

Overview of Vaccination Against Babesiosis and Theileriosis

Hazkeel Ahmed¹, Syed Muhammad Ali shah², Asim Shamim^{2*}

1. University of Veterinary and Animal Science (UVAS) Narowal Campus.
2. Faculty of Veterinary and Animal Sciences University of Poonch Rawalakot Azad Kashmir.

*Corresponding author: asimshamim@upr.edu.pk

ABSTRACT

Babesia and *Theileria* are continuously becoming a challenge for livestock. No part of the world is safe from these pathogens. Although some species of cattle like Zebu cattle are resistant to these pathogens, then other species of cattle are being infected by these pathogens, ultimately leading to economic losses in the form of decrease in milk and meat production. The use of vaccines has not given us so much benefit, because these vaccines require the maintenance of cold chain, causing difficulty for eradication of these pathogens from the developing countries, as a result of which exotic breeds are at greater risk of being infected from *Babesia* and *Theileria. spp* Moreover, the prevalence of these pathogens is now not only limited to animals, the cases of human babesiosis are also reported in some parts of the world like Europe, developing *Babesia* as a pathogen of zoonotic importance.

1. Introduction:

Babesiosis is a disease that affects the multiple systems of an animal's body. It is caused by a protozoan that belongs to the genus *Babesia* [1]. *Babesia* infects a variety of mammals and birds [2]. The *Theileria* genus includes a large number of parasites that infect a range of animals including domestic animals and wildlife species [3]. Babesiosis of cattle is usually considered a disease of tropical and subtropical regions, but in fact, it is a disease that has effects on the cattle population worldwide [4]. Tick-borne diseases including babesiosis and theileriosis are the cause of limiting the development of the livestock economy worldwide, resulting in the loss of hundreds of millions of dollars [5]. These diseases also impose threats on the trade of horses [6]. Although in the endemic regions, the animals have become resistant to tick-borne pathogens, the exotic breeds are still at greater risk of these pathogens [7]. The major problem arising today is that babesiosis is emerging as a worldwide zoonotic disease. The first case of human babesiosis is reported in Europe [8]. All these threats demand that there should be some preventive measures like vaccines against babesiosis and theileriosis, but scientists are facing challenges in the development of effective vaccines.

2. The Need for Vaccines Against Babesiosis And Theileriosis

The use of chemotherapeutic agents against babesiosis and theileriosis is essential for the management of these diseases, especially when safe and effective vaccines are not available for use in animals, but these chemotherapeutic agents are expensive and also require time to show their effects. Also, these chemotherapeutic agents are responsible for the development of resistance in *Babesia* and *Theileria* against drugs and it has also been observed that these drugs have side effects such as drug toxicity and the risk of contaminating the food chain [9]. These chemotherapeutic agents appear in the milk and meat of animals which are then consumed by humans [10]. All these factors suggest the need for vaccines for preventing babesiosis and theileriosis.

3. Overview of Vaccines Available Against Babesiosis And Theileriosis In Animals

Although scientists are continuously striving for the development of vaccines against babesiosis and theileriosis, only limited vaccines have yet been developed for preventing these diseases. Currently, live-attenuated vaccines are available against *Babesia bovis* and *Babesia bigemina*, but even these vaccines are not used worldwide due to legal restrictions and the side effects of these vaccines like pathogen contamination and other issues such as potential erythrocyte antigen. No vaccine has yet been developed against *Theileria equi* leading to the vulnerability of equines to this pathogen [11]. For preventing tropical theileriosis caused by *Theileria annulata*, culture-derived vaccines are being used in which schizonts are attenuated by growing the schizonts *in vitro* and after this, prolonged cultivation of these schizonts is carried out to achieve complete attenuation [12]. Although *Theileria annulata* and *Theileria parva* have similar life cycles, the mechanism of controlling these parasitic infections is different. In contrast to *Theileria annulata*, *Theileria parva* is controlled by using *Theileria parva* sporozoite in conjunction with long acting tetracyclines against extracellular fluid schizonts [13].

4. Availability of Vaccines Against Human Babesiosis

Not many vaccines are available for preventing human babesiosis, but the sub-unit vaccine has successfully been developed, resulting in a single option for the eradication of human babesiosis [14]. Vaccination against human babesiosis is not widely under operation. Only high-risk individuals are being

targeted in vaccination programs depending on the places where they live or where they work. Individuals who are vulnerable to these pathogens like immune-compromised persons or persons who are aiming to move towards endemic regions are also being vaccinated under the vaccination program [15].

