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Epidemiology of Piroplasm among Cattle of Ndé and Noun Divisions, West Region of Cameroon: A Cross-Sectional Study

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Abstract **Context:** In Cameroon, piroplasm infections have been reported among cattle, causing significant economic losses in the livestock industry. However, specific information about the epidemiology of piroplasm among cattle in Nde and Noun Divisions are limited. **Aims:** Highlight the prevalence of Piroplasm and the relationship between the blood density of Piroplasm and anaemia among cattle populations of Nde and Noun Divisions in the West region of Cameroon. **Settings and Design:** The present study was conducted during the rainy season from March to June 2022. **Methods and Material:** Blood samples from 532 cattle in Nde and Noun Divisions, located in the West region of Cameroon were collected in Ethylene Diamine Tetra Acetic acid (EDTA) tubes. The piroplasm parasites were identified at the laboratory of vector transmitted diseases of the applied biology and ecology research unit of the University of Dschang, using the standard method. **Statistical analysis used:** Statistical analysis was performed using the software R version 4.0.3. p values less than 0.05 were considered to be statistically significant. **Results:** A total of 532 cattle were sampled in Nde and Noun Divisions, with 354 (66.54%) being adults, 97 (18.23%) being juveniles, and 81 (15.23%) being calves. Among the sampled cattle, 31.39% were males and 68.61% were females. The prevalences of Babesia bovis, Babesia bigemina, and Theileria spp were recorded as 239 out of 532 (44.92%), 105 out of 532 (19.74%), and 344 out of 532 (64.6%) respectively. There was no relationship between the density of tick-borne Piroplasm and anaemia observed in cattle of Nde and Noun Divisions (P>0.05). **Conclusions:** Our findings underscore the existence of tick-borne transmissions of Babesia bovis, Babesia bigemina, and Theileria spp. Although we found no relationship between the density of these three protozoan species and anemia, their effects are generally associated with increased morbidity and mortality in cattle. This emphasizes the need for authorities to impose stringent regulations aimed at preventing and controlling piroplasm and its tick vectors. These measures are crucial to ensure sustainable cattle production.

Keywords: *Piroplasm, Babesia bovis, Babesia bigemina, Theileria spp*

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1. Introduction

Piroplasmosis is a significant tick-borne disease affecting livestock globally. It is caused by *Theileria* and Babesia species, haemoprotozoan parasites in the order Piroplasmida, Subclass Piroplasma and phylum Apicomplexa, which are transmitted by ticks. [1,2,3]. Indeed, in cattle, Piroplasm sporozoites infect mononuclear cells within the host, transforming into merozoites that then invade erythrocytes. [4] Research indicates that a high density of piroplasm in red blood cells can lead to diseases associated with anaemia. [2,4,5]

Animal production is an important activity that sustains human development by providing food, employment and maintaining the economy in sub-Saharan Africa Countries. [6,7] The cattle sector in Cameroon has grown from 6,859,359 heads in 2015 to 10,202,369 heads in 2021. [8] However, their spatial distribution in 2020 and 2021 indicates a strong concentration in the Adamawa, Far North, and North West regions. [8] The cattle raised in

Cameroon are 2% taurines (*Bos taurus*) and 98% zebus (*Bos indicus*).[9] In 2021, the cattle herd in western Cameroon totalled less than 300,000 heads, and the annual meat production was 6,306 tonnes, compared to the national production of 270,158 tonnes. [8] Cameroon is the main regional providers of beef and other products derived from cattle. [10,11,12] In the absence of effective control measures, Piroplasmosis may result in significant financial losses, which would seriously impede national socioeconomic progress. [13,14,15,16,17,18]

Due to the unrestricted movement of people and goods within Cameroon and the porous nature of its borders, there is a high likelihood of the spread of piroplasm through the movement of livestock, wild animals, or transhumant movements. [19,20] Cameroon is connected to western African regions through Nigeria and to eastern African regions through the Central African Republic, which makes it a potential ecological reservoir. [21] Various studies have reported high prevalence rates of Babesia and *Theileria* in bovine populations in the Western and Eastern African ecological zones. The burden of these diseases in cattle varies depending on the prevailing climatic conditions and local management practices. [22,23,24]

Understanding the prevalence of tick-borne diseases is crucial for assessing their risk and designing effective control methods. By accurately mapping out the presence of Babesia and *Theileria* within the West Agroclimatic Zones of Cameroon, fundamental knowledge can be gained to inform further measures for disease control. Accordingly, this study has been designed to investigate the prevalence of Piroplasm and the correlation between Piroplasm blood density and anaemia among cattle populations in Ndé and Noun Divisions of the West region in Cameroon.

