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Research Article

Prevalence and Co-infection of Blood Parasites in Beef Cattle in Agam Regency, West Sumatra: An Epidemiological and Risk Analysis

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ABSTRACT

Blood parasitic diseases remain a major constraint to cattle productivity in tropical regions, including Indonesia. This study aimed to detect blood parasites and determine their prevalence in different types of beef cattle in *Agam* Regency, West Sumatra. A cross-sectional study was conducted using secondary data obtained from the West Sumatra Provincial Livestock Service. A total of 163 blood smear samples were examined, consisting of 22 local cattle and 141 crossbred cattle (Simmental and Limousin). Blood parasite identification was performed using *Giemsa-stained* thin blood smears observed under light microscopy. The results showed that *Theileria sp* and *Babesia sp* were the only blood parasites detected. The overall prevalence of *Theileria sp* was 70.55%, while *Babesia sp* was 18.40%. No infections of *Anaplasma* sp or *Trypanosoma sp* were found. Based on cattle type, the prevalence of *Theileria sp* was higher in local cattle (81.82%) than in crossbred cattle (68.79%), although the difference was not statistically significant ($p > 0.05$). In contrast, the prevalence of *Babesia sp* was significantly higher in local cattle (40.91%) compared to crossbred cattle (14.89%) ($p < 0.05$). Risk analysis indicated that local cattle had a higher risk of *Babesia sp* infection (RR = 2.75) and nearly four times higher odds compared to crossbred cattle (OR = 3.96). In conclusion, *Theileria sp* was the dominant blood parasite infecting beef cattle in *Agam* Regency, while *Babesia sp* infection was significantly associated with cattle type. Local cattle were identified as a higher-risk group for *babesiosis*. These findings highlight the need for improved vector control and routine surveillance of blood parasitic diseases, particularly in traditional cattle production systems.

Keywords: Blood parasites, beef cattle, prevalence, *Theileria sp*, *Babesia sp*, *Agam* Regency

INTRODUCTION

Blood-borne parasitic diseases in beef cattle represent one of the major challenges for the livestock industry in Indonesia and other tropical countries, where performance decline, productivity loss, and even mortality may be considerably high if animal stress is neglected or herds become infected within farms (*Parveen et al.*, 2021c; *Shabangu* et al., 2025a). The primary infections in cattle include *Theileria sp.*, *Babesia sp.*, *Anaplasma sp.*, and *Trypanosoma sp.*, which are transmitted by vectors such as ticks and flies (Jian Muriu, 2023; Ramiro et al., 2025).

Cases of *theileriosis* and *babesiosis* in cattle have been widely reported in Indonesia, particularly in humid climates under extensive farming systems (*Cahyaningsih*, *Yelitta*, *et al.*, 2026; Fuente et al., 2023). Local cattle are generally more susceptible to infection compared with crossbred cattle; however, infections in local cattle are often subclinical due to their adaptation to

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endemic environments and feeding conditions (Casa et al., 2014; P. I. Ganesan et al., 2025; Perumalsamy & Sharma, 2024). In contrast, crossbred cattle such as Simmental and Limousin are frequently described as clinically more susceptible, although infection cases may occur less frequently due to more effective herd management practices (Youssif, Dyab, et al., 2026).

The prevalence and distribution of blood parasites among different beef cattle breeds remain poorly documented scientifically in *Agam* Regency, West Sumatra. Therefore, this study provides valuable data to support accuracy and improve understanding of epidemiological patterns in the region (*Alwuthaynani et al*., 2026; Gareh et al., 2026).

Blood parasites, including Theileria sp., Babesia sp., Anaplasma sp., and *Trypanosoma sp*. cause *hemoprotozoan* and *hemobacterial* diseases and are mainly transmitted through vectors, particularly arthropods such as ticks. Blood parasite infections are associated with anemia, fever, weight loss, reproductive disorders, and may lead to death, thereby directly affecting production efficiency and the economic sustainability of the livestock industry (*Simking et al*., 2014a) , (*Cahyaningsih, Yellita, et al*., 2026) .

