

# Distribution of Bovine Haemoparasites in the Peri-Urban Area of Bouaké in Côte d'Ivoire

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## Abstract

A cross-sectional survey (240 cattle, dry and rainy seasons 2021) assessed tick-borne haemoparasites in four peri-urban corridors of Bouaké using Giemsa-stained blood smears. The blood sample can permit some species to be identified, such as *B. bigemina*, *A. marginale*, *A. centrale* and *Theileria spp*. This species is considered the hemoparasites of cattle. The different results show the prevalence of different hemoparasite, linking the sex of the animal, age class, physiological aspect and breed (Méré, N'dama et Zébu) of cattle. *Anaplasma marginale* showed the highest prevalence (48.3%), followed by *Theileria spp* (21.3%), *Babesia bigemina* (9.6%) and *Anaplasma centrale* (4.6%); *Trypanosoma spp* were absent. Prevalence varied significantly ( $p < 0.05$ ) by site, season and, for *Theileria*, by breed. The study highlights the need for integrated tick control and further vector research.

## Keywords

Prevalence, Haemoparasites, Distribution, Cattle, Bouaké, Côte d'Ivoire

## 1. Introduction

In Côte d'Ivoire, the livestock production sub-sector, contributing 4.5% to the agricultural GDP (and only 2% to the national GDP), occupies a marginal position in the Ivorian economy [1]. Animal production from these livestock systems remains underexploited. The deficits in meat and dairy products are estimated at 55.4% and 87.4%, respectively.

Like the major cities of sub-Saharan Africa, large Ivorian cities are experiencing

rapid urbanization. The urbanization rate is 52% [2] according to the 2021 general population and housing census. Peri-urban livestock farming occupies a key position in meeting the needs of urban populations for meat, dairy, and poultry products. Numerous food and health constraints limit the development of livestock production. Among these constraints, blood parasites, particularly those of the genera *Trypanosoma*, *Anaplasma*, *Babesia*, and *Theileria*, occupy a prominent place.

Hemoparasites constitute a major obstacle to the development and improvement of cattle breeding worldwide, particularly in Africa [3]. Furthermore, hemoparasitoses of cattle can have a negative impact on animal health, the livestock industry and, sometimes, on humans. Parasitic diseases such as babesiosis, theileriosis and anaplasmosis are widespread in tropical and subtropical regions, including Côte d'Ivoire. Infections can be fatal to livestock but are also known to cause fever, anorexia, jaundice, increased abortion rates and infertility [4]. These hemoparasitoses caused by protozoa (*Theileria* and *Babesia*) and bacteria (*Anaplasma Ehrlichia*) constitute a serious challenge for the health and welfare of livestock, particularly in tropical and subtropical regions.

To our knowledge, few previous reports illustrate the distribution and microscopic identification of hemoparasites in cattle in the city of Bouaké. In order to improve livestock productivity in peri-urban areas while effectively combating food insecurity and reducing economic losses caused by parasitic diseases, this study was initiated to inventory the different hemoparasites and assess their prevalence in cattle raised in parks located in the peri-urban area of Bouaké.

## 2. Materials and Methods

### 2.1. Study Areas

The study is carried out on cattle farms located in urban and peri-urban areas of Bouaké. Bouaké is located in the center of Côte d'Ivoire in the Gbéké region on the major road and rail axis linking Abidjan to the north of the country (Figure 1).

With a population of 832,371 inhabitants [2], Bouaké presents a forest-savannah transition zone (Sudanese-Guinean) characterized by temperatures oscillating around 27°C with differences of the order of 3°C to 5°C. Average decadal evaporation varies between 35 and 55 mm during the rainy season and relative humidity fluctuates between 70 and 80%. The rainfall pattern is bimodal, with irregular precipitation reaching an average annual total of around 1100 mm [5]. Night parks located in the neighborhoods along the different corridors of the city were visited.

In each site, four farms were chosen for sampling. The sites are as follows:

- Site 1 located in the Southern corridor (Air France 3, cemetery and Kongodekro);
- Site 2 located in the Eastern corridor (Olienou, Belleville, and Kouassibilekro);
- Site 3 located in the Western corridor (Tchelekro, CIDT estate, Adjeyaokro);
- Site 4 located in the North corridor (CNRA breeding station, Tollakouadiokro).

