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Impact of tick infestation on haematological and biochemical profiles in cattle: A comparative study

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Abstract

Ticks are important ectoparasites of cattle which are associated with several direct and indirect losses and also act as vector of various pathogenic diseases which is associated with significant economic losses. The present study was conducted to determine the alterations in haematological and biochemical parameters in tick infested cattle. So, twenty-four tick infested cattle were selected for the study and the obtained findings were compared with healthy (apparently tick free) cattle. The analysis of haematology revealed significant decrease ($p < 0.05$) in several blood parameters such as haemoglobin, packed cell volume, total erythrocytes count and neutrophils and a significant increase ($p < 0.05$) in total leucocyte count, eosinophils and lymphocytes in tick infested cattle as compared to the healthy cattle. Several alterations in biochemical parameters were also found which included a significant decrease ($p < 0.05$) in serum glucose, total protein, albumin, globulin, A:G ratio, calcium and phosphorus and a significant increase ($p < 0.05$) in serum enzymes *viz.* aspartate aminotransferase, alkaline phosphatase and creatine kinase in tick infested cattle as compared to the healthy cattle. Thus, these findings highlight the detrimental impact of tick infestation on cattle health, as disturbances in haematological and biochemical findings are known to be the initial benchmark data that indicate negative impact on health.

Keywords: Cattle, biochemical profile, haematological profile, ticks

Introduction

As per the 20th livestock census India has a cattle population of 192.52 million in organized and unorganized sectors (BAHS, 2019) [5]. Ticks are the most important ectoparasites of all domestic animal species posing greater health risks, and approximately 80% of world's cattle population is subjected to tick infestation (FAO, 1984) [9]. About 106 tick species are reported from India out of which *Rhipicephalus microplus* and *Hyalomma anatolicum* are the most widely distributed species (Ghosh and Azhahianambi, 2007) [12] which are responsible for causing economic impact on cattle productivity. Ticks are obligate hematophagous ectoparasites that can attack animals and transfer infectious pathogens to animals thus causing serious health issues. This loss is associated with morbidity, mortality and decreased production yields of the animals. The poor health of animals due to tick infestation is a major concern for people in areas with heavy tick load (Tabor *et al.*, 2017) [25]. Tick infestation in cattle leads to extensive damage to the livestock health and production *via* transmission of various haemoprotozoan tick-borne diseases such as babesiosis, theileriosis and anaplasmosis (Ghosh and Nagar 2014) [11]. These ticks and tick-borne haemoprotozoan diseases make the survival of exotic and cross bred cattle a great challenge in India (Soundararajan and Rajavelu 2006) [24] as the hot and humid climate of India is favourable for the development and survival of the ticks, so a constant source of infection is present to susceptible animals (Chowdhury *et al.*, 2006) [7]. India holds a substantial share of the world's livestock resources and hence the damage caused by ticks and tickborne diseases to livestock is considered extremely significant.

Heavy tick load leads to tick worry that includes blood loss, tick bite, local skin infection and the secondary effects of tick infestation that include infection of the local region, causing suppurative lesions on the ears, legs and other parts of the body. In lambs the local infection may lead to tick pyaemia. Another consequence of heavy tick infestation is damage done to hides (Bhatia *et al.*, 2016) [6]. A single engorged female tick can cause a loss of 0.5–2 ml of blood, 8.9 ml of milk and 1 g of body weight per day (Minjauw and McLeod, 2003) [16].