5. Future Perspectives and Conclusion

The currently available vaccines are live-attenuated vaccines and have remained unchanged for the past few decades. Some vaccine-producing centers have remained successful in the further development of these vaccines and as a result, the shelf life of these vaccines has been improved. Also, the chances of parasite contamination during *in vitro* cultivation have also been decreased. The need of the hour is the development of subunit vaccines, in order to achieve solid immunity. As the severity of a parasitic infection is directly related to the number of pathogens causing disease, a subunit vaccine will be able to protect the animals from clinical signs and will also cease the replication of these pathogens inside the host's body. In comparison to chemotherapeutic agents, vaccines are a better way of controlling diseases. As *Babesia* is now a pathogen of zoonotic importance, scientists from both the medical and veterinary sciences should work in collaboration with each other for the effective eradication of this pathogen. Moreover, controlling the population of vectors is still the best method for preventing the attack of these pathogens on animals.

References

- [1] Bajer A, Beck A, Beck R, Behnke JM, Dwuznik-Szarek D, Eichenberger RM, Farkas R, Fuehrer HP, Heddergott M, Jokelainen P, Leschnik M. Babesiosis in Southeastern, Central and Northeastern Europe: An emerging and re-emerging tick-borne disease of humans and animals. *Microorganisms*. 2022 Apr 30;10(5):945.
- [2] Schnitger L, Rodriguez AE, Florin-Christensen M, Morrison DA. Babesia: a world emerging. *Infection, Genetics and Evolution*. 2012 Dec 1;12(8):1788-809.
- [3] Morrison WI. The aetiology, pathogenesis and control of theileriosis in domestic animals. *Rev. Sci. Tech*. 2015 Aug 1;34(2):599-611.
- [4] Kuttler KL. World-wide impact of babesiosis. In *Babesiosis of domestic animals and man* 2018 Jan 18 (pp. 1-22). CRC Press.
- [5] El-Alfy ES, Abbas I, Elseadawy R, Saleh S, Elmishmy B, El-Sayed SA, Rizk MA. Global prevalence and species diversity of tick-borne pathogens in buffaloes worldwide: a systematic review and meta-analysis. *Parasites & Vectors*. 2023 Mar 30;16(1):115.
- [6] Schnitger L, Ganzinelli S, Bhoora R, Omondi D, Nijhof AM, Florin-Christensen M. The Piroplasmida *Babesia*, *Cytauxzoon*, and *Theileria* in farm and companion animals: Species compilation, molecular phylogeny, and evolutionary insights. *Parasitology Research*. 2022 May;121(5):1207-45.
- [7] Shkap V, de Vos AJ, Zweygarth E, Jongejan F. Attenuated vaccines for tropical theileriosis, babesiosis and heartwater: the continuing necessity. *Trends in parasitology*. 2007 Sep 1;23(9):420-6.
- [8] Hildebrandt A, Zintl A, Montero E, Hunfeld KP, Gray J. Human babesiosis in Europe. *Pathogens*. 2021 Sep 9;10(9):1165.
- [9] Suarez CE, Noh S. Emerging perspectives in the research of bovine babesiosis and anaplasmosis. *Veterinary parasitology*. 2011 Aug 4;180(1-2):109-25.
- [10] Shkap V, de Vos AJ, Zweygarth E, Jongejan F. Attenuated vaccines for tropical theileriosis, babesiosis and heartwater: the continuing necessity. *Trends in parasitology*. 2007 Sep 1;23(9):420-6.
- [11] Silva MG, Villarino NF, Knowles DP, Suarez CE. Assessment of Draxxin®(tulathromycin) as an inhibitor of *in vitro* growth of *Babesia bovis*, *Babesia bigemina* and *Theileria equi*. *International Journal for Parasitology: Drugs and Drug Resistance*. 2018 Aug 1;8(2):265-70.
- [12] Pipano E, Shkap V. Vaccination against tropical theileriosis. *Annals of the New York Academy of Sciences*. 2000 Dec;916(1):484-500.
- [13] Jenkins MC. Advances and prospects for subunit vaccines against protozoa of veterinary importance. *Veterinary Parasitology*. 2001 Nov 22;101(3-4):291-310.
- [14] Al-Nazal HA, Cooper E, Ho MF, Eskandari S, Majam V, Giddam AK, Hussein WM, Islam MT, Skwarczynski M, Toth I, Kumar S. Pre-clinical evaluation of a whole-parasite vaccine to control human babesiosis. *Cell Host & Microbe*. 2021 Jun 9;29(6):894-903.
- [15] Al-Nazal H, Low L, Kumar S, Good MF, Stanisic DI. A vaccine for human babesiosis: prospects and feasibility. *Trends in Parasitology*. 2022 Aug 3.

Published on: 31 December 2023

<https://biologicaltimes.com/>

To cite this article: Ahmad H, SMA Shah & A Shamim. 2023. Overview of Vaccination Against Babesiosis and Theileriosis. *Biological times*, 2(12): 24