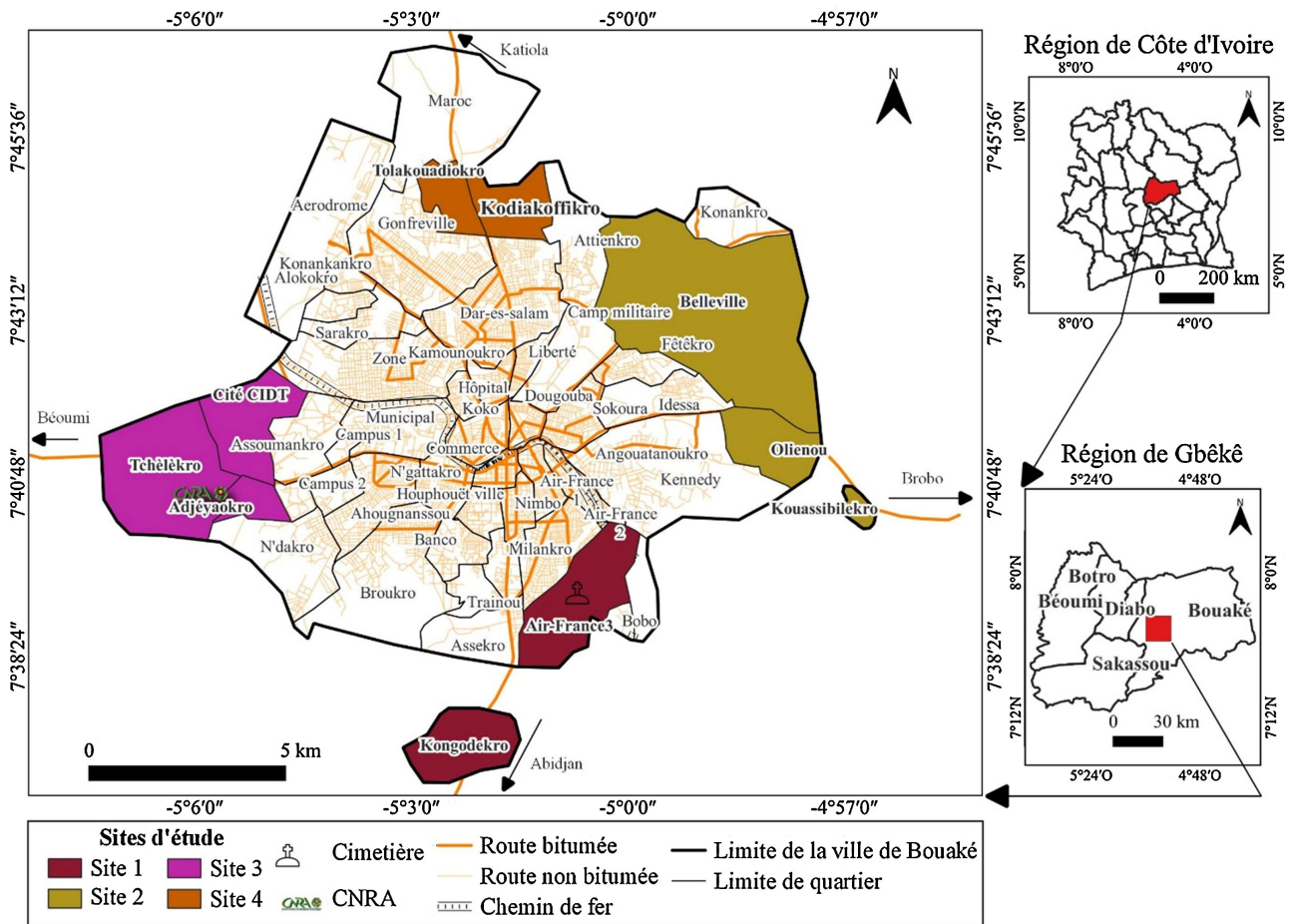


Figure 1. Location of the study area.

## 2.2. Materials

Cattle of all ages, breeds and both sexes belonging to different age classes were sampled as shown in Table 1. Standard equipment for identification of blood parasites was used, which consisted of a light microscope, immersion oil, GIEMSA stain, microscope slides, 95% methanol, lancet, microcapillary tube, microscope slide and gloves.

