(RESEARCH ARTICLE)

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Study of risk factors associated with the prevalence of bovine babesiosis in Mali: case of the Kita region

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Abstract

This study conducted in 2022 in 6 communes in the Kita region aimed to determine the risk factors associated with the prevalence of Babesia bovis and Babesia bigemina. It involved the analysis of 450 bovine blood samples from the communes of Bougaribaya, Djidjan, Founia-Benkady, Kassaro, Sébécoro and Souransan-Tomoto. The blood samples were examined in the laboratory using the GIEMSA staining technique. This work made it possible to obtain a prevalence of 10.00% of bovine babesiosis. The analysis did not reveal any statistically significant difference ($p > 0.05$) between the communes of Bougaribaya (10.67%), Djidjan (6.67%) Founia Benkady (5.33%), Kassaro (17.33%), Sébécoro (10.67%) and Souransan Tomoto (9.33%). There was no significant difference between male (10.90%) and female (9.21%) cattle by the chi2 test, ($p > 0.05$) 9.21% in female cattle, against 10.90% in males. Statistical analysis of the results revealed a statistically significant difference ($p < 0.05$) between adult (14.95%) and young (5.51%) cattle. Statistical analysis showed that the risk factor associated with the prevalence of Bebesiosis in this study is age

Keywords: Prevalence; Bovine Babesiosis; Risk Factors; Mali

1. Introduction

The Kita circle is located in the southwestern part of the Republic of Mali between the 14th and 18th degrees of northern altitude and the 10th degree of western longitude. It covers an area of 35,250 km² [1]. The economy of the Kita circle is mainly based on agriculture and livestock farming. However, livestock farming faces several difficulties linked, among other things, to the illicit sale of veterinary drugs, the illegal practice of the veterinary profession and the irregular monitoring of certain animal pathologies including *babesiosis* [1]. Recent studies conducted on bovine babesiosis in certain eco-climatic zones of Mali as well as in the Bamako Distinct have revealed that bovine babesiosis is increasingly becoming a threat to the livestock sector in Mali [10] Even today, very few studies have been conducted on animal hemoparasitic diseases in general and animal babesiosis in particular in the Kita circle. These realities have led us to conduct investigations with a view to improving our knowledge of the situation of bovine babesiosis in the Kita circle.

2. Materials and methods

The survey was conducted between September and December 2022 in six municipalities in the Kita circle. Blood samples were taken from 450 cattle in the municipalities of Bougaribaya, Djidjan, Founia-Benkady, Kassaro, Sébécoro and Souransan-Tomoto. Blood was taken from the jugular vein of the cattle using a sampling needle in vacuum-sealed "Vaccutainer" tubes containing the anticoagulant "EDTA". The site code, animal identification number and collection date were noted on each tube. The tubes containing the blood collected were placed in a rack and then stored in a cooler

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containing pieces of ice sent to the Central Veterinary Laboratory in Bamako. In, the smears were prepared on glass slides with a margin at one end. The smears were fixed in methanol solution for 5 minutes, then stained in GIEMSA Rapid solution for 5 minutes. They were then washed under running tap water and dried. After receiving 2 or 3 drops of immersion oil, the dried smears were placed under the ''X100'' objective of the binocular electric microscope for the search for Babesia bovis and Babesia bigemina in red blood cells. The raw data were entered with Microsoft EXCEL 2010 software and analyzed with Stata software version 12.1. The ''chi 2'' test was used to compare the different variables.

3. Results

3.1. Overall prevalence rate by municipality

Table 1 prevalence of Babesiosis

Municipality	Villages	Negative	Positive	Total	Prevalence (%)
Bougaribaya	Bagnagafata	23	2	25	8,00
	Behon	22	3	25	12,00
	Bougaribaya	22	3	25	12,00
	S/total 1	67	8	75	10,67
Djidjan	Batimakana	24	1	25	4,00
	Djidjan	23	2	25	8,00
	Sandiabougou	23	2	25	8,00
	S/total 2	70	5	75	6,67
Founia Benkady	Doumba	24	1	25	4,00
	Founia-Moribougou	24	1	25	4,00
	Kodogoni	23	2	25	8,00
	S/total 3	71	4	75	5,33
Kassaro	Ballandougou Morola	22	3	25	12,00
	Kassaro	19	6	25	24,00
	Manabougoucoura	21	4	25	16,00
	S/total 4	62	13	75	17,33
Sébécoro	Badinko,	25	0	25	0,00
	Sébécoro	21	4	25	16,00
	Sounty	21	4	25	16,00
	S/total 5	67	8	75	10,67
Souransan Tomoto	Kassan	22	3	25	12,00
	Mambri	24	1	25	4,00
	Souransan Tomoto	22	3	25	12,00
	S/total 6	68	7	75	9,33
Total		405	45	450	10,00

Between municipality; X-squared = 7.3333, p-value = 0.197

45 cattle were positive for bovine babesiosis out of a total of 450 cattle examined, representing a prevalence of 10.00%. The analysis did not reveal any statistically significant difference (p>0.05) between the communes of Bougaribaya (10.67%), Djidjan (6.67%), Founia Benkady (5.33%), Kassaro (17.33%), Sébécoro (10.67%) and Souransan Tomoto (9.33%), (Table 1).