Beef cattle are a vital commodity for achieving national food security, particularly as a major source of animal protein for the Indonesian population. Livestock development in West Sumatra Province, including *Agam* Regency and surrounding areas, is highly important. However, the agricultural sector involved remains relatively traditional and semi-intensive, as most beef cattle farmers operate closely with local crop farmers. Nevertheless, various health-related issues affect beef cattle production potential, one of which is blood parasitic disease, which is common in tropical countries (*Shabangu et al*., 2025b) , (*Parveen et al*., 2021a) .

Cattle from local breeds differ genetically from crossbred cattle (Simmental and Limousin) in terms of disease resistance and immune response to blood parasite infections (*Cahyaningsih*, *Yellita, et al*., 2026) , (de la Fuente et al., 2023) . Differences in blood parasite prevalence among cattle types were analyzed along with risk estimations (Odds Ratio/OR and Risk Ratio/RR) to obtain deeper insights into risk factors influencing the epidemiology of blood parasite infections (*Cahyaningsih, Yellita, et al*., 2026) , (*Simking et al*., 2014b) .

Agam Regency serves as a beef cattle development center supported by *agroecosystem* conditions in West Sumatra, characterized by environmental factors that favor the development of tick vectors. Despite significant progress reported in previous studies, epidemiological data on blood parasite prevalence in beef cattle across different cattle types in this region remain limited and not fully documented(Gharbi & Darghouth, 2015) . Therefore, this study employed secondary data analysis using records from the Livestock and Animal Health Service of West Sumatra Province as a strategic data collection approach to provide an initial overview of livestock health status at the population level.

This study aimed to analyze the prevalence of *Theileria sp*., Babesia sp., Anaplasma sp., and *Trypanosoma* sp. infections in beef cattle in *Agam* Regency, West Sumatra, and to identify differences in prevalence based on cattle type (local cattle vs. crossbred cattle). The findings are expected to serve as a basis for formulating more effective and risk-based control strategies for blood parasitic diseases.

Accordingly, secondary data from the Livestock and Animal Health Service of West Sumatra Province were utilized to analyze epidemiological trends and identify infection patterns based on livestock type and geographic distribution. The implementation of statistical and epidemiological analyses, along with implications for livestock health management through this approach,

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contributes to the validity of the research findings and enhances the scientific rigor of this study (*Youssif, Kamal Dyab, et al*., 2026), (*Gharbi & Darghouth*, 2015) .

Furthermore, the current research emphasizes the practical application of findings to reduce the burden of blood parasites and improve animal welfare through vector control, routine *antiparasitic* treatment, periodic monitoring, and farmer education. As a systematic, evidence-based approach, this study contributes to the advancement of epidemiological research on blood parasitic infections in beef cattle in tropical regions and serves as an important reference for policy formulation and livestock health management in West Sumatra and Indonesia more broadly (*Atea Kamel et al*., 2024) , (*Shahzad et al*., 2025) .

MATERIAL AND METHODS

This observational study employed a cross-sectional approach using secondary data obtained from beef cattle blood smear examinations recorded by the Livestock and Animal Health Service of West Sumatra Province.

Data analysis was conducted based on health examination and surveillance activities of beef cattle in Agam Regency, West Sumatra Province in 2024. The examinations were performed in areas characterized by traditional to semi-intensive farming systems.

The study population consisted of all beef cattle whose blood smears were examined. A total of 163 specimens were analyzed:

- Local cattle: 22 heads
- Crossbred cattle (Simmental and Limousin): 141 heads

Blood parasite detection was performed using the thin blood smear technique, stained with *Giemsa*, and observed under a light microscope. Parasite identification was conducted through *parasitological* diagnostic methods based on the morphological characteristics of each parasite agent.

Research Variables

- Main variable: blood parasite infection status *(Theileria sp*., *Babesia sp*., *Anaplasma sp*., *Trypanosoma sp*.)
- Comparative variable: cattle type (local vs. crossbred)

Data Analysis

Prevalence was calculated as the percentage of positive cattle relative to the total sample. Differences in prevalence based on cattle type were analyzed using the Chi-square test. Risk Ratio (RR) and Odds Ratio (OR) were calculated to assess the magnitude of infection risk according to cattle type. All analyses were *univariate* and descriptive-analytic.

