Biological Times

Volume No. 3| Issue No. 5|Pages 9-10

The Tick-Tock of Babesiosis: Understanding the Risks, Signs, and Treatment Options, plus a Look at Herbal Tick Control

Muhammad Muneeb[1*], Asfand Yar Khan[1], Ahmad Haroon[1], Moin Khan[1], Fahad Mumtaz[1]

[1] Faculty of Veterinary and Animal Sciences, Quaid-e-Azam Sub Campus Gomal University, Dera Ismail Khan, Pakistan

*Corresponding author: **muneebkhankhan2002@gmail.com**

ABSTRACT

Babesiosis is a protozoal tick-borne disease caused by Babesia species characterised by high fever, anaemia, haemoglobinemia and haemoglobinuria. Animals kept on katcha floor, closed housing system and tethering system are more prone to Babesiosis. It is mainly diagnosed through thin and thick blood smears and PCR. Diminazene aceturate and imidocarb dipropionate are most commonly used drugs against Babesiosis. In vectors control the various phytopharmacueticals with acaricidal and larvicidal properties are *Azadirachta indica* (Neem Tree), *Gynandropsis gynandra* (Spiderwisp), *Lavandula angustifolia* (English Lavender), *Pelargonium Roseum* (Rose-scent geranium), and *Cymbopogon* (Lemon Grass) species.

Introduction

Bovine Babesiosis is also known as red water disease, Texas fever, Cattle tick fever and Piroplasmosis. Babesiosis is a tick-borne parasitic disease caused by haemoprotozoan belonging to the phylum Apicomplexa, order Piroplasmidia, family Bebesiidae, and genus *Babesia* and characterised by high fever and intravascular haemolysis leading to progressive anaemia, haemoglobinuria, haemoglobinemia and jaundice [1,2]. Cattle and buffalo are mostly affected by *Babesia* species and are prevalent worldwide. It may affect horse, sheep, goat, dog, pig, wild animals and human too. Health and productivity of in livestock animals is significantly affected by Babesiosis infection leading to numerous economic losses [2].

Aetiology

Babesiosis is mainly caused by *Babesia bigemina*, *Babesia bovis*, *Babesia divergens* and *Babesia major* in cattle and buffalo. It is transmitted by following genus of ticks; *Ixodes* and *Rhipicephalus* in bovine [2].

Epidemiology

The Friesian breed of cattle is highly susceptible to Babesia Bovis infection because they are more sensitive to ticks [3,22]. From the previous research, it is stated that prevalence of Babesiosis in Pakistan in all domestic livestock animals is 32.8% (59/180), with varying rates among species: with Punjab exhibiting the highest frequency (33.87%) and KPK the lowest (13.24%) [3].

Risk Factors

Table.1: Risk factors associated with Babesiosis [1,21]

Factor	% Prevalence	Reason
Species	Cattle-20.19% vs Buffalo-14.28%	Softer skin of the cattle making it more prone to ticks
Cattle breed	Exotic-29.34%, Cross bred-21.45% and Indigenous-10.3%	Natural resistance of local breeds to ticks
Sex	Female-21.13% vs male-12.68%	Hormonal disturbances which exerts stress in female
Age	Young-23.17% vs adult-11.9%	Lesser or no exposure to the parasites leading to weaker immunity and soft skin also allows easy penetration of mouthparts in young ones
Animal keeping	Tethered-23.48% Vs open-11.10%	Reduced immune response due to tethering stress and lesser movement of animals in confinement have more chances of being attacked by ticks
Housing system	Closed-22.10%, semi closed-19.25% and open-9.24%	Crevices of bricks and heaps and masses of dung cakes might have higher in closed housing leads to vector population
Floor pattern	Uncemented-20.39%, partially cemented-17.54% & cemented-11.98%	Poor hygienic system
Season	Summer-23.41%, autumn-20.47%, spring-17.77% and winter-7.29%	Due to favorable environmental condition for growth and development of the vectors

Identification of Ticks

All hard ticks have a scutum on their topside of their body. The scutum covers the entire body in males but it covers only front 1/3 of the body in female. The scutum have no elasticity even if the female tick engorges. Nymph and larval stage ticks also have a scutum covering the front 1/3. Ticks body is divided into 2 distinct regions, the capitulum and the idiosoma. The most characteristic components of the head are the palps and toothed hypostome. When a tick attaches to a host, the hypostome is exposed as palps folds back. The hypostome have a pair of chelicerae which act like a pincer [4].