3.2. Overall prevalence rate of babesiosis by municipality and *Babesia* species

Table 2 Prevalence of Babesiosis by municipality and species of *Babesia*

Municipality	Villages	Positive	*Babesia bigemina*		*Babesia bovis*	
			Number	(%)	Number	(%)
Bougaribaya	Bagnagafata	2	2	100.00	0	0.00
	Behon	3	1	33.33	2	66.67
	Bougaribaya	3	3	100.00	0	0.00
	S/total 1	8	6	75.00	2	25.00
Djidjan	Batimakana	1	1	100.00	0	0.00
	Djidjan	2	2	100.00	0	0.00
	Sandiabougou	2	1	50.00	1	50.00
	S/total 1	5	4	80.00	1	20.00
Founia Benkady	Doumba	1	1	100.00	0	0.00
	Founia-Moribougou	1	0	0.00	1	100.00
	Kodogoni	2	2	100.00	0	0.00
	S/total 1	4	3	75.00	1	25.00
Kassaro	Ballandougou Morola	3	2	66.67	1	33.33
	Kassaro	6	4	66.67	2	33.33
	Manabougoucoura	4	3	75.00	1	25.00
	S/total 1	13	9	69.23	4	30.77
Sébécoro	Badinko,	0	0	0.00	0	0.00
	Sébécoro	4	2	50.00	2	50.00
	Sounty	4	3	75.00	1	25.00
	S/total 1	8	5	62.50	3	37.50
Souransan Tomoto	Kassan	3	3	100.00	0	0.00
	Mambri	1	1	100.00	0	0.00
	Souransan Tomoto	3	2	66.67	1	33.33
	S/total 1	7	6	85.71	1	14.29
Total		45	33	73.33	12	26.67

Global (here it is the chi2 between the global prevalence of B. bigemina (73.33%) and B. Bovis (26.67%); X-squared = 17.778, p-value = 2.483e-05; Babesia bovis (here it is the chi2 between the communal prevalences of B. bovis); X-squared = 1.2714, p-value = 0.9378; Babesia bigemina (here it is the chi2 between the communal prevalences of B. bigemina); X-squared = 1.2714, p-value = 0.9378

33 cattle were positive for bovine babesiosis due to Babesia bigemina out of a total of 45 cattle positive for bovine babesiosis, representing an overall prevalence rate of 73.33%. In addition, 12 cattle were positive for Babesia bovis out of a total of 45 cattle positive for bovine babesiosis, representing an overall prevalence rate of 26.67%. Statistical analysis revealed a significant difference (p<0.05) between the overall prevalence rates of Babesia bigemina and Babesia bovis. (Table 2). There was no significant difference (p>0.05) between the prevalence rates of Babesia bovis in

the communes of Bougaribaya (25.00%), Djidjan (20.00%), Founia Benkady (25.00%), Kassaro (30.77%), Sébécoro (37.50) and Souransan-Tomoto (14.29), (Table 2).

Statistical analysis of the results also revealed no significant difference (p>0.05) between the prevalence rates of Babesia bigemina in the communes of Bougaribaya (75.00%), Djidjan (80.00%), Founia Benkady (75.00%), Kassaro (69.23%), Sébécoro (62.50%) and Souransan-Tomoto (85.71%), (Table 2)

3.3. Overall prevalence rate of bovine babesiosis by sex

The prevalence rate of bovine babesiosis was 9.21% in female cattle, compared to 10.90% in males. There was no significant difference between male and female cattle by the chi2 test, (p>0.05) (Table 3).

Table 3 Prevalence of babésiose bovine by sex

Bovine sex	Total	Negative	Positive	Prevalence (%)
Female	239	217	22	9.21
Male	211	188	23	10.90
Total	450	405	45	10.00

X-squared = 0.19433, p-value = 0.6593

Statistical analysis of the results revealed a significant difference (p < 0.05) between the prevalence rates of Babesia bigemina (72.73%) and Babesia bovis (27.27%) in female cattle, (Table 4).

A significant difference (p < 0.05) between the prevalence rates of Babesia bigemina (73.91%) and Babesia bovis (26.09%) in male cattle, (Table 4).