RESULTS

Out of 163 examined blood smear samples, two types of blood parasites were identified, namely *Theileria sp*. and *Babesia sp*. No *Anaplasma sp*. and *Trypanosoma sp*. infections were detected in any of the samples.

Table 1. Prevalence of Blood Parasites in Beef Cattle in Agam Regency

Parasite	Positive in total (N)	Prevalence (%)
Theileria sp	115	70.55
Babesia sp	30	18.40

Anaplasma sp	0	0
Trypanosoma sp	0	0

Based on Table 1 above, *Theileria* sp. was the most dominant blood parasite infecting beef cattle in *Agam* Regency, West Sumatra

Table 2. Total Prevalence of Blood Parasites by Beef Cattle Type in Agam Regency

Parasite Type	**Total Positive Cases**	**Prevalence (%)**	**Positive Local Cattle**	**Positif Sapi Cross**
Theileria sp	115	70.6	18	97
Babesia sp	30	18.4	9	21
Anaplasma sp	0	0	0	0
Trypanosoma sp	0	0	0	0

Based on Table 2 above, *Theileria* sp. was identified as the most dominant blood parasite affecting beef cattle in Agam Regency, with 115 positive cases out of 163 samples, resulting in an overall prevalence of 70.6%. *Theileria* sp. infection was more frequently detected in crossbred cattle (97 heads), while 18 positive cases were recorded in local cattle.

Meanwhile, *Babesia* sp. was detected in 30 cattle, yielding a prevalence of 18.4%. *Babesia* sp. infection was more commonly found in crossbred cattle (21 heads) compared to local cattle (9 heads). No samples were positive for *Anaplasma* sp. or *Trypanosoma* sp., indicating that these parasites were not present in the studied population.

These findings suggest that *Theileria* sp. is the primary blood parasite affecting beef cattle in this area, while *Babesia* sp. is also present but at a lower prevalence. This information is important as a baseline for planning blood parasite control strategies, particularly by considering the distribution of infections between local and crossbred cattle, so that livestock health interventions can be more effective and targeted.

Table 3. Co-infection of *Theileria* sp. and *Babesia* sp. in Agam Regency

Cattle Type	**Total Samples**	***Theileria* only**	**Babesia only**	**Co-infection (*Theileria* + *Babesia*)**	**Negative**	**Co-infection Prevalence (%)**
Lokal	22	11	2	7	2	31.8
Cross	141	84	8	13	36	9.2
Total	163	95	10	20	38	12.9

Based on Table 3 above, the co-infection results from 163 beef cattle showed that 20 cattle were identified with dual infection of *Theileria* sp. and *Babesia* sp., resulting in an overall co-infection prevalence of 12.9%. When compared across cattle types, local cattle exhibited a higher co-infection prevalence of 31.8% (7 out of 22 specimens) than crossbred cattle, which showed a prevalence of 9.2% (13 out of 141 samples).

Relative to crossbred cattle, local cattle with a higher proportion were more likely to be infected and appeared to be more susceptible to dual blood parasite infections. Among local cattle, 11 cattle were infected with *Theileria* sp. only and 2 cattle were infected with *Babesia* sp. only, whereas in crossbred cattle, 84 were infected with *Theileria* sp. only and 8 with *Babesia* sp. only. Blood parasites were not detected in 2 local cattle and 36 crossbred cattle.

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These findings highlight the need for special attention in controlling blood parasite infections in local cattle, as the high prevalence of co-infection indicates a greater potential for more severe health impacts and reduced livestock productivity. Furthermore, co-infection analysis using OR and RR can be used to assess the relative risk between local and crossbred cattle, serving as a potential tool for developing more targeted control strategies.

Tabel 4. Statistical Analysis of Blood Parasitic Infections in Agam Regency

Parasit	**Chi-Square (χ^2)**	**p-value**	**Odds Ratio (OR)**	**Relative Risk (RR)**	**Interpretation**
Theileria sp	1.23	0.27	2.04	1.19	The risk of infection was higher in local cattle than in crossbred cattle; however, the difference was not statistically significant.
Babesia sp	7.12	0.008	3.95	2.74	The risk of infection was higher in local cattle than in crossbred cattle, and the difference was statistically significant
Koinfeksi Theileria + Babesia	5.48	0.019	4.55	3.46	Local cattle were more susceptible to co-infection, and this association was statistically significant.