2. Subjects and Methods

Ethical approval

This study received ethical approval from the Regional Ethics Review Committee. Sample collection was performed following ethical guidelines.

Study Sites

This study was carried out in the West Region of Cameroon, specifically at the Nde **(5°08'29''N; 10°31'18''E)** and Noun **(5°43'56''N; 10°52'57''E)** Divisions. These areas have savannah vegetation and their yearly mean temperatures are 22°C and 21°C respectively for Ndé and Noun Divisions. The mean yearly precipitation in these divisions is 916.6 mm. Ndé is known for its suitable agricultural and bovine breeding zone. Four sub-divisional sites were involved in the study: IRAD (Institut de Recherche Agricole pour le développement), Banekane, Manko and Kafeng. Noun Division, which neighbors Ndé Division, is also known for its bovine livestock. The study was conducted in four (4) sub-divisional sites: Massagam, Kouoptamo, Koutaba and Foumban (Figure 1).

Study design and duration

This study was a cross-sectional study conducted during the rainy season from March to June 2022.

Study Population

The consent of the cattle rearers was obtained before sampling. Both males and females cattle of all species and all ages were included in the study. The cattle ages were determined by either inspecting the horn bands or by examining the teeth where those less than two (< 2) years as calf, those between two (2) and four (4) years as juveniles while those above four (>4) years as adults. [25,26]

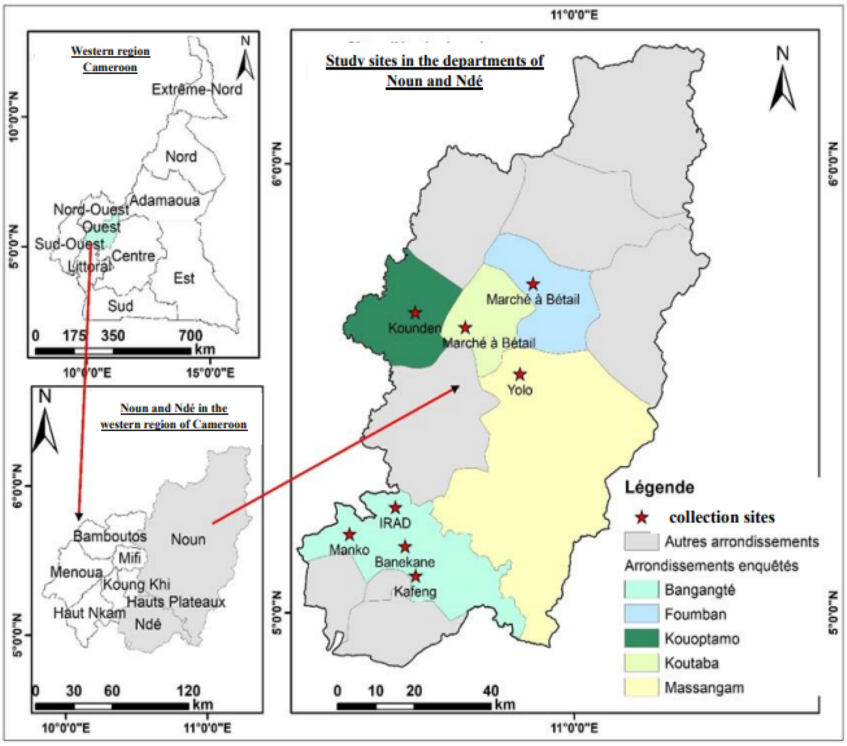

Figure 1. study and sampling sites_094346

Sampling size and techniques

For each site, we used the simple random sampling of a cattle herd as shown in Figure 1. The number of cattle was determined by the following formula [27] $N = \frac{Z^2PQ}{D^2}$ where: N = total sample size; Z= constant degree (1.96); P = Estimated prevalence; Q= (1-P); D= confidence interval designed by 0.05.

