded in cattle on microscopic blood smear examination (Duilko, 1955). Blood smears were also examined microscopically for *Theileria* and/or *Babesia* spp. and 5.14% were positive (Kursat et al, 2008).The data of Veterinary clinical registered book was analyzed and found 3.2-4.9% clinical prevalence and 7.3-14.5% mortality rate of bovine babesiosis in an area in North Co-Meath, Ireland, (Gray and Fitzgerald, 1985)

19 clinical cases of *Babesia bigemina* and 1122 (64.86%) sub-clinical prevalence of *Theileria mutans* were recorded in cattle and buffaloes in the district of Dhaka, Bangladesh (Ahmed, 1976). 5.5% sub-clinical prevalence of *Babesia* organisms in cattle and 2.1 % in buffaloes was detected on microscopic blood smear examination from Asam, Meghaloya and Arunachal Prodesh of India (Singh *et al.,* 1978). 23% sub-clinical form of babesiosis and 17% theileriosis as lone infections in cattle and 41 % as mixed infections with *Babesia* and *Theileria* parasities recorded in Korea (Jeon, 1978). Higher susceptibility of cross-bred cattle to *Babesia bigemina* to experimental infection in comparison with Hariana breed of cattle was observed (Dwivedi and Gautam, 1979). 80% cattle infested with *B. microplus* and 40% with *H. bispinosa* was recorded. In goats *H. bispinosa* infestation was 74% and *B. microplus* 1.7% (Rahman and Mondal, 1985).

In India, 4.97% babesiosis, 12.69% theileriosis and 7.82% anaplasmosis as lone infections was detected. 3.26% prevalence of mixed infection of *Babesia sp.* with *Theileria sp.* and *Anaplasma sp.* and 18.58% *Theileria sp.* with *Anaplasma sp.* infection was also detected (Malhotra and Chandramani, 1980). 27.04% prevalence of *Babesia bigemina* antibodies in India and 14.53 % in cattle of Bangladesh was detected with the help of capillary tube agglutination test (Banerjee *et al.*, 1983).

In Bangalore, north India, the prevalence of haemoprotozoan disease in crossbred cattle was studied by screening 132 clinically suspected blood samples by Geimsa's stained blood smear method. Among 132 crossbred cattle screened, 57 animals were found positive for haemoprotozoan parasites. Out of 57 positive cases, 41 were found positive for *Theileria annulata* and the remaining 16 were positive for *Babesia bigemina* (Ananda *et al.*, 2009).

T. annulata piroplasm forms have been reported to be present between 2.3 and 43.9% in different parts of Turkey (Goksu, 1970; Tuzer, 1982; Dumanli and Ozer, 1987). 8.47% sub-clinical prevalence of *T. annulata* infections on Giemsa's stained microscopic blood smear examinations and 22.03% seropositive for *T. annulata* on complement fixation test was detected among cattle in Bangladesh (Samad *et al.,* 1984)

The outbreaks caused by *B. argentina, B. bigemina and A. marginate* was recorded in Queenslad between 1 July 1966 and 30 June 1976. Of all outbreaks 73 percent were caused by *B. argentina,* 21 percent by *A. marginalae* and 6 percent by *B. bigemina.* (Copeman *et al.,* 1978)

The prevalence of bovine piroplasms in the Sudan vegetation zone (Runka) and the Northern Guinea vegetation zone (Samaru) was investigated by means of blood and brain smear examination, and the indirect immunofluorescence antibody test. In both vegetation zones, the prevalence of *T. mutans* in cattle was high. The detection of *B. bigemina* and *B. argentina* by blood smear examination was remarkably low, although antibody titres against both parasites were detected by the immunofluorescence test. The prevalence of *B. argentina* was markedly higher in the Northern Guinea vegetation zone (Mohammed, 1978).

A serological survey and an epidemiological investigation were carried out in Paraguay to determine the prevalence of *Anaplasma marginale, Babesia bigemina* and *B. bovis* in cattle. In the serological survey, a total of 1228 samples were collected from 54 farms throughout the country: antibodies to *A. marginale* were detected by the rapid card agglutination test (CAT) and antibodies to *B. bigemina* and *B. bovis* were detected by IFAT (serum samples being applied at a dilution of 1/80 to minimise cross-reactions between the 2 species of *Babesia*). A high proportion of sera contained antibodies to *A. marginale* (928), B. *bigemina* (798) and *B. bovis* (718). The proportion of animals that had antibodies to all 3 parasites was generally high in areas where producers reported the presence of ticks *(Boophilus microplus)*. In the epidemiological investigation, the age at which calves first acquired infection with *A. marginale. B. bigemina* and *B. bovis* was studied: 20 calves of less than one month in age were chosen from each of 3 farms and blood samples were collected monthly for 9 months. On each occasion, the PCV was measured by the microhaematocrit method, thin blood films were examined and serum samples were taken and tested for the presence of *A. marginale, B. bigemina* and *B. bovis* using CAT and IFAT, respectively. The serological tests showed that higher proportions of calves were exposed to infection (especially with *Babesia* spp.) than was indicated by examination of the blood films: although 97% of calves had antibodies to *B. bigemina* and 88% to *B. bovis,* blood film examinations indicated prevalences of 23% and 12%, respectively. It was suggested that most of Paraguay can be considered as being enzootically stable with respect to anaplasmosis and babesiosis (Payne, 1990).

2.5.4. Clinical signs

In babesiosis, affected animals have low parasitemia, may suffer mild fever and anorexia, and make an uneventful recovery (Gray and Murphy, 1985).

More severe cases of red water present with an acute onset of fever (up to 41°C), anemia, anorexia, depression, weakness, cessation of rumination and an increase in respiratory and heart rate. The mucous membranes are pale and may be jaundiced. Intestinal and ruminal motility are increased and spasms of the anal sphincter cause pipe stem diarrhea (Collins *et al.*, 1970; Gray and Murphy, 1985; Christensson, 1989; Sherlock *et al.*, 2000; Bock *et al.*, 2004). Hemoglobinuria, frequently the clinical sign first detected by the owner, occurs at the peak of the hemolytic crisis (Purnell, 1981; Sherlock *et al.*, 2000). As the anemia advances, the animal becomes further depressed. Dehydration is severe, and diarrhea is replaced by constipation. The very rapid heart rate with extremely loud cardiac sounds may be heard a few feet distant from the cow. The body temperature falls to near or below normal and hemoglobinuria ceases. Terminally, the animal is unable to rise and exhibits toxemic shock, a subnormal temperature, weak pulse, severe jaundice, constipation and dehydration (Collins *etal.,* 1970; Coombs, 1977; Purnell, 1981; Gray and Murphy, 1985; Sherlock, 2000). Brain anoxia resulting from severe anemia may cause behavioral changes (Gray and Murphy, 1985). Levels of carboxypeptidase B, an enzyme thought to regulate circulating vasoactive peptides, may fall during very severe infections, causing vasoactive shock (Taylor and Elliott, 1983). Death is usually attributed to cardiac failure or hepatic and renal insufficiency (Collins *et al.,* 1970).

The clinical symptoms of bovine anaplasmosis may include fever, weight loss, abortion, lethargy, icterus and often death in animals older than two years (de Waals, 2000). Cattle that survive acute infection develop persistent infections characterized by cyclic low level rickettsaemia (French *et al.*, 1998; French *et al.*, 1999). Persistently infected or "carrier" cattle have lifelong immunity and are resistant to clinical disease on challenge exposure (de Waals, 2000).