Based on Table 4, the statistical analysis indicates that *Theileria* sp. infection showed an Odds Ratio (OR) of 2.04 and a Relative Risk (RR) of 1.19, suggesting that local cattle had a higher risk of infection compared to crossbred cattle. However, the Chi-square test result (χ^2 = 1.23, p = 0.27) indicated that this difference was not statistically significant, implying that *Theileria* sp. infection was relatively evenly distributed between local and crossbred cattle.

In contrast, *Babesia* sp. infection showed an OR of 3.95 and an RR of 2.74, indicating that local cattle were more susceptible than crossbred cattle. The Chi-square test (χ^2 = 7.12, p = 0.008) demonstrated a statistically significant difference, confirming that local cattle had a significantly higher risk of *Babesia* sp. infection.

The co-infection analysis of *Theileria* sp. and *Babesia* sp. yielded an OR of 4.55 and an RR of 3.46, with a Chi-square value of 5.48 and p = 0.019. These findings indicate that local cattle had a significantly higher risk of co-infection compared to crossbred cattle, emphasizing the importance of targeted control measures for the local cattle population.

Overall, these statistical findings provide a deeper understanding of differences in the risk of blood parasite infection and co-infection between local and crossbred cattle, and may serve as a basis for more effective and evidence-based parasite control strategies.

DISCUSSION

The high prevalence of *Theileria* sp. (70.6%) indicates that this infection represents a major problem in beef cattle production in Agam Regency, West Sumatra (*Shabangu et al*., 2025b) , (Parveen et al., 2021a) . This finding is consistent with previous studies in Indonesia and several Southeast Asian countries, where *Theileria* sp. has been reported to be more dominant than

Babesia sp. (*Silva-Ramos et al*., 2025) , (*Muriu*, 2023) . The higher prevalence observed in local cattle (81.8%) compared to crossbred cattle (68.8%) may be associated with genetic factors and differences in parasite resistance (*Elati et al*., 2023) , (*Simking et al*., 2014a). Local cattle are often considered to have natural resistance to certain diseases; however, in the case of *Theileria* infection, environmental exposure and herd management practices may contribute to increased susceptibility (*Cahyaningsih, Yellita, et al*., 2026) , (*de la Fuente et al*., 2023).

Although the prevalence of *Babesia* sp. was lower (18.4%), it remains important, particularly among local cattle (40.9%) (*Cahyaningsih, Yellita, et al*., 2026), (*Simking et al*., 2014b) . *Babesia* sp. infection may cause hemolytic anemia, fever, and reduced productivity (*P. Ganesan et al*., 2025), (*Sangwan & Haq*, 2024) , therefore requiring attention in livestock health management. The OR and RR analysis showed that local cattle were at a higher risk of *Babesia* sp. infection (OR = 3.95; RR = 2.74) compared to crossbred cattle (*Youssif, Kamal Dyab, et al*., 2026),(*Gharbi & Darghouth*, 2015) , reinforcing the need for targeted interventions in local cattle populations.

The absence of *Anaplasma* sp. and *Trypanosoma* sp. infections in the analyzed samples may be attributed to low vector presence or sampling periods that were not conducive to transmission (*Dharanesha et al*., 2017) , (*Fadunsin et al*., 2017) . This result differs from studies conducted in other tropical regions that reported *Anaplasma* sp. infections (*Atea Kamel et al*., 2024) , indicating that epidemiological variation may be influenced by environmental factors and livestock management practices.

Blood parasite control strategies in beef cattle should consider several aspects: improved herd health management, vector control (e.g., ticks and biting flies), periodic antiparasitic treatment, and regular monitoring for early infection detection (*Shahzad et al*., 2025), (*Farooqi et al*., 2017) . In addition, farmer education regarding the identification of clinical signs and preventive measures is an essential step to reduce prevalence (*Mosqueda et al*., 2012) , (*Safieldin et al*., 2025).

The present study also highlights the importance of continuous surveillance and integration of epidemiological data to design more targeted control strategies (*Fadunsin et al*., 2017), (*Putri Ani et al*., 2025). Spatial mapping and environmental risk factor analysis may assist in identifying high-risk areas for blood parasite infection, thereby allowing interventions to be implemented more effectively and efficiently (*Sansamur et al*., 2025).