Table.2: Key features Rhipicephalus & Ixodes

Features	*Rhipicephalus*	Ixodes
Eye Palps	Wider than long	Eyes are absent but palps are longer than wider
Basis Capitulum	Hexagonal dorsally, with spurs on each side	Hexagonal dorsally
Scutum	Not ornamented	Not ornamented
Festoons	Present	Absent
Anal Groove	Never extending anteriorly around anus	Wraps anteriorly around anus
Spiracular Plates	With bill-like protrusion	Circular
		

Clinical Signs

Incubation period may range from eight to fifteen days [5]. There will be high fever (104°F [40°C]), anaemia, jaundice, pale mucous membrane, swollen lymph node, stopped rumination and mild to moderate tick infestation [6]. Haemoglobinuria and haemoglobinemia occur in the final stages. Involvement of the CNS due to adhesion of parasitized erythrocytes in brain capillaries [7]. Late-term pregnant cows may abort [5]. Temporary infertility due to transient fever may occur in bulls [8]. There may be spasm in anal sphincters causing passage of pipe stem faeces [9].

Differential Points of Babesiosis in comparison with Anaplasmosis and Theileriosis

Microscopic Examination

Under microscope, *Babesia bigemina* appeared as pear-shaped bodies joined at an acute angle within the mature erythrocyte in the blood smear stained with Giemsa stain [6]. Under microscope, *Anaplasma* species appears as small and roughly circular intraerythrocytic parasite [10]. In case of *Anaplasma marginale* pointed round dot appears at periphery of RBC and in *Anaplasma centrale* pointed round dot appears inside of RBCs. In case of *Theileria* spp, RBCs appears slight triangle in shape and *Theileria* spp itself appears in the form of ring (Annular) [11].

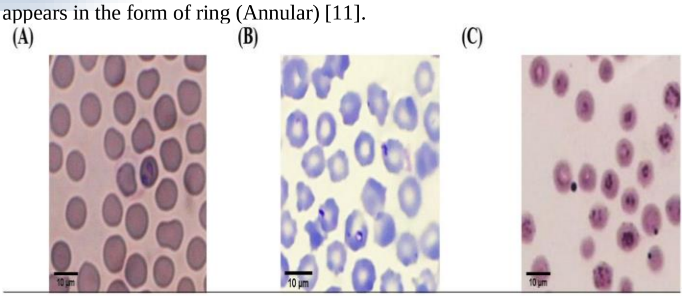

Fig.1: (A) *Babesia* spp.; (B) *Theileria* spp.; (C) *Anaplasma* spp. [12]

To cite this article: Muneeb M, AY Khan, A Haroon, M Khan & F Mumtaz. 2024. The tick-tock of babesiosis: understanding the risks, signs, and treatment options plus a look at herbal tick control. Biological Times, 3(5): 9-10.

Clinical Pathology

There will be low erythrocyte count (2 million/µL), low packed cell volume, low haemoglobin level (3 g/dL) and increased red blood cell sedimentation in case of Babesiosis [23].

Based on clinical signs

There will be acute fever along with marked hemoglobinuria and pipe stem faeces in Babesiosis. In Theileriosis, there will be prescapular and precrural lymph node enlargement while there is no hemoglobinuria and mature animal will be more susceptible in case of anaplasmosis. [21,24]

Polymerase Chain Reaction and ELISA

Treatment

In treatment protocols, the author [6,13] stated that Diminazene aceturate at dose rate of 3.5 mg/kg b.wt. IM, once and imidocarb dipropionate at the dose rate of 1-3 mg/kg, SC, once; had the best result against Babesiosis. In supportive treatment authors included antipyretics (Meloxicam at dose rate of 0.5 mg/kg b.wt. IM) [6], corticosteroid (Dexamethasone at dose rate of 0.2 mg/kg b.wt. SC) [14] and fluid therapy along with multivitamins including Thiamine hydrochloride, Riboflavin, Niacinamide, Vitamin B12 and Liver extract at two different sites at neck region with dosage rate of 10ml IM [6]. Vitamin E can also be used as a supportive therapy because it reduces the oxidative effect of babesia by increasing antioxidant activity [5].

Herbivory vector control

Extracts of various species, including *Azadirachta indica* (Neem Tree), *Gynandropsis gynandra* (Spiderwisp), *Lavandula angustifolia* (English Lavender), *Pelargonium roseum* (Rose-scent geranium), and *Cymbopogon* (Lemon Grass) species have excellent acaricidal properties with 90-100% efficacy, comparable to current synthetic acaricides in the market, and have larvicidal action [16]. A number of active compounds have been isolated from different plant species which have good acaricidal and larvicidal effect [16,17].