Blood sampling

Using a syringe with a vacuum container needle, 5 mL of blood were aseptically collected from the jugular vein of each apparently healthy animal in EDTA tubes These samples were then labelled and transported in a cool flask to the laboratory of vector transmitted diseases of the applied biology and ecology research unit of the University of Dschang for analysis.

Haematocrit determination: EDTA tubes were transferred into heparin microtube capillaries (75×1.5 mm) shelled with plasticine and placed in a microhematocrit centrifuge with 3500 rotations per minute for 5 minutes and estimated using a haemocrit reader as described by Woo. [28]

Identification of Piroplasm

Thin blood smears were realized on clean slides using the standard method as described by Cheesbrough. [29] In brief, one drop of blood was placed at one end of a clean grease-free glass slide and made thin with the assistance of a spreader. The smear was made by tilting the edge of the spreader on the dropped blood at about 30° to 45° to the horizontal plane of the slide bearing the blood. This was air-dried and fixed in absolutely pure methyl alcohol for 5 minutes and then stained in 10% Giemsa (10 ml Giemsa solution and 90 ml buffer solution) for 25–30 minutes. The stained slides were subsequently rinsed in tap water, dried and observed using a microscope under a 100X objective. Piroplasma species (*Babesia* spp *and Theileria* spp) were identified using the morphological identification key of Kaufmann. [30]

Data analysis

Statistical analysis was performed using the software R version 4.0.3 (R Core Tem and R Studio, Inc., Boston, MA). The chi-square (χ2) test was used to compare the prevalence of the infection in animals while the Kruskal-wallis test was used to compare the parasite densities. The relation between the haematocrit and the parasite density of the animals was established using Pearson's correlation (r). p values < 0.05 were considered to be statistically significant.

3. Results

1. Distribution of cattle according to sex, age groups and races

Overall, 532 cattle sampled in Ndé and Noun Divisions with n= 167/532 (31.39%) were males and n= 365/532 (68.61%) were females (Figure 2). The distribution of cattle sampled for this study shows a predominance of adult animals which represented n= 354; (66.54%) of the population as well as juveniles n=97; (18.23%) and calves n= 81; (15.23%) where less numerous (Figure 3). The cattle herd in the study area is mainly made up of the Goudali (n= 307; 57.71%), the Djafoun (n= 101; 18.98%) and to a lesser extent the Akou (n= 95; 17 .86%) as for the Métis (n= 12; 2.26%), Bokolo (n= 9; 1.69%) and Simmental (n= 8; 1.5%). (Figure 4)

2. Identification of species of Piroplasm

Three (3) species of parasitic protozoa were identified, namely: *Babesia bovis* (Figure 5), *Babesia bigemina* (Figure 6). and *Theileria* spp (Figure 7). *Babesia bovis* (Figure 5) was found in 1 /3 of red blood cells. *Babesia bigemina* (Figure 6) was found in 2/3 of red blood cells and was easily identified thanks to its remarkable size (4 to 5 µm long and 2 to 3 µm wide). *Theileria* spp (Figure 7) was recognized by its bacillary form inside the erythrocytes.

3. The relationship between Piroplasm infestation of cattle and their locations, age, and sex

among the 532 cattle included in this study, 401 were positive for one or more species of tick-borne Piroplasm, representing a general occurrence of infested cattle of 75.37% (Table 1). Our study showed a variation in the prevalence of *B. bovis, B. bigemina and Theileria* spp in cattle depending on the study sites, sex and age groups. The prevalence of infestation of *Babesia bovis*, *Babesia bigemina* and *Theileria* spp was rescectively 44.92%, 19.74% and 64.6% (Table 2). The infestation density of animals in Noun is between 5434 and 4142 parasites/µl of blood while in Ndé, this value is on average around 3541 parasites/µl of blood. The density of infestations of calves are higher (4741 parasites/µl of blood) than those of adults and juveniles (4397 and 4421 parasites/µl of blood, respectively) (Table 1). The prevalence and density of infestation of cattle by *B. bovis, B. bigemina and Theileria* spp depending on the study sites, sex and age groups (Table 2).