The observed clinical findings in cattle with theileriosis such as anorexia, pyrexia (up to 106° F), drop in milk production, cessation of rumination, Enlargement of superficial lymph nodes (may go upto coconut size), rough hair coat, excessive salivation, dry muzzle, respiratory distress (Soulsby, 1982; Shehata *et al.*, 1984; Ruprah, 1985; Sandhu *et al.*, 1998; Radostits *et al.*, 2000; Balasubramaniam, 2004)

2.5.5. Diagnosis

Laboratorial diagnosis of clinical infection by piroplasms in cattle is usually based on the detection of the parasite in Giemsa's-stained blood smears. Carrier animals, in which low numbers of erythrocytes remain infected, are important contributors to the transmission of the infection by tick bites. Serological tests can be used to detect circulating antibodies; cross-reactivity with antibodies directed against other species of piroplasms has been reported (Birkenheuer, 2003). Serological tests have been developed for the evaluation of anaplasmosis and these are useful in the development of preventive measures (Barros *et al.*, 2005).

CHAPTER 3

MATERIALS AND METHODS

CHAPTER III

MATERIALS AND METHODS

3.1. Experimental animals, areas and duration

The study was conducted from January to December 2011, at Dinajpur Sadar area. 240 cattle were selected from different areas and age (Hossain and Akhter, 2004), sex, breed as well as season of the year were recorded carefully.

3.2. Clinical examination of animals

3.2.1. Distant inspection

Distant inspection was done by visual examination of the animal to record the general health condition.

3.2.2. Close inspection

Close inspection was done by parting of hair, lifting of tail, careful inspection in the chest region and hind quarter with hand to find out the presence or absence of tick.

3.3. Clinical findings

The clinical signs of the affected cattle were recorded. The clinical signs were observed from the visual examination of the affected cattle.

3.4. Collection and preservation of blood

3.4.1. Materials used for blood collection

- Animal

- Syringe and needle
- Antiseptic solution
- Cotton
- Shaving blades

3.4.2. Site for collection of blood

In case of cattle, Jugular vein, milk vein, coccygeal vein, ear vein. In this investigation, blood was collected from jugular vein.

3.4.3. Blood collection procedure

- At first, the animal was controlled in standing condition.
- The area of the vein was clipped and shaved.
- Tincture of iodine was applied to the site for disinfection.
- Distention of vein with blood was made by occluding it by the application of pressure with fingers.
- Neck was made tensed and the vein was fixed in position by thumb.
- The needle was inserted into the raised portion of the vein and released the digital pressure to allow circulation to be resumed before drawing the sample.
- Then, very gentle fraction was applied on the syringe plunger until the desired amount of blood (3ml) has been drawn.
- Then the needle was withdrawn.

3.4.4. Preservation of blood

3.4.4.1. Materials used for preservation of blood

- Vial
- Anticoagulant (EDTA)

After collection of blood, it was taken in a vial which contains EDTA solution (anticoagulant) and preserved in refrigerator at 5° C.

3.5. Laboratory preparation of blood for microscopic examination

Blood smears were prepared from the collected blood.

3.5.1. Preparation of blood smears

3.5.1.1. Materials used for Preparation of blood smear

- Clean grease free glass slides
- Pipette
- Blood
- Cotton

3.5.1.2. Method of preparation of blood smears

Two clean grease free slides were taken

↓

One slide was placed on the table and a medium size drop was taken on the slide about 1 inch apart from the right side

↓

Then the slide on the table was hold with the left hand fingers and the smooth edge of the other slide which holding about 45° angle with the right hand fingers was touched from the left side of the blood drop and the drop of blood was spread properly with the smooth edge

↓

Then a thin smear of blood was prepared by pushing the slide of the right hand forwardly.

After preparation of blood smears, they were air dried, fixed with ethyl alcohol and labeled with diamond marker pen. Two slides were wrapped in paper with smeared surface opposed to each other and separated by match sticks were brought to Dinajpur sadar Veterinary Hospital for examination. These were stained with Geimsa's stain and examined for detection of protozoan species.

3.5.2. Staining procedure of Geimsa's stain

3.5.2.1. Materials used for staining procedure of blood smear

- Geimsa's stain- working solution.
- Immersion oil.
- Coplin jar
- Tape water
- Microscope (binocular)

❖ **Composition of stock solution of Geimsa's stain:**

- Geimsa's Powder-3.8 gm
- Glycerine-250ml
- Methanol- 250ml

❖ **Composition of working solution of Geimsa's stain:**

- Stock solution of Geimsa's stain-10ml
- Buffer solution-90ml

❖ **Composition of buffer solution:**

- Monopotassium di hydrogen phosphate- 6.63gm
- Di sodium hydrogen phosphate- 2gm

- Distilled water- 1000ml

P^H of the solution- 6.4-6.8

3.5.2.2. Method of staining procedure of blood smear

After air drying and fixation, the blood smear was dipped in working solution of Geimsa's stain in a coplin jar and it was kept there for 30-45 minutes to react with the solution

↓

Then the slide was removed from the coplin jar and washed with running tape water for 4-5 minutes

↓

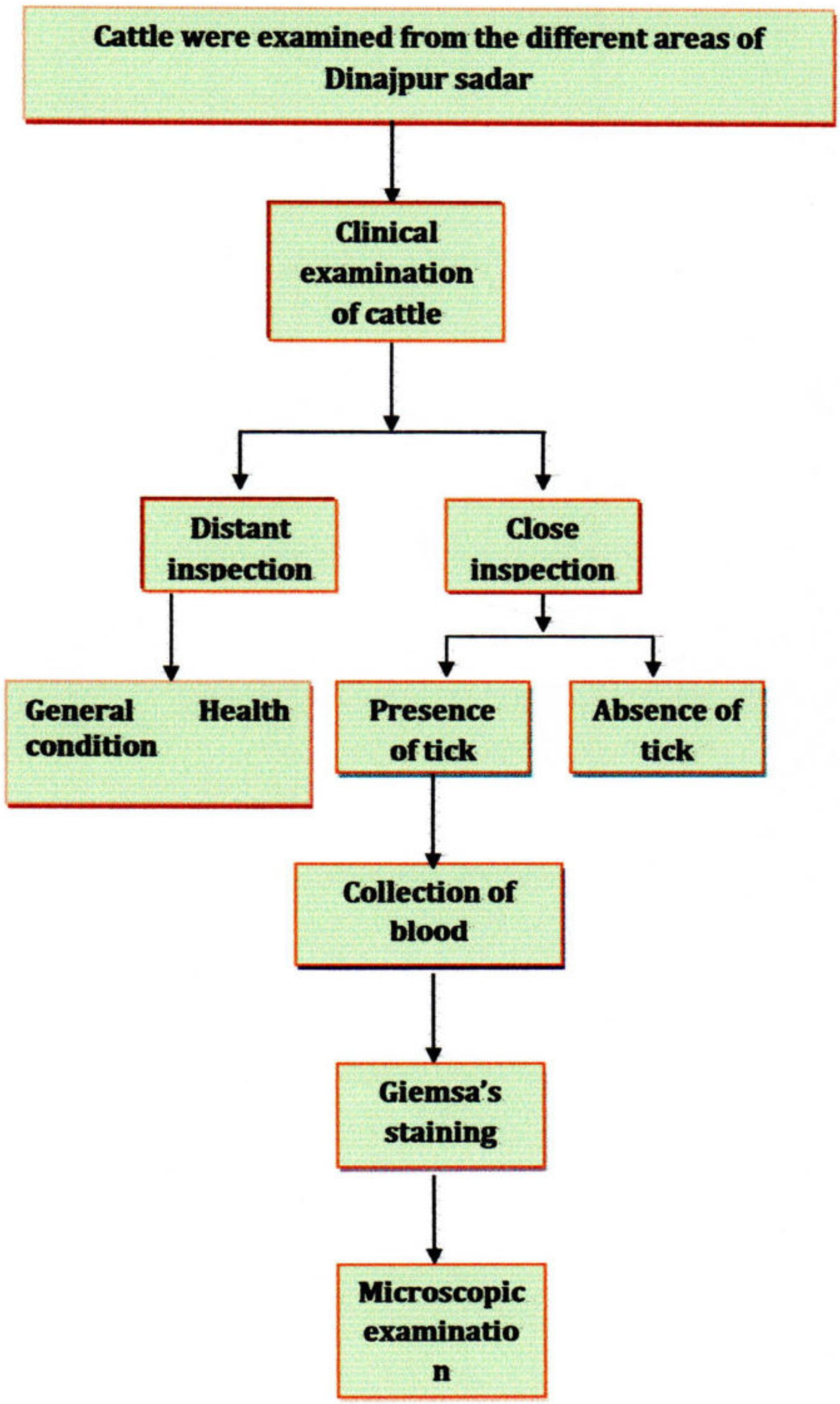
Then the slide was air dried and examined under microscope in oil immersion objective (100X).