Table.3: Plant-derived compounds with potential for tick control [17]

Compound	Effect	Species of Ticks
α-Pinene	acaricidal	*R. microplus*
β-Citronellol	acaricidal, repellent	*I. ricinus*
Borneol	repellent	*I. ricinus*
Citronellol	acaricidal	*R. microplus, I. ricinus*
Eucalyptol	acaricidal	*R. microplus*
Geraniol	acaricidal, repellent	*R. microplus, I. ricinus*
Limonene	acaricidal	*R. microplus*
Linolool	acaricidal	*R. microplus*
Spilanthol	acaricidal	*R. microplus*
β-Caryophyllene	acaricidal	*R. microplus, I. ricinus*
Azadirachtin	acaricidal	*R. microplus*

- The methanol extract of *Acmella oleracea* (Jambu Plant) is particularly toxic to tick larvae with a lethal concentration 90 by 1.6 mg/mL for larvae of *Rhipicephalus (Boophilus) microplus* [17].
- 100% of engorged *Rhipicephalus (Boophilus) microplus* females are killed with 2% solution of *Annona muricate* (Sweetsop) seeds extracted with ethanol [17].
- A lethal concentration 50 by 0.548 mg/mL of *Annona squamosa* (Sugar Apple) extracts with aqueous extracts of fruit peels is effective against *Rhipicephalus (Boophilus) microplus* larvae [17].
- Hexane extractions from *Nicotiana tabacum* proved more effective with a lethal concentration 50 by 0.6 mg/mL for female *Rhipicephalus (Boophilus) microplus* [17].
- Tannin-rich plant extracts (*Acacia pennatula*, *Piscidia piscipula*, *Leucaena leucocephala*, and *Lysiloma latisiliquum*) showed insecticidal effects against larvae of *Rhipicephalus (Boophilus) microplus* (54.8%, 88.14%, 66.79%, and 56.0%, respectively), but these plant extracts have no effect on adults or egg-laying females [17].
- Recent studies examined the potential use of essential oils of *Laurus nobilis* (Laurel), *Ocotea odorifera* (Sassafras), *Chrysopogon zizanioides* (Vetiver grass), and *Schinus molle* (Peruvian Mastic Tree) with levels of control between 7.59% to 99%, depending on the concentration of essential oil, tick life stage, and species [18,19]. The combination of essential oils appears to enhance the effect of individual oils. A promising blend of essential oils is *Cinnamomum verum* (Cinnamon), *Cuminum cyminum* (Cumin) and *Pimenta diocia* (Allspice), which achieved acaricidal activity from 90% to 100% [19].
- Extract of *Capsicum* spp. mixed with butter fat, latex preparation of *Euphorbia obovalifolia* (Spurge), fruit juice preparation *Solanum incanum* (Thorn apple) and latex preparation of *Ficus brachypoda* (Weeping fig) were found to have 30-100% killing effects [20].
- Pyrethrum, derived from the dried flower heads of *Chrysanthemum cinerariifolium* and *Chrysanthemum coccinea*, has been used as an insecticide and flea medicine in the Middle East for centuries [16]. The insecticide activity of pyrethrum has low mammalian toxicity and an exceptionally fast decomposition rate, making it the most widely used organic insecticide.
- Whole-plant extract derived from *Calotropis procera* and *Taraxacum officinale* significantly reduced the index of egg laying and increased the percentage inhibition of adult female ticks at a concentration of 40mg/ml [23].