The estimated annual control cost of ticks and tick-borne diseases in India is reported to be 498.7 million USD (Minjauw and McLeod, 2003) [16]. Economic losses due to tick infestation are of great importance in India, as majority of population depend on dairy products as a primary source of protein (Anon 2016) [4] and cattle play an important role in economy of India *via* production of milk, meat, hide, fuel and draught power. Feeding habits of ectoparasites such as ticks can lead to several health issues in cattle which is associated with decrease in several blood parameters, trace elements, mineral levels and biochemical parameters (Aatish *et al.*, 2007) [1]. Tick infestation also lead to various physiological changes and stress conditions which can be detected by changes in haematological and biochemical attributes (Sakina *et al.*, 2010) [19]. Hematological and biochemical alterations are the indicators of severity of disease and are considered to be good tools for the diagnosis and prognosis for effective therapy (Col and Uslu, 2006) [8]. The aim of the present study was to evaluate the effect of tick infestation in cattle in haematological and biochemical parameters which reflects the general health of cattle and compare it with the healthy control.

Materials and Methods

Selection of animals

The present study was conducted at Govind Ballabh Pant University of Agriculture and Technology, Pantnagar and surrounding areas of Pantnagar which is situated at 29°N latitude and 79.3°E longitude at an elevation of 232.8 m above mean sea level. The study was conducted during the period from November 2020 to April 2021. A total of 24 cross-bred adult cattle with high tick burden were selected for the present study which were not given any acaricidal treatment for the past 6 months. Non-tick infested cattle group was also taken in the study which served as healthy control. The usage of animals in the present study was approved by the Institutes Animal Ethics Committee (IAEC) of G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand.

Collection and Identification of Ticks

Ticks on the skin surface of infested cattle were observed with naked eyes (Bhatia *et al.*, 2016) [6]. Collection of ticks from the host body was done either by using forceps or by grasping them between finger and thumb and then pulled out gently. Collected ticks were stored in 70% ethanol and further identification was done after observation of morphological characteristic of the ticks (Bhatia *et al.*, 2016) [6].

Haematological Profile

The influence of ticks on blood cellular components was investigated by haematological studies. For study of haematological parameters, 5 ml of blood was drawn aseptically from jugular vein of each animal using 18-gauge needle and blood was immediately transferred to a vial containing EDTA (ethylene diamine tetra acetate) as an anticoagulant for the examination of blood cellular components. All blood samples were examined within 2 hours of collection. Haematological parameters *viz.* haemoglobin, total erythrocyte count (TEC), total leucocyte count (TLC), differential leucocyte count (DLC) and packed cell volume (PCV) were studied as per the standard laboratory procedures (Jain, 1986) [13].

Biochemical Profile

For study of biochemical parameters, blood samples were collected to harvest serum, in 5 ml capacity gel clot activator and was allowed to stand in undisturbed slant position for about 1-2 hours. The clot was retracted and the serum was separated after rapid centrifugation at 3000 rpm for 10 minutes and extreme care was taken to prevent haemolysis. The collected serum was then stored in deep freeze at -20 °C in micro-centrifuge tubes properly capped and labelled for further biochemical assessment. Commercially available diagnostic kits of ERBA diagnostics were used for colorimetric determination of serum glucose, total protein, serum albumin, serum globulin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), creatinine, blood urea nitrogen (BUN), calcium, phosphorus and creatine kinase (CK).

Statistical Analysis

Statistical analysis of data was performed using software SPSS-16.0. Data pertaining haematological and biochemical profiles was analysed by student t-test to test the significance of means and $p < 0.05$ was accepted as statistically significant (Snedecor and Cochran, 1994) [22].

Results and Discussion

Identification of the tick species

The ticks affecting cattle was identified as *Boophilus microplus* by permanent mounting of the tick specimen. *Boophilus microplus* was reported as the most prevalent and widespread tick species infesting cattle in region of Uttarakhand (Vatsya *et al.*, 2008) [27]. *Boophilus microplus* was reported as the only tick present on the body of animals infected with theleriosis in Kumaon and Garhwal region of Uttarakhand (Sharma *et al.*, 2021) [20].