Identification of the blood protozoa was made on the basis of description made by, Soulsby (1982) and Trapido *et al.* (1964).

3.6. Photography

The blood smear slides of tick borne infections affected animal blood was placed in microscope (Leica, Germany) and the respective microphotographs were taken directly by a digital camera (SONY DSC-W180, 10.1 MEGA PIXEL, Germany) using both low and high objectives (X4, X10 and X40). The photographs were then placed in computer; image selection and magnification were further modified and placed in this thesis for better illustration of the results.

Experimental design



CHAPTER 4

RESULTS

CHAPTER IV

RESULTS

4.1. Prevalence of tick infestation in cattle

Two hundred and forty cattle were examined randomly in Dinajpur sadar. Among these animal, 119 cattle were found positive for tick infestation shown in the table no.1. The overall percentages of tick infestation in cattle were 48.75%. The infestation was peaked in May (85.00%) and then gradually decline and the least infestation was recorded in November (20.00%). This is shown in table 1.

Table 1: Prevalence of tick infestations at different month of the year in cattle

Month (In the year 2011)	No. of cattle examined	Cattle infested with tick	
		No.	Percentage (%)
January	20	7	35.00
February	20	5	25.00
March	20	15	75.00
April	20	14	70.00
May	20	17	85.00
June	20	16	80.00
July	20	10	50.00
August	20	11	55.00
September	20	9	45.00
October	20	6	30.00
November	20	4	20.00
December	20	5	25.00
Total	240	119	48.75

4.1.1. Association of prevalence of tick infestation with season

Tick infestation varied with the season. In summer (March-June, 2011), the tick infestation increased and then decreased in rainy (July-October, 2011) and least in winter (November-February, 2011) which is shown in the table 2.

Table 2: Season wise tick infestations in cattle

Season	**No. of cattle examined**	**No. of cattle affected**	**Prevalence (%)**
Summer (March-June, 2011)	80	62	77.5
Rainy season (July-October, 2011)	80	36	45
Winter season (November-December, 2011)	80	21	26.25
Total	240	119	48.75

4.1.2. Association of prevalence of Tick infestation with sex

In this study, it was detected that the prevalence of tick was higher in female animal (75.55%) than the male animal (16.19%) which is shown in table 3.

Table 3: Sex wise prevalence of tick infestations in cattle

Sex	**No. of cattle examined**	**No. of cattle affected**	**Prevalence (%)**
Male	105	17	16.19
Female	135	102	75.55
Total	240	119	48.75

4.1.3. Association of prevalence of Tick infestation with breed

In this study, it was detected that the prevalence of tick was higher in indigenous cattle (51.02%) than crossbreed cattle (47.31%) which is shown in table 4.

Table 4: Breed wise prevalence of tick infestations in cattle.

Breed	No. of Cattle examined	No. of Cattle affected	Prevalence (%)
Indigenous	147	75	51.02
Crossbreed	93	44	47.31
Total	240	119	48.75

4.2. Tick load at different topographic location of cattle body

Ticks are mostly located in the hairless region of cattle body. They are mainly located in ear, eye, perineal region, flank region, neck and tail of the body of the cattle. The highest number of tick found in the inner surface of ear.

4.3. Clinical findings

In babesiosis, clinical findings revealed fever (up to 41°C), anemia, anorexia, depression, weakness, cessation of rumination, hemoglobinuria and an increase in respiratory and heart rate. The mucous membranes were pale and might be jaundiced.

The clinical findings of bovine anaplasmosis included fever, weight loss, abortion, lethargy and icterus.

In theileriosis, clinical findings were pyrexia (up to 106° F), anorexia, drop in milk production, cessation of rumination , enlargement of superficial lymph nodes (may go up to coconut size), rough hair coat, excessive salivation, dry muzzle and respiratory distress.

4.4. Prevalence of tick borne infections

Among 119 ticks infested cattle examined, 42 cattle had anaplasmosis (35.29%), 36 cattle had theileriosis (30.25%) and only 06 cattle had babesiosis (5.04%) which is shown in table 5.

Table 5: Prevalence of different tick borne infections in different month of the year in cattle.

Month	No. of cattle Examined	Cattle clinically affected							
		Theilariosis		Anaplasmosis		Babesiosis		Total	
		No.	%	No.	%	No.	%	No.	%
January/11	07	02	28.57	01	14.28	00	00	03	42.86
February/11	05	01	20.00	00	00	01	20	02	40.00
March/11	15	04	26.66	06	40.00	01	6.66	11	73.34
April/11	14	03	21.42	07	50.00	01	7.14	11	78.57
May/11	17	08	47.05	06	35.29	01	5.88	15	88.23
June/11	16	07	43.75	07	43.75	00	00	14	87.5
July/11	10	02	20.00	04	40.00	00	00	06	60
August/11	11	04	36.36	03	27.27	01	9.09	08	72.72
September/11	09	03	33.33	04	44.44	00	00	07	77.78
October/11	06	01	16.66	02	33.33	01	16.66	04	66.67
November/11	04	00	00	01	25.00	00	00	01	25.00
December/11	05	01	20.00	01	20.00	00	00	02	40.00
Total	119	36	30.25	42	35.29	06	5.04	84	70.58

4.4.1. Association of prevalence of tick borne infections with season

Tick borne infections were found to be more prevalent in summer season (March-June, 2011) followed in order to rainy (July-October, 2011) and winter seasons (November-February, 2011). The lowest prevalence was found in babesiosis in winter season shown in table no.6.

Table 6: Season wise prevalence of tick borne infections in cattle.

Season	No. of cattle examined	No. of cattle clinically affected	Percentage (%)
Summer (March-June, 2011)	62	51	82.25
Rainy season (July-October, 2011)	36	25	69.44
Winter season (November-February, 2011)	21	08	38.09
Total	119	84	70.58

4.4.2. Association of prevalence of tick borne infections with breed

The overall prevalence of tick borne infections was 84.09% in crossbred and 62.66% in indigenous cattle. Crossbred cattle were mostly affected by anaplasmosis (40.90%) than theileriosis (32.00%) and babesiosis (9.09%), respectively. On the other hand, the prevalence of babesiosis was higher in crossbred cattle (9.09%) than indigenous cattle (2.66%).The prevalence of theileriosis was 34.09% in crossbred and 28.00% in indigenous cattle which shown in table 7.