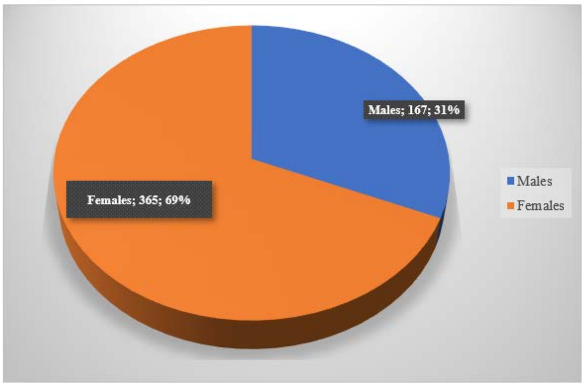

Figure 2. Distribution of cattle according to sex_094403

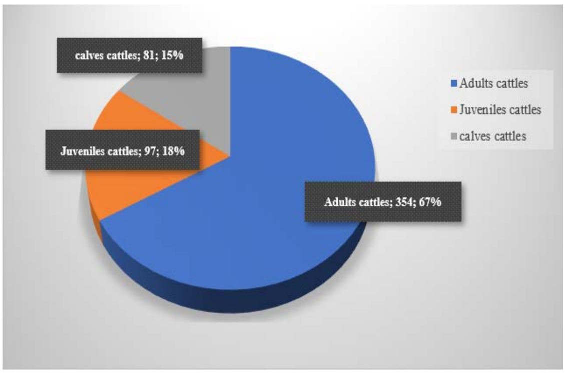

Figure 3. Distribution of cattle according to age groups_094405

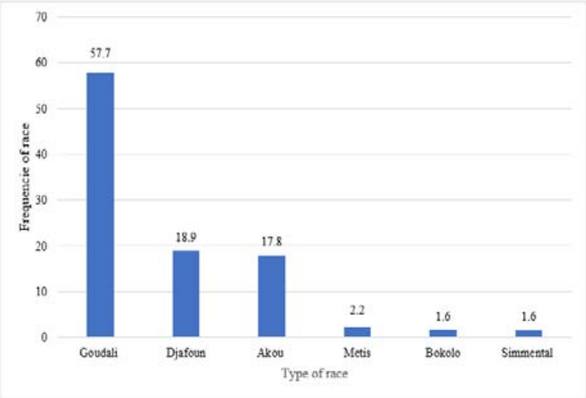

Figure 4. Distribution of cattle according to races_094409

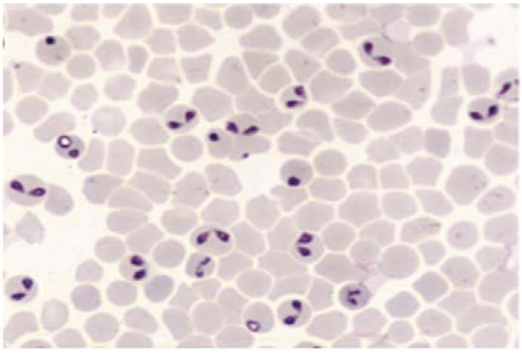

Figure 5. Babesia bovis_094410

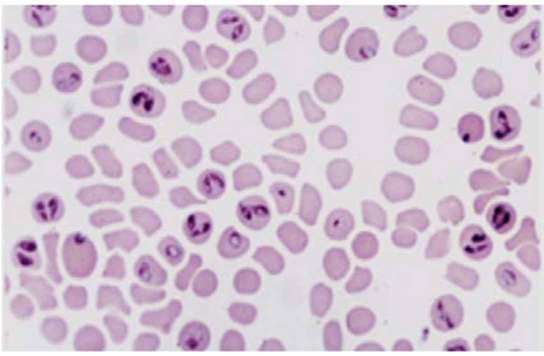

Figure 6. Babesia bigemina_094430

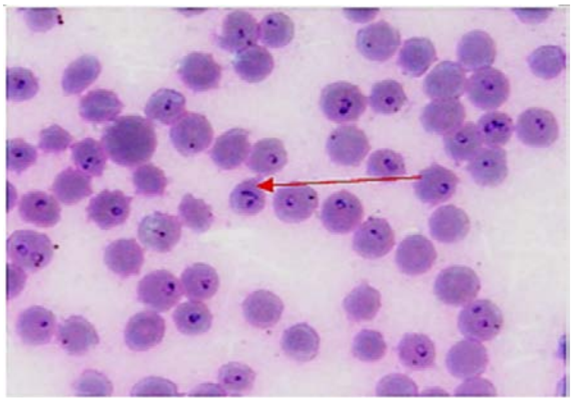

Figure 7. Theileria spp_094450

Table 1. Prevalence and density of infestations of cattle by tick-transmitted Piroplasm

Variables	n/N(%)	p-value*	Density ±SD	p-value**
Department				
Noun	221/302(73.1)	0.08	3541±30	0.001
Ndé	183/230 (79.5)		5434±41	
Total	401/532 (75.37)			
Sites of Ndé				
Banekané	69/90 (76.6)	0.3	3692±36	<0.0001
IRAD	46/60 (76.6)		3643±29	
Kafeng	41/63 (65.07)		3192±25	
Manko	64/89 (71.9)		3639±31	
Sites of Noun				
Foumban	54/61 (88.5)	0.04	6369±37	0.001
Kouptamo	42/60 (70.0)		5450±46	
Koutaba	38/50 (76.0)		3857±32	
Massangam	47/59 (79.6)		6063±49	
Sex				
Females	269/365 (73.6)	0.07	4219±35	0.137
Males	135/167 (80.8)		4955±42	
Age range				
Calves	100/132 (75.7)	0.1	4741± 46	0.958
Juveniles	79/95 (83.1)		4421±34	
Adults	225/305 (73.7)		4397±36	
Race				
Akou	77/95 (81.05)	0.2	4223±37	0.001
Bokolo	8/9 (88.88)		6215±51	
Djafoun	76/101 (75.24)		4367±30	
Goudali	225/307 (73.28)		4219±37	
Métis	10/12 (83.33)		5419±37	
Simmental	8/8 (100.00)		11589±49	

n: number of parasitized host individuals; N: number of individuals examined; % (Percentage) number of cattle infested/number examined; SD = Standard Deviation; *X^2= chi-square; **Kruskal-Wallis;

Table 2. Prevalence and density of *Babesia bovis, Babesia bigemina and Theileria* spp infestations in cattle