Haematological Profile

The mean values of haematological parameters are shown in Table 1 and Figure 1. In the present study it was found that there was significant decrease in haemoglobin concentration (gm/dl), TEC (millions/ μ l) and PCV (%) in tick infested cattle as compared to the healthy control. It was also found that there was significant increase in TLC (thousands/ μ l), eosinophil count (%), lymphocyte count (%) and a significant reduction in neutrophil count (%). No significant changes were found in basophil count (%) and monocyte count (%) in the present study.

It is reported that there is significant reduction in haemoglobin ($p < 0.001$) in tick infested cattle than in non-infested cattle (Kaur *et al.*, 2017) [15]. Lower haemoglobin is present in tick infested animal due to anaemia because of blood sucking nature of the ticks and the haemorrhage caused by the blood sucking activity of the ticks (Soulsby, 1982) [23]. A significant reduction ($p < 0.05$) in TEC and PCV of tick infested cases of cattle is also reported (Kaur *et al.*, 2017) [15]. There are reports that the mean values of TLC were higher in naturally tick infested calves (Singh, 2006) [21]. Leukocytosis is also reported in tick infested dogs (Katariya *et al.*, 2018) [14]. Neutropaenia is also reported in cases of tick infestation (Singh, 2006) [21]. A significant increase in eosinophil count in high tick infestation cases is reported in other studies (Narang *et al.*, 2015; Kataria *et al.*, 2018) [17, 14]. A significant increase ($p < 0.05$) in lymphocytes of tick infested cattle is reported (Kaur *et al.*, 2017) [15]. No

significant change in basophil count and monocyte count is reported in tick infested cattle (Narang *et al.*, 2015; Kaur *et al.*, 2017; Kataria *et al.*, 2018) [17, 15, 14].

Biochemical Profile

The mean values of biochemical parameters are presented in Table 2 and Figure 2. In the present study it was found that tick infestation led to a significant reduction in certain biochemical parameters *viz.* serum glucose (mg/dl), total protein (g/l), albumin (g/l), globulin (g/l) and albumin globulin ratio. Also, a significant increase in values of AST, ALP and CK (IU/l) were found. There was no significant change in ALT values in case of tick infested cattle. No significant differences in the values of creatinine and BUN levels of healthy and tick infested cattle were observed. A significant decrease was observed in the values of serum calcium (mmol/l) and phosphorus (mmol/l) in cases of tick infested cattle as compared to non-tick infested cattle.

Lowered values of glucose and total protein is reported in cases of tick infestation in cattle as compared to healthy, non-tick infested cattle (Pandey *et al.*, 2007) [18]. The explanation for hypoproteinemia may be the negative energy balance caused due to parasitism. Decrease in values of albumin is reported in cases of tick infestation in cattle (Pandey *et al.*, 2007) [18]. No significant changes are reported in globulin values in tick infestation cases (Abubakar *et al.*, 2019) [2]. A:G ratio is usually altered by a

decrease in albumin or globulin and/or an increase in albumin or globulin values. A decrease in A:G ratio in tick infested animals is also reported earlier (Narang *et al.*, 2015) [17]. In previous studies, a significant increase in activities of serum AST, ALT and CK is reported in cases of tick infestation in cattle (Tharwat and Al-Sobayil, 2013) [26]. No significant differences between creatinine and BUN values of tick infested and non-tick infested cattle is reported (Amer and Amer, 2020) [3]. A significant decrease in serum calcium and phosphorus is reported in cases of tick infestation (Pandey *et al.*, 2007) [18] which may be indicating nutrient drainage due to feeding behaviour of ticks.