Table 7: Breed wise prevalence to tick borne infections in cattle

Breed	No. of cattle examined	No. of cattle affected							
		Anaplasmosis		Theileriosis		Babesiosis		Total	
		No.	%	No.	%	No.	%	No.	%
Indegenous	75	24	32.00	21	28.00	02	2.66	47	62.66
Cross breed	44	18	40.90	15	34.09	04	9.09	37	84.09
Total	119	42	30.25	36	35.29	06	5.04	84	70.58

4.4.3. Association of prevalence of tick borne infections with sex

However, female cattle were more prone to tick borne infections than male. Higher prevalence (77.45%) of infections was recorded in female cattle which were shown in table 6.

Table 8: Sex wise prevalence to tick borne infections in cattle

Sex	No. of cattle examined	No. of cattle affected							
		Anaplasmosis		Theileriosis		Babesiosis		Total	
		No.	%	No.	%	No.	%	No.	%
Male	17	03	17.64	02	11.76	Nil	0.00	05	29.41
Female	102	39	38.23	34	33.33	06	5.88	79	77.45
Total	119	42	35.29	36	30.25	06	5.04	84	70.58

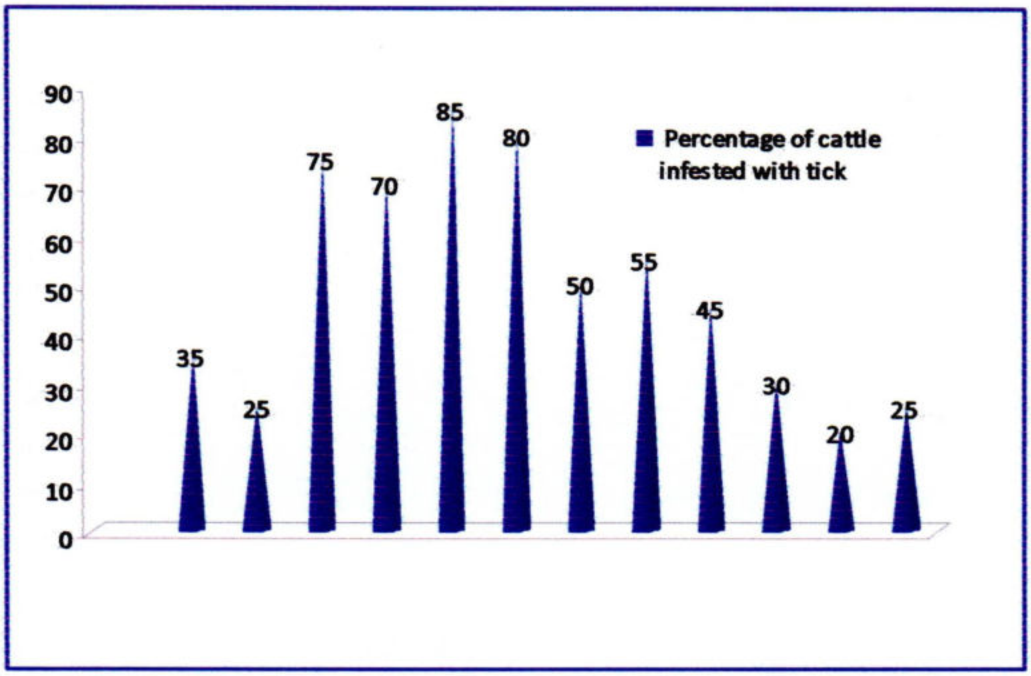


Fig.1: Monthly prevalence of tick infestation in cattle

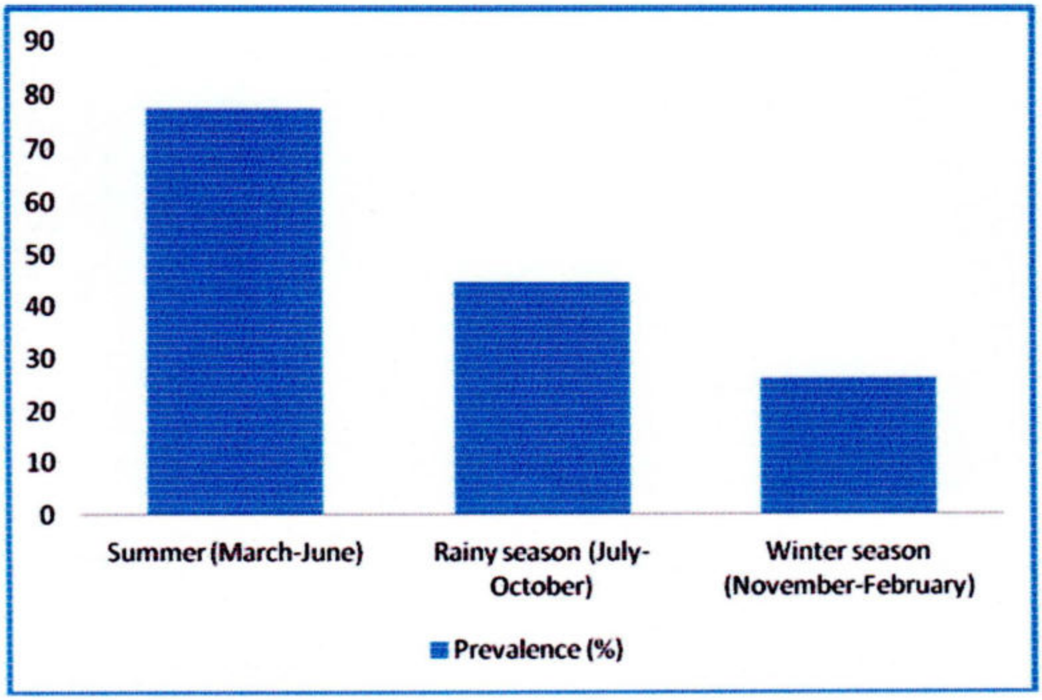


Fig. 2: Season wise prevalence of tick infestation in cattle

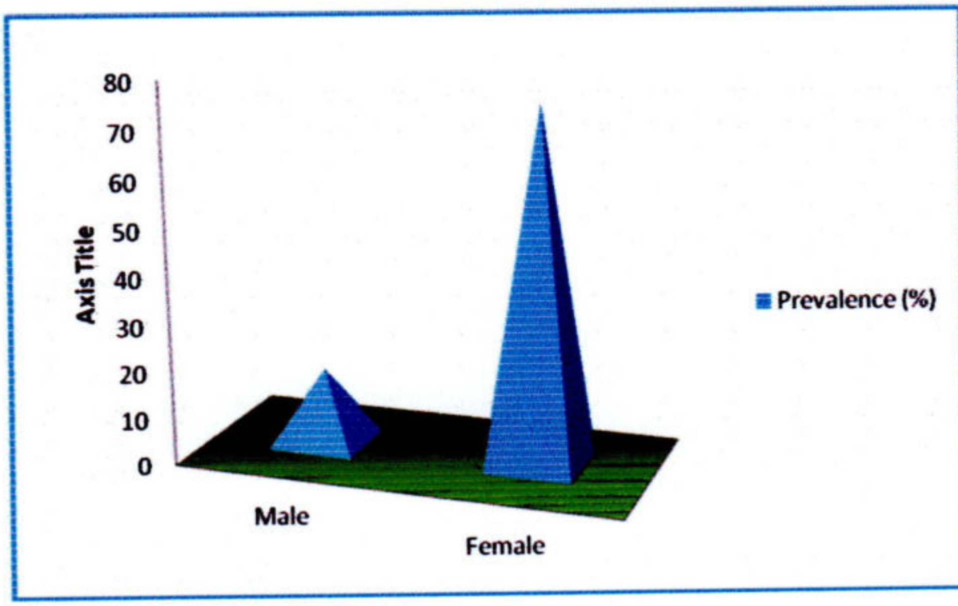


Fig. 3: Sex wise prevalence of tick infestation in cattle

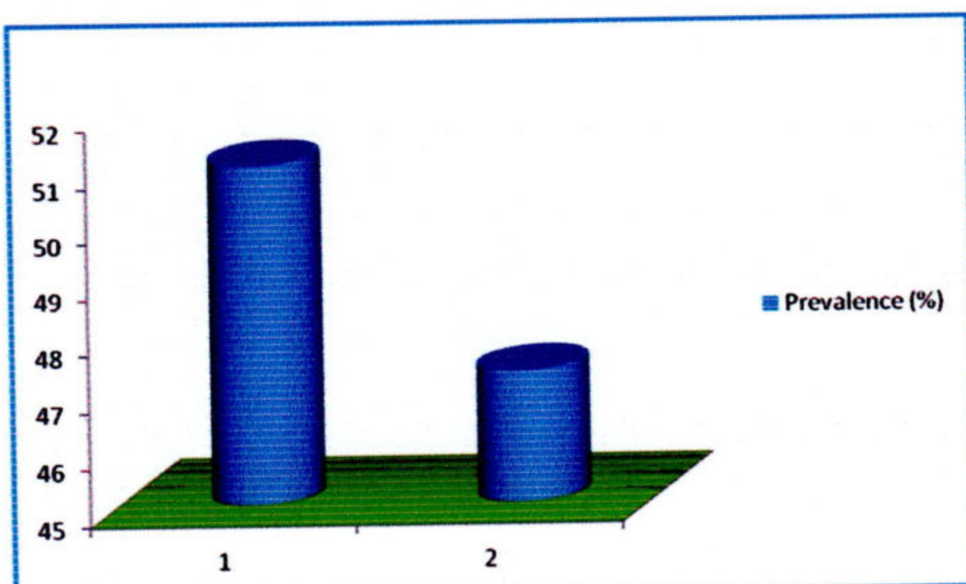


Fig. 4: Prevalence of tick infestation in cattle in different breed.