Variables	*Babesia bovis*		*Babesia bigemina*		*Theileria* spp	
	n/N (%)	Density ±SD	n/N (%)	Density ±SD	n/N (%)	Density ±SD
Department						
Noun	119/230 (51.7)	535±2.1	32/302 (39.6)	609±2.3	201/302 (66.5)	3266±2.8
Ndé	120/302 (39.7)	772±2.3	73/230 (13.9)	352±2.2	164/230 (71.3)	2361±2.4
Total	239/532 (44.92)	//	105/532 (19.74)	//	344/532 (64.6)	//
Sites of Ndé						
Banekané	38/90 (42.2)	581±2.2	11/90 (12.2)	584±2.1	61/70 (87.1)	2452±2.5
IRAD	25/60 (41.6)	583±2.0	4/60 (6.6)	299±1.7	46/55 (83.6)	2230±2.4
Kafeng	20/63 (31.7)	501±2.1	8/63 (12.6)	357±2.2	38/41 (92.6)	2008±2.6
Manko	36/89 (40.4)	479±2.2	9/89 (10.1)	201±2.0	56/64 (87.5)	2650±2.3
Sites of Noun						
Foumban	45/61 (73.7)	775±2.4	35/61 (63.6)	826±2.5	48/55 (87.2)	3943±2.6
Kouptamo	20/60 (33.3)	695±2.6	8/60 (19.0)	436±2.1	42/42 (100.0)	2958±3.0
Koutaba	21/50 (42)	687±2.1	12/50 (31.5)	486±2.0	34/38 (89.4)	2256±2.7
Massangam	34/59 (57.6)	877±2.1	18/59 (36.7)	452±2.1	40/49 (81.6)	3958±2.8
Sex						
Females	152/365 (41.6)	521±2.3	59/365 (16.1)	421±2.3	246/365 (67.3)	411±1.3
Males	87/167 (52.09)	435±2.1	46/167 (27.5)	445±2.1	119/167 (71.2)	305±1.1
Age range						
Calves	50/77 (64.9)	575±2.2	23/132 (17.4)	378± 2.6	89/132 (67.4)	2841±2.9
Juveniles	38/64 (59.3)	711±2.3	28/95 (29.4)	581±2.4	73/95 (76.8)	2819±2.3
Adults	151/273(55.3)	650±2.3	54/305 (17.7)	544±2.3	203/305 (66.5)	2682±2.7
Race						
Akou	40/78 (51.28)	485±2.40	19/95 (20)	643±2.64	70/95 (73.68)	2515±2.80
Bokolo	7/8 (87.50)	946±2.28	4/9 (44.44)	591±4.66	7/9 (77.77)	2903±3.98
Djafoun	45/77(58.44)	627±2.17	24/101 (23.76)	419±2.47	67/101 (66.33)	2965±2.69
Goudali	138/232 (59.48)	661±2.24	48/307 (15.63)	490±2.11	203/307 (66.12)	2594±2.59
Métis	4/11(36.36)	890±3.77	9/12 (75)	560±2.50	10/12 (83.33)	2899±2.54
Simmental	5/8(62.50)	1589±1.73	1/8 (12.50)	3333±000	8/8 (100.00)	9235±1.52

n: number of parasitized host individuals; N: number of individuals examined; % (Percentage) number of cattle infested/number examined; SD = Standard Deviation

4. Parasitic associations in cattle

Overall, of the 401 cattle infected with Piroplasm, 241 cattle were poly-infected by different tick-borne Piroplasm circulating in the study area. Table 3 presents the proportions of poly-infected cattle according to Piroplasm. The *Babesia bovis* + *Theileria* spp 140/241 (58.09%) co-infection and the *Babesia bigemina* + *Babesia bovis* 22/241 (9.1%) co-infection were in the minority Table 3.

Table 3. Poly-infestation of Piroplasm in cattle of Ndé and Noun Divisions

Species	n/N (%)
Babesia bigemina + *Babesia bovis*	22/241 (9.1)
Babesia bigemina + *Theileria* spp	26/241 (10.7)
Babesia bovis + *Theileria* spp	140/241 (58.09)
Babesia bigemina + *Babesia bovis*+ *Theileria* spp	53/241 (21.9)
Total	241/532 (45.3)

5. Distribution of average haematocrit levels in cattle

Overall, the distribution of anaemia in cattle sampled during this study showed that the prevalence of haematocrit infestation is not significant depending on sex (p=0.4) and age groups(p=0.1) Table 4.

6. Correlation between density of infestations of cattle by piroplasm transmitted by ticks and their rate of anaemia

Overall, the infestation of cattle by tick-borne Piroplasm in the context of our study is not responsible for the occurrence of anaemia r = -0.1; r= -0.1 and r= -0.2 (P>0.05) respectively for *Babesia bovis*; *Babesia bigemina* and *Theileria* spp. Because the correlations between Piroplasm and anaemia were not only negative but all were less than 0.5 (Table 5).

Table 4. Distribution of anaemia in cattle according to sexes and age groups

Variables	Haematocrit ± SD		p-value
	Non infected	Infected	
Sex			
Females	30.40±4.46	29.60±5.10	0.4
Males	30.58±3.69	29.37±4.32	
Age range			
Calves	29.33±4.91	28.73±4.95	0.1
Juveniles	31.20±3.69	29.84±5.19	
Adults	30.55±4.22	29.67±4.73	

SD = Standard Deviation; Kruskal-Wallis

Table 5. Correlation between density of infestations of cattle by tick-borne Piroplasm and the rate of anaemia