Table 1: Haematological values (Mean±SE) of healthy and tick infested cattle

Parameters	Healthy control	Tick infested cattle
Hb (gm/dl)	12.03±0.18 ^a	8.05±0.21 ^b
TEC (×10 ⁶ /μl)	8.09±0.22 ^a	6.49±0.19 ^b
TLC (×10 ³ /μl)	9.76±0.20 ^b	12.55±0.21 ^a
PCV (%)	41.03±0.25 ^a	36.56±0.35 ^b
Neutrophils	45.17±0.36 ^a	30.92±0.41 ^b
Eosinophils	1.83±0.21 ^b	6.71±0.3 ^a
Lymphocytes	47.16±0.38 ^b	59.67±0.45 ^a
Monocytes	1.66±0.15 ^a	1.92±0.16 ^a
Basophils	1.33±0.19 ^a	1.75±0.16 ^a

(Figures having different superscripts across the rows are significantly different upto 5% level of significance)

Table 2: Biochemical values (Mean ±SE) of healthy and tick infested cattle

Parameters	Healthy control	Tick infested animals
Glucose (mg/dl)	62.33±0.68 ^a	46.00±0.68 ^b
Total protein (g/l)	68.43±0.98 ^a	44.56±0.32 ^b
Albumin (g/l)	32.73±0.85 ^a	17.36±0.38 ^b
Globulin (g/l)	35.70±1.43 ^a	27.21±0.41 ^b
A: G	0.93±0.05 ^a	0.65±0.02 ^b
ALT (IU/l)	31.03±1.01 ^a	34.90±1.95 ^a
AST (IU/l)	86.90±3.02 ^b	110.57±2.39 ^a
ALP (IU/l)	135.16±2.55 ^b	150.03±1.76 ^a
CK (IU/l)	8.33±0.41 ^b	63.96±1.06 ^a
Creatinine (mg/dl)	1.07±0.10 ^a	1.10±0.08 ^a
BUN (mg/dl)	21.87±0.93 ^a	22.26±0.62 ^a
Calcium (mmol/l)	2.90±0.11 ^a	1.70±0.08 ^b
Phosphorus (mmol/l)	1.93±0.04 ^a	1.31±0.07 ^b

(Figures having different superscripts across the rows are significantly different upto 5% level of significance)