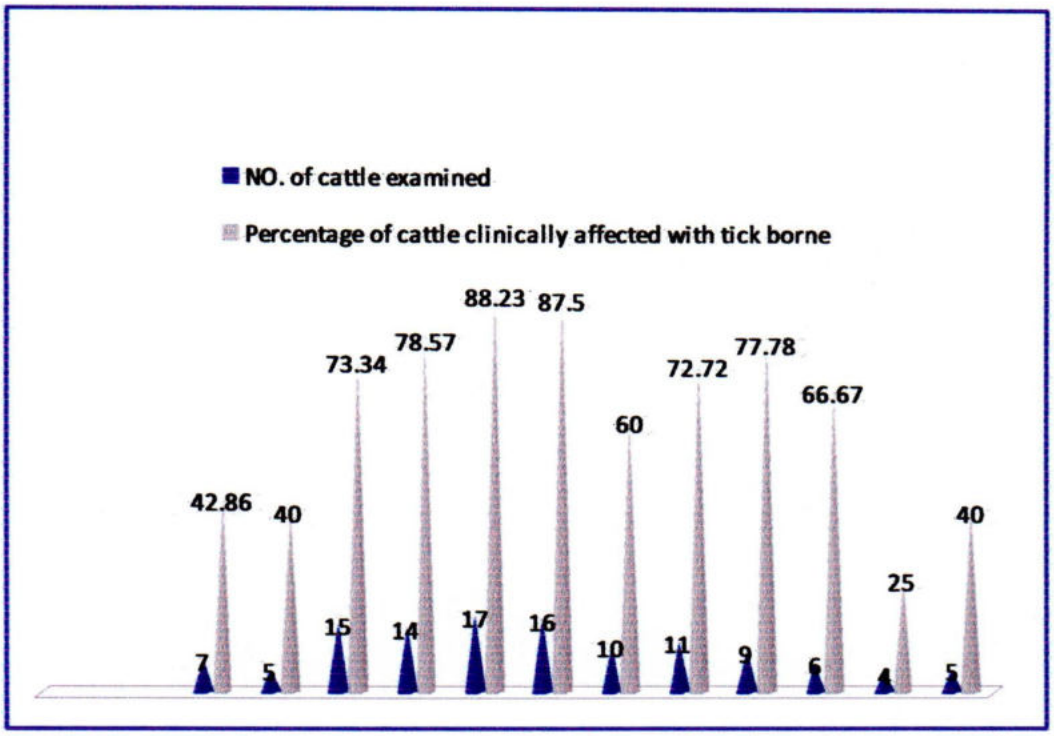


Fig. 5: Monthly prevalence of tick borne infections in cattle

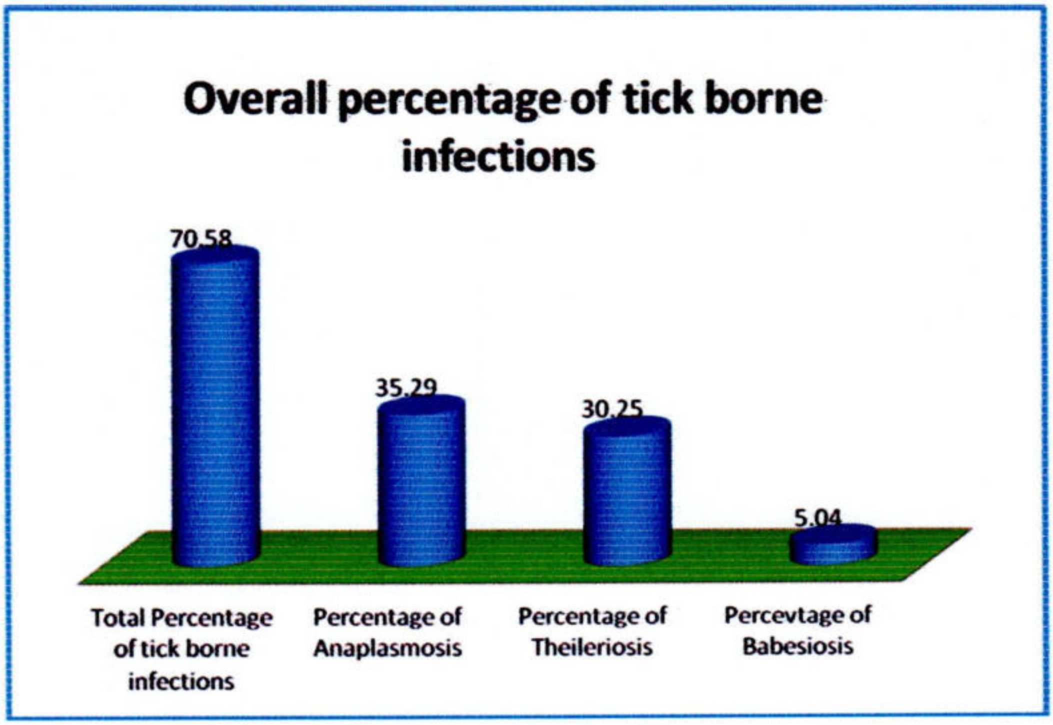


Fig. 6: Overall percentage of tick borne infections

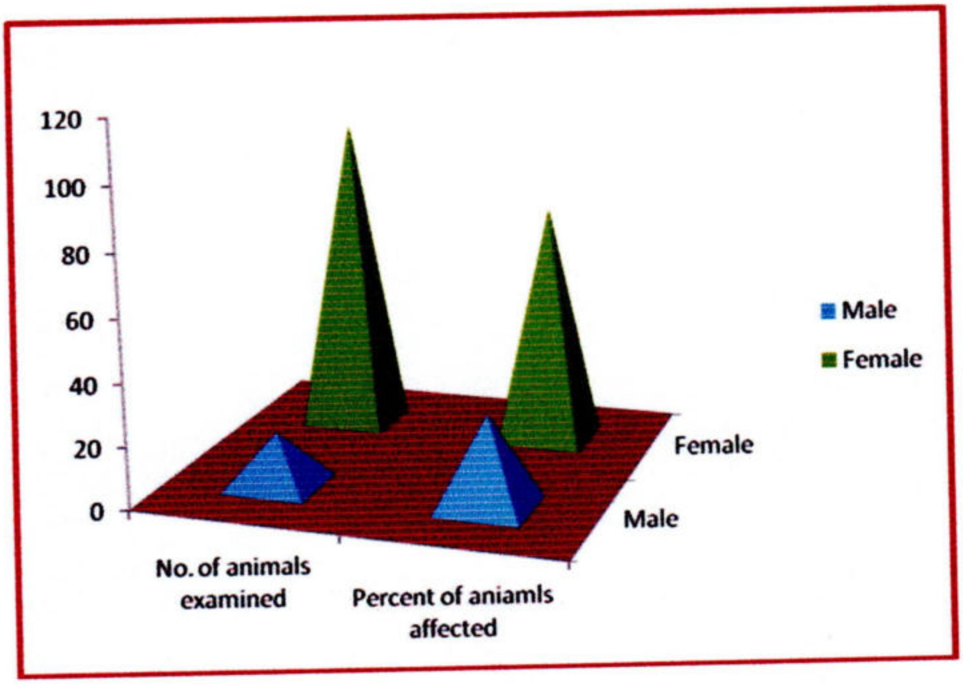