## 2.3. Methods

The samples were collected in February and October, corresponding to the dry and rainy seasons respectively. Consent from the farm was obtained before the animals were sampled. For a more representative sample, 60 animals were selected randomly per site. In total, 240 cattle were sampled, including 163 females and 77 males. One hundred and twenty (120) samples were taken during the dry season (February 2021) and 120 during the rainy season (October 2021). The age of the cattle ranged from 1 to 12 months for calves and she-calves, from 13 to 36 months for young bulls and heifers and from 37 months and over for bulls and cows. The distribution of cattle numbers collected at the collection sites is shown in Table 1.

**Table 1.** Distribution of the number of cattle collected from the collection sites according to sex, age classes and physiological status of the animals.

Collection Site	Sex		Age classes			Physiological status					
	M	F	JUV ( $\leq 1$ year)	SAD (1 - 3 years)	ADU ( $\geq 3$ years)	Vx	Ve	Tn	Gn	Tx	Vc
Southern corridor	20	40	14	20	26	9	5	7	13	4	22
Eastern corridor	20	40	10	21	29	6	4	10	11	4	25
West corridor	21	39	22	15	23	14	8	3	12	4	19
northern corridor	16	44	16	19	25	6	10	8	11	2	23
<b>Total</b>	<b>77</b>	<b>163</b>	<b>62</b>	<b>75</b>	<b>103</b>	<b>35</b>	<b>27</b>	<b>28</b>	<b>47</b>	<b>14</b>	<b>89</b>

M: male; F: female; JUV: juvenile; SAD: subadult; ADU: adult; Vx: calf; Ve: female calf; Tn: young bull; Gn: heifer; Tx: bull; Vc: cow.

Blood samples were collected from the ear vein. The animal is immobilized and the base of the ear is compressed. A lancet is then used to prick the ear and collect the blood sample. A drop of blood was then placed on one slide and another slide was beveled at a 30° angle. The beveled slide was then brought into contact with the drop of blood, and when it spread by capillary action and slid forward, the smear was applied to clean, dry slides. Smears were fixed in 95% methanol and stained with GIEMSA diluted to 10% in distilled water. The smears were then observed under a light microscope to detect different species of hemoparasites. Microscopic observation was carried out at 100× magnification using immersion oil and the results were recorded. After observing 3/4 of the observable fields, the smears were considered negative if no parasites were detected. All analyses were carried out at the Bouaké Regional Laboratory (LRB), a technical sub-unit of the National Laboratory for Agricultural Development Support (LANADA).

## 2.4. Statistical Analysis

The results were recorded using Excel software. A descriptive analysis was carried out to calculate the prevalences according to the following formula:

$$\text{prevalence}(\%) = \frac{\text{Number of smears positive for a parasite}}{\text{Total number of smears examined}} \times 100$$

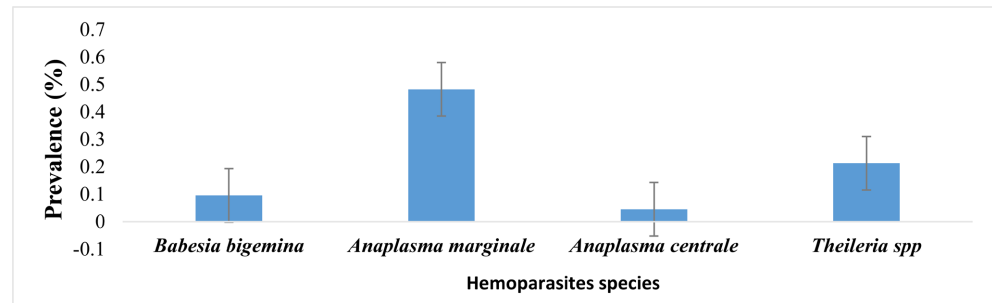
The Chi-square statistical test was performed using STATISTICA version 7.0 software to compare the prevalence of the different parameters studied, and the values obtained (percentages) were compared with the 5% threshold.