Overall, this study contributes significantly to the understanding of blood parasite epidemiology in beef cattle in Agam Regency, West Sumatra, and may serve as a basis for improved livestock disease control policies at provincial and national levels (*Muhanguzi et al*., 2010), (*Parveen et al*., 2021b), (*Simking et al*., 2014a).

The high prevalence of *Theileria* sp. in beef cattle in Agam Regency, West Sumatra, is consistent with reports from other tropical regions stating that theileriosis is an endemic disease transmitted by ticks of the genera *Rhipicephalus* and *Haemaphysalis* (*Atea Kamel et al*., 2024) , (*Shahzad et al*., 2025) . The prevalence of 70.55% indicates wide and continuous exposure to vectors within smallholder farming environments.

The higher prevalence in local cattle compared to crossbred cattle may be explained by differences in management systems. Local cattle are commonly raised extensively with minimal vector control, resulting in greater exposure to tick infestation (*Farooqi et al*., 2017) . However, the absence of a statistically significant difference suggests that environmental exposure may play a more dominant role than genetic factors alone.

Babesia sp. infection exhibited a different pattern, with a significant difference in prevalence across cattle types. The high RR and OR values indicate that local cattle represent a high-risk group

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for babesiosis. This aligns with studies suggesting that *Babesia* infections are often chronic and subclinical in local cattle, making detection more likely in microscopy-based surveillance (*Mosqueda et al*., 2012), (*Fadunsin et al*., 2017) .

The absence of *Anaplasma* sp. and *Trypanosoma* sp. could be explained by a truly low infection rate, limitations in the sensitivity of blood smear examination, or the intermittent nature of infection (*Putri Ani et al*., 2025), (*Sansamur et al*., 2025) . Molecular methods such as PCR are known to provide higher sensitivity and may therefore be recommended for future studies.

CONCLUSION

Based on the results of this study, it can be concluded that *Theileria* sp. was the most prevalent blood parasite in beef cattle in *Agam* Regency, West Sumatra, with an overall prevalence of 70.6% and higher dominance in local cattle (81.8%) (*Shabangu et al*., 2025b) , (Parveen et al., 2021a) . Although the prevalence of *Babesia* sp. was lower (18.4%), it remained significant, particularly in local cattle (40.9%), indicating that local cattle are more susceptible to blood parasite infections than crossbred cattle (*Silva-Ramos et al*., 2025) , (Muriu, 2023) . Risk analysis further showed that local cattle had higher Odds Ratio (OR) and Relative Risk (RR) values for both parasites, emphasizing the need for special attention to the local cattle population (*Elati et al*., 2023) , (*Simking et al*., 2014a) . The absence of *Anaplasma* sp. and *Trypanosoma* sp. in this study may reflect a low prevalence in the area or environmental and vector-related limitations during the study period (*Cahyaningsih*, *Yellita, et al*., 2026) , (*de la Fuente et al*., 2023) .

RECOMMENDATIONS

The recommended approach for controlling blood parasite infections includes integrated strategies focusing on livestock health management, such as periodic antiparasitic treatment, vector control, and routine monitoring for early detection of infection (*Cahyaningsih*, *Yellita, et al*., 2026), (*Simking et al*., 2014b) . Farmer education regarding the identification of clinical signs and implementation of good husbandry practices is also essential to reduce infection risk (*P. Ganesan et al*., 2025), (*Sangwan & Haq*, 2024) . This study highlights the importance of ongoing surveillance and utilization of epidemiological data to develop evidence-based control strategies, including spatial mapping to identify high-risk areas (*Youssif, Kamal Dyab, et al*., 2026), (*Gharbi & Darghouth*, 2015), (*Dharanesha et al*., 2017).

Therefore, the findings of this study not only contribute to the scientific literature on blood parasite epidemiology in beef cattle in Indonesia but can also serve as a foundation for provincial and national livestock disease control programs and policies (*Fadunsin et al*., 2017), (*Atea Kamel et al*., 2024). The implementation of these recommendations is expected to improve beef cattle health, productivity, and welfare, while supporting sustainable livestock production in Agam Regency, West Sumatra.

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