Fig. 7: Prevalence of tick borne infections in different Sex

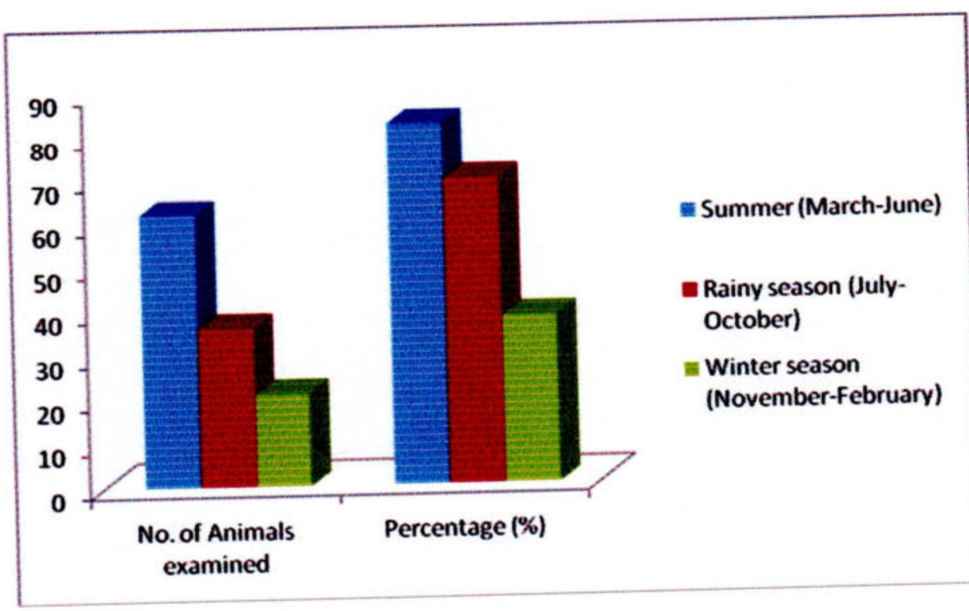


Fig. 8: Prevalence of tick borne infections in different season

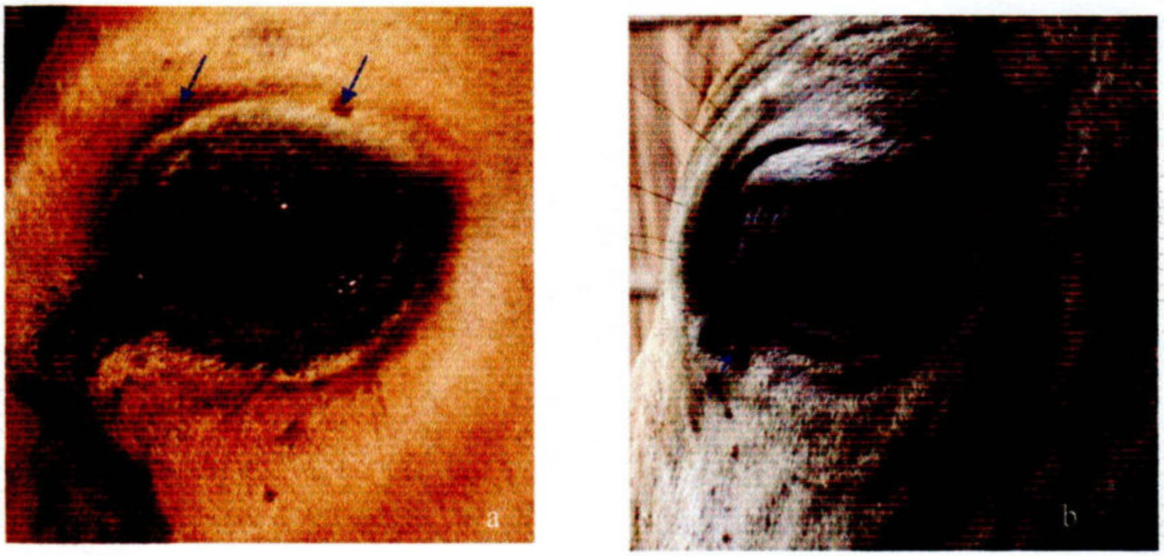


Fig. 9: a & b Tick load in the eye of cattle (show arrow)