	Piroplasm (Density ±SD)	r	p-value
Anaemia (Hematocrit ± SD)	*Babesia bovis*	-0.1	0.8
	Babesia bigemina	-0.1	0.3
	Theileria spp	-0.2	0.9

r = correlation coefficient; p-value

4. Discussion

Cattle breeding is a vital source of revenue and employment for breeders and individuals involved in extensive value chains in Cameroon. Additionally, for households in various countries and subregions, cattle serve as a crucial sustenance and economic resource. [11,22,31,32] These socioeconomic roles have become increasingly significant as they contribute to the sustainable development of nations. [7,33] As part of our study, we aimed to investigate the prevalence of babesiosis and theileriosis, as well as explore the relationship between the blood density of Babesia spp, *Theileria* spp, and anaemia in cattle populations residing in the Ndé and Noun Divisions of the West region in Cameroon.

In the present study, *Babesia bovis*, *Babesia bigemina*, and *Theileria* spp. were detected in 44.92%, 19.74% and 64.6% respectively in the sampled cattle of Ndé and Noun divisions in the West Region of Cameroon. Comparing these results to other local studies conducted in different regions of Cameroon, the prevalence of *Babesia bovis*, *Babesia bigemina*, and *Theileria* spp. in our study was higher. For example, a study by Lontsi-Demano et al. (2021) conducted in the Menoua Division reported a prevalence of *Babesia bovis* of 20.52%, *Babesia bigemina* of 9.39%, and *Theileria* spp. of 28.60%. [10] Another study by Hayatou et al. (2023) conducted in the Guinean high savannah agro-ecological zone and Donga-Mantung in the western highland agro-ecological zone of Cameroon reported a prevalence of *Babesia bovis* of 1.3%. [34] Silatsa et al. (2020) reported a prevalence of *Theileria* parva of 1.86% in the five agro-ecological zones of Cameroon. [19] Abanda et al. (2019) reported a prevalence of *Theileria*/Babesia spp. of 78.8% in the North (Adamaoua, Far North, and North) region of Cameroon. [12] These variations in prevalence could be attributed to several factors, such as differences in sampling techniques, study periods, diagnostic methods used, and the geographical locations of the studies. It is also possible that the cattle populations in Ndé and Noun divisions have different levels of exposure to these parasites due to variations in environmental conditions, climate, or management practices. This study did not cover the entire year and the influence of transhumance could not be assessed. Although we used microscopic methods to obtain proband results in the field, microscopy is still routinely used in local laboratories which means that we got difficulty to identify Piroplasm at the species level because this study did not integrate molecular biology to better assess the prevalence Piroplasm. Microscopy remains clearly an insufficient method for monitoring and surveillance of Piroplasmosis. [35,36]

The flow of cattle in the network showed a clear seasonality over the study period, with more cattle traded during the rainy season (April to August) than during the dry season. This pattern is probably because there is more pasture available during the rainy season, which makes the animals attractive to buyers due to their increased fat content. [37] The high proportion of Babesia spp. and *Theileria* spp. found in this study could be explained by variations in the climate in the Ndé and Noun Divisions, which have a tropical sudano-guinean climate along with variations in temperature, relative humidity, and precipitation. This combination of factors promotes a high vegetation coverage and cattle pastures. [38] Over this period, there was a clear flow of cattle in the network due to the higher abundance of pasture allowing animals to be fatter and therefore more marketable. [37] These environmental factors influence positively tick abundance and influence consequently the prevalence of Piroplasma such as *Babesia* spp *and Theileria* spp., transmitted by ticks. [39]