Statistical analysis of the results revealed a significant difference (p < 0.05) between the prevalence rates of Babesia bigemina (73.33%) and Babesia bovis (26.67%) in male and female cattle, (Table 4).

Table 4 Prevalence of babésiose bovine by sex and *Babesia* species

Sex	Positive	Babesia bigemina		Babesia bovis	
		Number	Prevalence (%)	Number	Prevalence (%)
Female	22	16	72,73	6	27.27
Male	23	17	73,91	6	26.09
Total	45	33	73,33	12	26.67

Between females X-squared = 7.3636, p-value = 0.006656; Between males X-squared = 8.6957, p-value = 0.00319; Between males and females X-squared = 19.613, p-value = 0.0002042

The prevalence rate of bovine babesiosis was 14.95% in adult cattle, compared to 5.51% in young cattle. There was a significant difference between adult and young cattle by the chi2 test, (p < 0.05) (Table 5)

Table 5 Prevalence rate of bovine babesiosis by age

Age	Total	Negative	Positive	Prevalence (%)
Adult	214	182	32	14.95
Joung	236	223	13	5.51
Total	450	405	45	10.00

X-squared = 10.099, p-value = 0.001483

Statistical analysis of the results revealed a significant difference (p < 0.05) between the prevalence rates of Babesia Bigemina (68.75%) and Babesia bovis (31.25%) in adult cattle.

A significant difference (p < 0.05) between the prevalence rates of Babesia Bigemina (84.62%) and Babesia bovis (15.38%) in young cattle.

Statistical analysis of the results revealed a significant difference (p < 0.05) between the prevalence rates of Babesia Bigemina (73.33%) and Babesia bovis (26.67%) in adult and young cattle

Table 6 Prevalence of Babésiose bovine by Age et *Babesia species*

Age	Positive	*Babesia bigemina*		*Babesia bovis*	
		Number	Prevalence (%)	Number	Prevalence (%)
Adult	32	22	68.75	10	31.25
Joung	13	11	84.62	2	15.38
Total	45	33	73.33	12	26.67

Between adults X-squared = 7.5625, p-value = 0.00596; Between juveniles X-squared = 9.8462, p-value = 0.001702; Between adults and juveniles X-squared = 21.462, p-value = 8.442e-05

4. Discussion

The overall prevalence rate of bovine babesiosis in the study area was 10.00%. This relatively low prevalence rate may be due to the fact that the cattle examined were dewormed with acaricides or they underwent chemotherapy with diminazen diaceturate (diminazene diaceturate). This result can be explained by the sensitivity of the test used, because the parasitological diagnostic test is much less sensitive than the serological (ELISA) and molecular biology (PCR) tests. Our results are similar to the overall prevalence rate of bovine babesiosis (11.7%) obtained by Abdela. Our results are different from the overall prevalence rates of bovine babesiosis obtained by Kamani and al [2] (16.0%), Sawitri and al[3], ((7.1%), Fethu et al [9] (23%), Haben et al[8], (21.7%) and by Modibo et al[10] (15.86%). The overall prevalence rate of Babesia bigemina (73.33%) is higher than the overall prevalence rate of Babesia bovis (26.67%) in the six municipality. This predominance of Babesia bigemina compared to Babesia bovis can be explained by the absence of the main vector of Babesia bovis (Boophilus microplus) in the Kita region. Our results are comparable to those obtained by Haben et al, who recorded higher prevalence rates in Babesia bigemina (15.53%) than in Babesia bovis (6.17%). Our results are different from those obtained by Nawolo and al. [4] with a prevalence rate of Babesia bovis (45.83%) higher than the prevalence rate of Babesia bigemina (13.61%). The study revealed that the prevalence rate of bovine babesiosis in male cattle (10.90%) is slightly higher than the prevalence rate of bovine babesiosis in female cattle (9.21%). There was no significant difference between male and female cattle by the chi2 test, (p>0.05), which shows that male cattle are as susceptible to this infection as females and that sex was not a risk factor associated with bovine babesiosis in this study. This result is similar to the work of Alemayehu and al[5] who did not find a statistically significant difference between male (16.6%) and female (10.5%) cattle. The same trend observed in the work of Wada and al [6], who also did not find a statistically significant difference between male (4.35%) and female (7.63%) cattle. The prevalence rate of bovine babesiosis was higher in adult cattle (14.95%) than in young cattle (5.51%) and a statistically significant difference observed between these two age categories. This shows that age was a risk factor for bovine babesiosis in this study. Our result is different from the result of Hamsho and al [7], who did not find a statistically significant difference between adult (15%) and young (13.2%) cattle.

5. Conclusion

This study revealed that bovine babesiosis is on the rise in the Kita region and is increasingly becoming a constraint on cattle breeding in this locality. It also showed that the risk factor associated with the prevalence of this disease is age.

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