Fig. 10: Tick load in the outer surface of ear of cattle

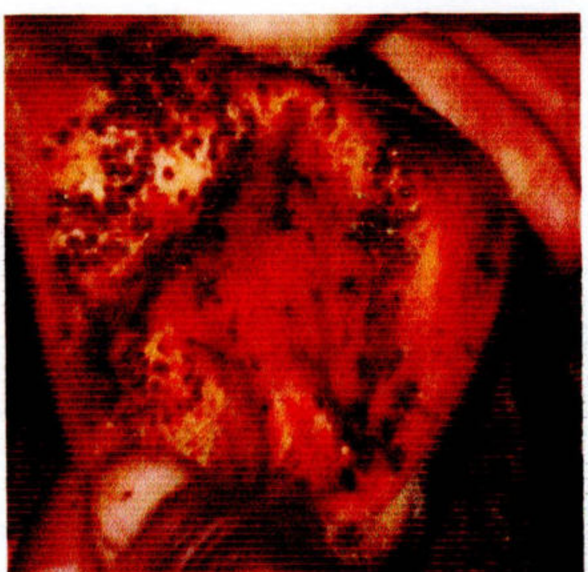


Fig. 11: Tick in the inner surface of ear of cattle

Fig. 12: Tick load in the neck region of cattle

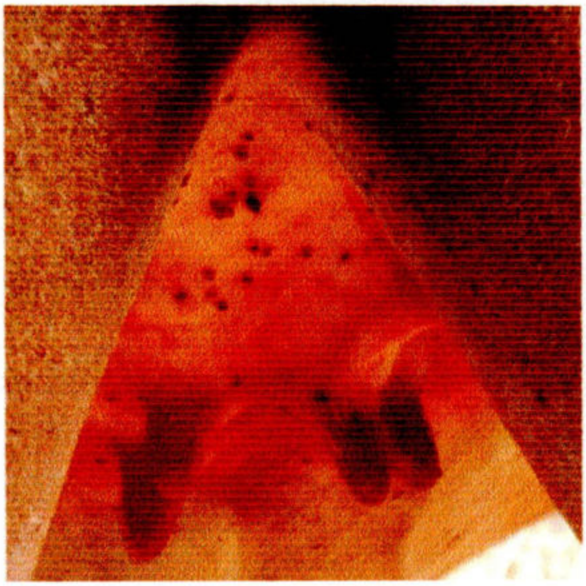


Fig. 13: Tick in the udder of cattle

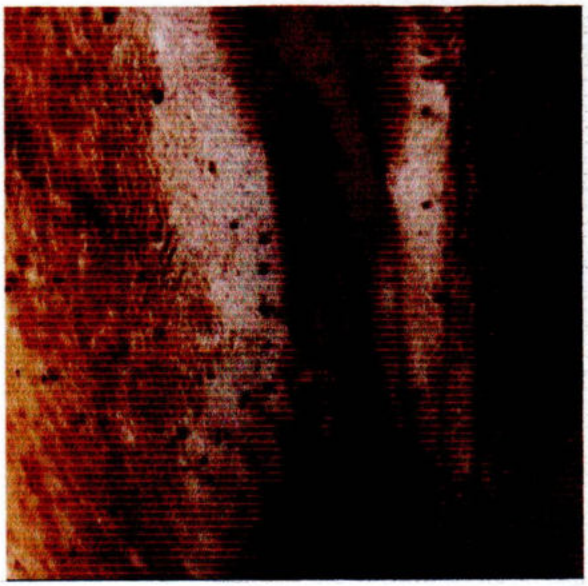


Fig. 14: Tick load in the perineal region of cattle

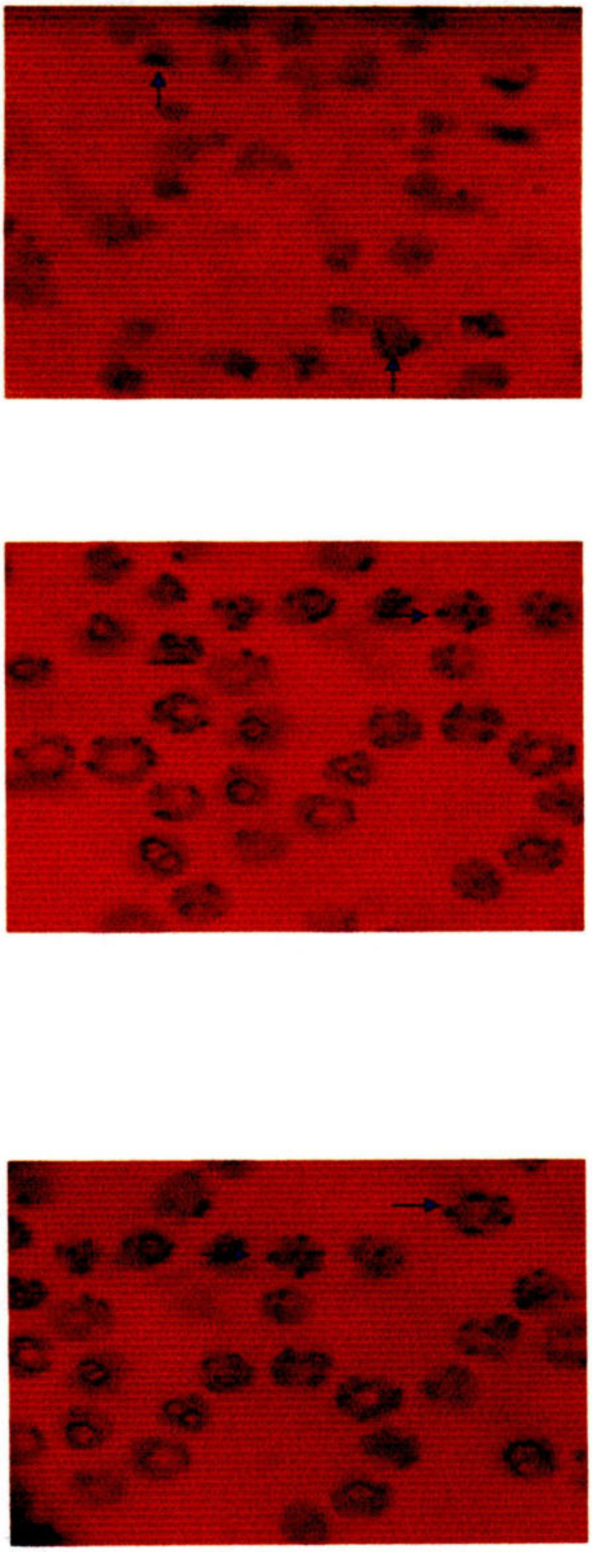


Fig. 15: a. b. c. showed *Anaplasma sp.* within the RBC (shown by arrow)

CHAPTER 5

DISCUSSION

CHAPTER V

DISCUSSION

5.1. Prevalence of tick infestation of cattle

The prevalence of tick infestation in cattle in this investigation partially consistent with the earlier report of Kamal *et al.* (1996) who documented slightly higher prevalence of tick infestation.

5.1.1. Association of prevalence of tick infestation with season

In this study, it was revealed that, tick infestation varied with the season. In summer, (March-June), the tick infestation increased and then decreased in rainy (July-October) and least in winter (November-February). This findings also observed by Razzak and Skaikh (1969); Chaudhury *et al.* (1969); Kamal *et al.* (1996); Kabir *et al.* (2011).

The environment become suitable for them at summer for their multiplication, so, the no. of tick increase as well as the percentage of tick infestation increases. The no. of tick and the percentage of tick infestation lower in winter because most of them dropped from the animal body and remain dormant.

5.1.2. Association of prevalence of tick infestation with sex

In this study, it was detected that the prevelance of tick was higher in female animal (75.55%) than the male animal (16.19%). This findings also observed by Kabir *et al.* (2011).

Although, the exact cause of higher prevalence of tick infestation in female cattle cannot be explained but it can be hypothesized that some hormonal influences may be associated with this phenomenon. Lloyd (1983) reported that higher level of prolactin and progesterone hormones make the individual more susceptible to any infection. Moreover, stresses of production such as pregnancy and lactation make the female animals more susceptible to any infection.