Silatsa and colleagues have previously reported that healthy cattle in the Ndé and Noun divisions of western Cameroon are subclinical carriers of Babesia spp. and *Theileria* spp. This suggests that there is a competent tick vector present in the region. Even though the sampled cattle did not show clinical signs of piroplasmosis, the high incidence of Babesia and *Theileria* species implies the possibility of transboundary cattle movement. The removal of the Mbé sanitary barrier in 2001, which previously restricted the passage of animals from the North to the South, has led to a significant increase in cattle trade in certain towns, particularly Foumban. [19,20] This increased movement of cattle facilitates the passive transport of tick vectors like Rhipicephalus appendiculatus, which is a major vector for *Theileria*. These ticks are highly prevalent in the Adamawa plateau region. [40,41] Given these results, there is a need for enhanced surveillance of bovine movement throughout Cameroon to prevent the spread of tick-borne diseases. Tick vectors of the genera Rhipicephalus, Hyalomma, and Amblyomma are widely distributed throughout the country, and there have been reports of tick-borne diseases such as theileriosis and babesiosis in cattle. These Ixodid ticks have the potential to transmit various pathogens including species of the genera *Theileria*, Babesia, and Anaplasma. To effectively control and prevent the spread of these tick-borne diseases, it is crucial to have comprehensive surveillance systems in place, monitor bovine movement, implement appropriate tick control measures, and raise awareness among cattle owners and stakeholders about the risks and prevention strategies associated with tick-borne diseases.

Infection with blood parasites depends on several host conditions, including immunological state and concurrent infections by other pathogens. infection with Babesia or Theleiria species can persist for two to three years and can be easily reactivated during this time. [10,12,19,20,34,42,43,44] This could explain the higher prevalence observed in this study Cattle sampled seemed healthy, the Piroplasm (Babesia and *Theileria*) found in their blood suggests that cattle may be related to a state of enzootic stability with the parasite [45]. The pathogenic risk to human health and the limited resources available to rural farmers exacerbate this condition, which further suggests that the cattle included in this survey did not receive normal veterinarian care. [36,46]

Although the sampled cattle were more female 68.61% than males 31.39%, *Babesia bovis* (52.0%), *Babesia bigemina* (27.5%) and *Theileria* spp (71.2%) were more prevalent in male cattle. These results are different from those reported by Mohammed-Ahmed and colleagues, Salih and colleagues. [47,48] Ours findings have direct implications for economic activity in the region. Farmers typically utilize male cattle for reproduction and meat consumption, while female cattle play a crucial role in pregnancy, parturition, and milk production. However, these stress factors make the delicate female cattle more susceptible to piroplasmosis caused by parasites like Babesia and *Theileria*. [49,50]

Our results showed that Calves and juveniles cattle were more infected by Piroplasm (Table 2) compared to adults. The same were reported by Gachohi *et al*; Nyabongo *et al*.; and Lorusso *et al*. respectively in Kenya Burundi, and Nigeria. [51,52,53] This could be explained by the fact that calves and juvenile cattle still have immature immunity compared to adult cattle which present a strong immunity and could developed resistance against Piroplasm.

Parasite poly-infestation, which refers to the presence of two or more parasites in the sampled cattle, was observed in this study. Four different combinations of parasite species were identified,with 45% of cattlefound to be infected with three different Piroplasms, namely *Babesia bovis*, *Babesia bigemina*, and *Theileria* spp. Parasite poly-infestation has significant implications for cattle survival, treatment, and clinical outcomes. [53] When multiple parasites co-infect a single animal, it can lead to more severe disease manifestations and increased treatment challenges. The presence of different tick species carrying distinct parasites simultaneously can facilitate further infestations, as the animal's immune system may be compromised due to immunosuppression caused by various intrinsic and extrinsic factors. [42]

5. Conclusion

Our findings reveal the presence of tick-borne transmissions of *Babesia bovis, Babesia, bigemina, and Theileria* spp. in the Ndé and Noun Divisions of the West Region, Cameroon. These findings underscore the importance of implementing strict regulations and control measures to prevent and manage piroplasm infections and their tick vectors. Such efforts are crucial to ensure sustainable cattle production and safeguard the health and well-being of livestock in the region. However, to fully understand the regional variations in disease prevalence and species diversity, as well as the availability of appropriate tick vectors, further epidemiological research is needed. This additional research will help inform targeted interventions and control strategies to effectively combat piroplasm infections and protect the cattle population. Overall, the insights gained from this study emphasize the importance of continuous surveillance, effective control measures, and interdisciplinary collaborations among researchers, veterinarians, and authorities to mitigate the impact of piroplasm diseases in the studied regions and beyond.

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