References

[1] Siddique, R. M., Sajid, M. S., Iqbal, Z., & Saqib, M. (2020). Association of different risk factors with the prevalence of babesiosis in cattle and buffalos. Pakistan Journal of Agricultural Sciences, 57(2).
[2] Azhar, M., Gadahi, J. A., Bhutto, B., Tunio, S., Vistro, W. A., Tunio, H., ... & Ram, T. (2023). Babesiosis: Current status and future perspectives in Pakistan and chemotherapy used in livestock and pet animals. Heliyon.
[3] Tariq, M., Badshah, F., Khan, N. U., Zafar, M. I., De Los Ríos-Escalante, P. R., Ibáñez-Arancibia, E., Mehnaz, S., Mubashir, M., Khan, M. S., Khan, M. S., Rafiq, N., Shaheen, N., Saeed, S., & Ben Said, M. (2024). Assessment of Babesia spp. prevalence in various domestic animals across Southern Punjab, Pakistan. Brazilian journal of biology = Revista brasleira de biologia, 84, e277636. https://doi.org/10.1590/1519-6984.277636
[4] Madder, M., Horak, I., & Stoltsz, H. (2014). Tick identification.Pretoria: Faculty of veterinary Science University of Pretoria,58.
[5] Ali, K. N., & Marif, H. F. (2023). Babesiosis in cattle. One Health Triad, 3, 114-121.
[6] Hemaswathy, L., Selvam, V., & Sunilkumar, N. S. (2020). Therapeutic management of Babesisois in Cattle. Int. J Vet. Sci. Anim. Husband, 5(5), 01-03.
[7] Locke, S., O'Bryan, J., Zubair, A. S., Rethana, M., Moffarah, A., Krause, P. J....Farhadian, S. F. (2023). Neurologic Complications of Babesiosis, United States, 2011–2021. Emerging Infectious Diseases, 29(6), 1128-1135.
[8] Ganzinelli, S., Rodriguez, A., Schnittger, L., & Florin-Christensen, M. (2018). Babesia in domestic ruminants.Parasitic Protozoa of farm animals and pets, 215-239.
[9] Sherlock, M., Healy, A., Larkin, H. A., & Doherty, M. L. (2000). Bovine babesiosis: clinical assessment and transfusion therapy.
[10] Shabana, I. I., Alhadlag, N. M., & Zaraket, H. (2018). Diagnostic tools of caprine and ovine anaplasmosis: a direct comparative study. BMC veterinary research, 14, 1-8.
[11] Hassan, M. Z., Giasuddin, M., Rahman, M. M., Ershaduzzaman, M., & Hasan, M. (2019). Identification of vector-borne blood protozoa in cattle and sheep in Bangladesh. J Virol Antivir, 2(004).
[12] Koonyosying, P., Rittipornlertrak, A., Chomjit, P., Sangkakam, K., Muenthaisong, A., Nambooppha, B., ... & Sthitmatee, N. (2022). Incidence of hemoparasitic infections in cattle from central and northern Thailand. PeerJ, 10, e13835.
[13] Maharana, B. R., Tewari, A. K., Saravanan, B. C., & Sudhakar, N. R. (2016). Important hemoprotozoan diseases of livestock: Challenges in current diagnostics and therapeutics: An update.Veterinary world, 9(5), 487–495.
[14] Haider, M. J., & Siddiqui, H. R. (1990). Effect of dexamethosone on babesiosis in Tatera indica (Hardwicke). Pakistan journal of pharmaceutical sciences, 3(1), 61–65.
[15] Alvarez, J. A., Rojas, C., & Figueroa, J. V. (2020). An overview of current knowledge on in vitro Babesia cultivation for production of live attenuated vaccines for bovine babesiosis in Mexico. Frontiers in veterinary science, 7, 364.
[16] Adenubi, O. T., Ahmed, A. S., Fasina, F. O., McGaw, L. J., Eloff, J. N., & Naidoo, V. (2018). Pesticidal plants as a possible alternative to synthetic acaricides in tick control: A systematic review and meta-analysis. Industrial Crops and Products, 123, 779-806.
[17] Quadros, D. G., Johnson, T. L., Whitney, T. R., Oliver, J. D., & Oliva Chávez, A. S. (2020). Plant-derived natural compounds for tick pest control in livestock and wildlife: Pragmatism or Utopia?. Insects, 11(8), 490.
[18] Singh, N. K., Singh, H., Mehta, N., & Rath, S. S. (2019). In vitro assessment of synergistic combinations of essential oils against Rhipicephalus (Boophilus) microplus (Acari: Ixodidae).Experimental parasitology, 201, 42-48.
[19] Rey-Valeirón, C., Pérez, K., Guzmán, L., López-Vargas, J., & Valarezo, E. (2018). Acaricidal effect of Schinus molle (Anacardiaceae) essential oil on unengorged larvae and engorged adult females of Rhipicephalus sanguineus (Acari: Ixodidae). Experimental and Applied Acarology, 76, 399-411.
[20] Regassa, A. (2000). The use of herbal preparations for tick control in western Ethiopia. Journal of the South African Veterinary Association, 71(4), 240-243.
[21] Khan, A., Nasreen, N., Niaz, S., Ayaz, S., Naeem, H., Muhammad, I., ... & Kumar, S. (2019). Acaricidal efficacy of Calotropis procera (Asclepiadaceae) and Taraxacum officinale (Asteraceae) against Rhipicephalus microplus from Mardan, Pakistan. Experimental and Applied Acarology, 78, 595-608.
[22] Shoaib, M., Rashid, M. I., Akbar, H., Sheikh, A. A., Farooqi, S. H., Ayari-Akkari, A., ... & Khan, R. (2022). Molecular epidemiology and characterization of Babesia bovis in cattle of Khyber Pakhtunkhwa province, Pakistan. Tropical Animal Health and Production, 54(6), 337.
[23] Radostits, O. M., Gay, C. C., Hinchcliff, K. W., & Constable, P. D. (Eds.). (2006). Veterinary Medicine E-Book: Veterinary Medicine E-Book. Elsevier Health Sciences.
[24] Ziam, H., Kernif, T., Saidani, K., Kelanemer, R., Hammaz, Z., & Geysen, D. (2020). Bovine piroplasmosis-anaplasmosis and clinical signs of tropical theileriosis in the plains of Djurdjura (north Algeria). Veterinary Medicine and Science, 6(4), 720-729.