5.1.3. Association of prevalence of tick infestation with breed

In this study, it was detected that the prevalence of tick was higher in indigenous cattle (51.02%) than crossbred cattle (47.31%). This findings also observed by Kabir *et al.* (2011).

The cause of higher prevalence of tick infestation in indigenous is exactly not known but it can be assumed that farmer given more attention to crossbreed cattle than indigenous cattle.

5.2. Tick load at different topographic location of cattle body

Ticks were found throughout the body. Ticks were mostly located in the hairless region of cattle body. They were mainly located in ear, eye, perineal region, flank region, neck and tail of the body of cattle. The highest number of tick found in the inner surface of ear. These findings also observed by Chaudhury *et al.* (1969); Kamal *et al.* (1996); Rahman, (2011); Kabir *et al.* (2011).

5.3. Clinical findings

In the investigation of clinical signs and symptoms of the infected cattle with babesiosis, clinical findings revealed fever (up to 41°C), anemia, anorexia, depression, weakness, cessation of rumination, hemoglobinuria and an increase in respiratory and heart rate. The mucous membranes were pale and may be jaundiced. However, these types of similar typical signs and symptoms of infections have been described previously (Collins *et al.*, 1970; Purnell, 1981; Fujinaga, 1981; Gray and Murphy, 1985; Christensson, 1989; Georgi *et al.*, 1990; Sherlock *et al.*, 2000).

The observed clinical findings in cattle with anaplasmosis include fever, weight loss, abortion, lethargy, and icterus. De Waals, (2000) supported this view.

The observed clinical findings in cattle with theileriosis such as anorexia, pyrexia (up to 106° F), drop in milk production, cessation of rumination, enlargement of superficial lymph nodes (may go up to coconut size), rough hair coat, excessive salivation, dry muzzle, respiratory distress. These findings were in agreement of Soulsby, (1982); Shehata *et al.* (1984); Sandhu *et al.* (1998); Radostits *et al.* (2000); Balasubramaniam, (2004) also supported this view.

5.4. Prevalence of tick borne infections

The prevalence of tick borne infections in this investigation partially consistent with the earlier report of Chowdhury *et al.* (2006); Ananda *et al.* (2009); Kamani *et al.* (2010).They documented higher prevalence of tick borne infections. Alim *et al.* (2011) also recorded lower prevalence in Chittagong, Bangladesh. Higher prevalence of tick borne infections in the current study might be due to selection of tick infested cattle. However, variation in geo-climatic condition, breed and exposure of vectors and age of the animals might contribute to variable prevalence of tick borne infections in the study areas (Muhanguzi *et al.,* 2010).

The prevalence of theileriosis was found partially consistent with the report of Alim *et al.* (2011) who recorded lower prevalence in Chittagong division, Bangladesh. The higher prevalence of theileriosisis due to the location of the area, the type of vector ticks and the environmental condition.

The prevalence of anaplasmosis was in agreement with the reports of Chowdhury *et al.* (2006) who recorded 70% in Sirajgonj sadar area. (Talukdar *et al.*, 2001) supports the report who recorded 33% cattle of Baghabari Milk Shed Area had anaplasma infection. The occurrence of subclinical anaplasma infection in 5.93% cattle has been reported from Bangladesh (Samad *et al.*, 1989). The constant trend of such infection in the study areas due to frequent transmission of organisms by tick vectors or mechanical means was observed in the result of this study. Higher prevalence of anaplasmosis in different areas of the world was explained by endemicity of the disease (Brito *et al.*, 2010).

On the contrary, babesia infection (5.04%) recorded in this study is quite similar to the record of Samad *et al.* (1989) who recorded 3.28% subclinical prevalence of *Babesia bigemina* infection in cattle of the selected Milk vita project areas of Bangladesh. Chowdhury *et al.* (2006) recorded 3.3% in sirajgonj sadar area. Shahidullah, (1983) recorded a comparatively lower (2.29%) prevalence rate of such infections on microscopic peripheral blood smear examination whereas Banerjee *et al.* (1983) detected higher (14.53%) prevalence of *Babesia bigemina* in cattle of Bangladesh. Alim *et al.* (2011) also recorded higher prevalence of babesiosis in Chittagong division, Bangladesh.

5.4.1. Association of prevalence of tick borne infections with season

Seasons affect greatly the prevalence of tick borne infections. The higher prevalence of tick borne infections was observed in summer season which in accordance with the report of Alim *et al.* (2011). Radostits *et al.* (1994) observed that higher prevalence of tick borne infections was found soon after peck of tick population depending on temperature, humidity, rainfall etc. Lower temperature and humidity of winter months were less favourable for the growth and multiplication of tick vectors which might contribute to lower frequency of such diseases in the study population (Muhammad *et al.,* 1999; Zahid *et al.,* 2005).

5.4.2. Association of prevalence of tick borne infections with breed

In the present study, lower prevalence of tick borne infections in indigenous cattle in compared to crossbred cattle was found in agreement with the reports of Radostits *et al.* (2000); Chowdhury *et al.* (2006); Alim *et al.* (2011). Constant exposure of infections and development of immunity against such infections might responsible for lower prevalence in indigenous cattle (Siddiki *et al.*, 2010). On the contrary, more attention in the management of crossbred cattle give less chance of pre exposure of vectors and develop no or less immunity resulting frequent occurrence of such diseases (Chowdhury *et al.,* 2006; Ananda *et al.,* 2009; Siddiki *et al.*, 2010; Alim *et al.,* 2011).

5.4.3. Association of prevalence of tick borne infections with sex

The prevalence of tick borne infections in female cattle of this investigation showed uniformity with the report of Alim *et al.* (2011) and Kamani *et al.* (2010). Higher prevalence in female cattle possibly due to the fact that they were kept longer for breeding and milk production purpose, supplied insufficient feed against their high demand (Kamani *et al.,* 2010) or variation in sample size.

CHAPTER 6

SUMMARY AND CONCLUSION

CHAPTER VI

SUMMARY AND CONCLUSION

Ticks and tick borne infections in cattle was studied epidemiologically and clinically. The annual prevalence of tick infestation in cattle was 48.75%. Highest tick infestation was found in the summer season (77.5%). Females (75.55%) were more susceptible to tick infestation than male. Indigenous cattle (51.02%) were more prone to tick infestation than cross bred. Highest tick load found in the animal body was in ear, udder and perineal region. The annual prevalence of tick borne infections in cattle was determined based on the types of breed, sex and seasons. The overall prevalence of tick borne diseases was 70.58% where theileriosis (35.29%) and anaplasmosis (30.25%) were predominant. Tick-borne infections were predominant in summer season followed by rainy and winter seasons. Female animals (77.45%) were more susceptible to tick borne infections than male (29.41%). Cross breed cattle (77.55%) were more prone to tick borne infections than indigenous cattle (38.09%). It could be stated that breed and season were the important predictor of tick borne infections. The major clinical signs were fever (up to 41°C), anemia, anorexia, depression, weakness, cessation of rumination, hemoglobinuria and an increase in respiratory and heart rate.

The following conclusions were drawn based on the facts and findings studied throughout the course of the study:

- Prevalence of tick was more in summer season in Dinajpur sadar.
- Tick borne infections were more prevalent in cross bred cattle than the indigenous cattle in Dinajpur sadar.
- The comparatively more prevalence of tick borne infections was found in rural housed farms, in summer season and in female animals.

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