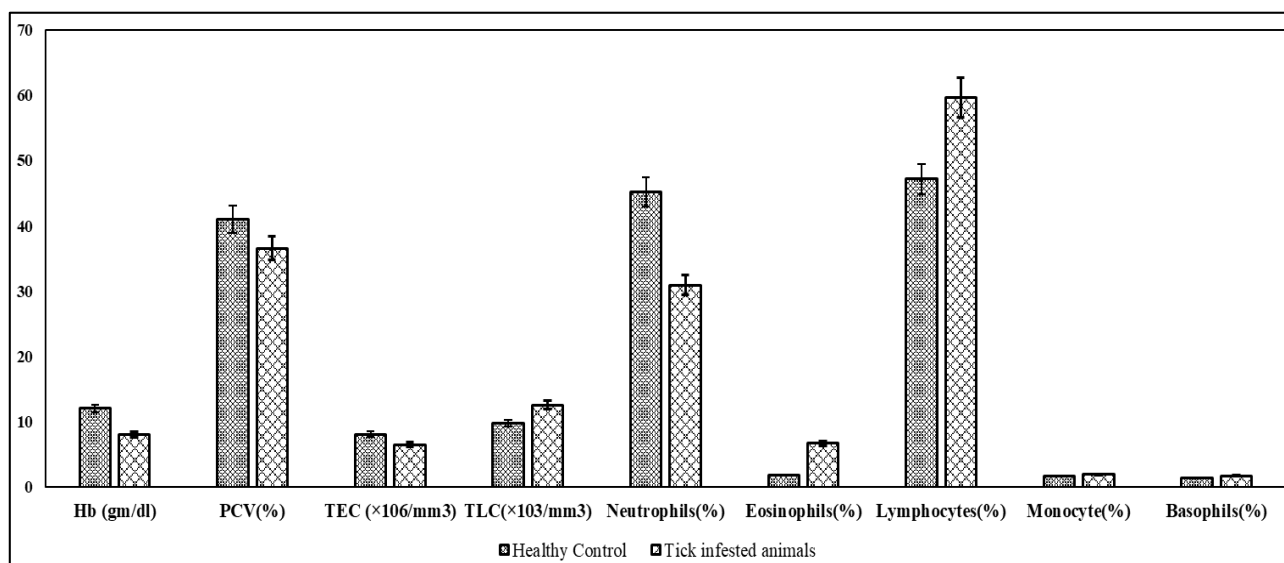


Fig 1: Haematological values of healthy and tick infested cattle

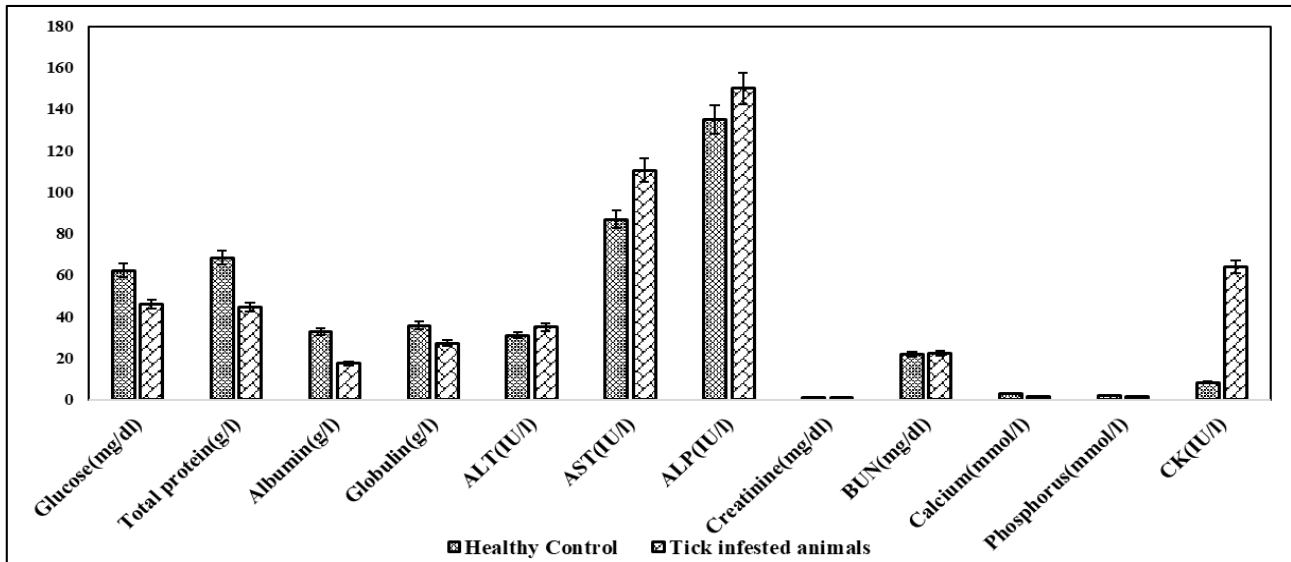


Fig 2: Biochemical values of healthy and tick infested cattle

Conclusion

The most common tick species found in the region of Pantnagar, Uttarakhand is *Boophilus microplus*. The haematological analysis revealed significant decrease ($p < 0.05$) in Hb, PCV, TEC and neutrophils in tick infested cattle accompanied by leucocytosis, eosinophilia and lymphocytosis. Alteration in biochemical parameters included significant decrease ($p < 0.05$) in serum glucose, total protein, albumin, globulin, A:G ratio, calcium and phosphorus in tick infested cattle. There was significant increase ($p < 0.05$) in serum enzymes *viz.* aspartate aminotransferase, alkaline phosphatase and creatine kinase. Thus, tick infestation causes significant and important alterations in various important haematological and biochemical parameters of the infested animals which suggest compromised health and reduced productivity, underlining the importance of effective tick control measures in cattle management to mitigate economic losses and improve animal welfare.

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