## 3. Results

### 3.1. Parasitic Screening for Blood Parasites

Microscopic examination of the 240 samples revealed that 201 smears were positive (83.75%) for at least one blood parasite and 39 samples were negative (16.25%). **Figure 2** shows the prevalence of the different species of hemoparasites encountered in the study area. A total of 04 species belonging to 03 genera of blood

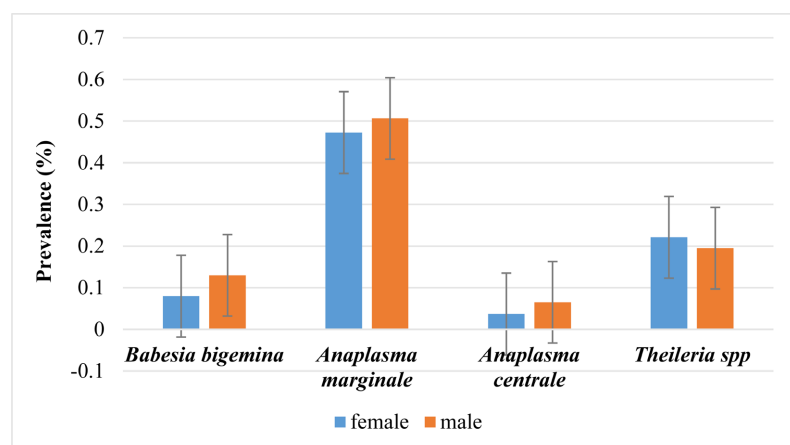
parasites were identified. This is the genus *Anaplasma* with two species, *A. marginale* (48.33%) and *A. centrale* (4.58%); *Babesia* includes the species *B. bigemina* with a prevalence of 9.6%; and the genus *Theileria*. The prevalence of *Theileria spp* was estimated at 21.25%. Statistical analysis revealed a significant difference ( $p = 0.0001$ ) between the prevalences of these hemoparasites. Hemoparasites of the genus *Trypanosoma* were not encountered.



**Figure 2.** Prevalence of the different species of blood parasites encountered.

### 3.2. Prevalence of Parasites Identified According to the Sex of the Animal

The inventory of hemoparasite species in cattle was also carried out taking into account the sex of the animals. Of a total of 77 male subjects, the species *A. marginale*, *Theileria spp* and *B. bigemina* were the most prevalent. Their respective prevalences were 50.65%, 19.48% and 12.99%. *A. centrale* represented the lowest prevalence encountered (6.49%), with 5 infected male cattle out of 77 male subjects. Among the 163 females, *A. marginale*, *Theileria spp* and *B. bigemina* were the most numerically dominant species, with respective prevalences of 42.24%, 22.08% and 7.97%. *A. centrale* had the lowest infectivity (7.97%) in females (**Figure 3**). Overall, the Chi<sup>2</sup> test showed that the presence of parasites was not related to sex ( $p > 0.05$ ).

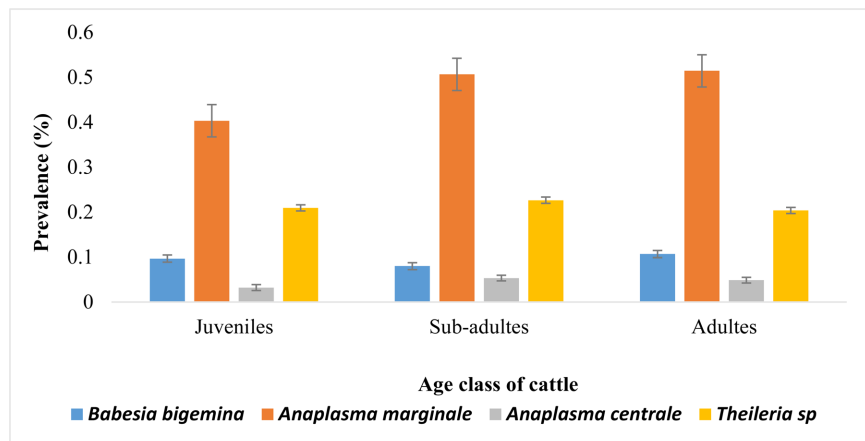


**Figure 3.** Variation in parasite prevalence according to the sex of the animal.

### 3.3. Prevalence of Parasite Species According to Animal Age Class

**Figure 4** shows the prevalence of hemoparasites encountered according to the age

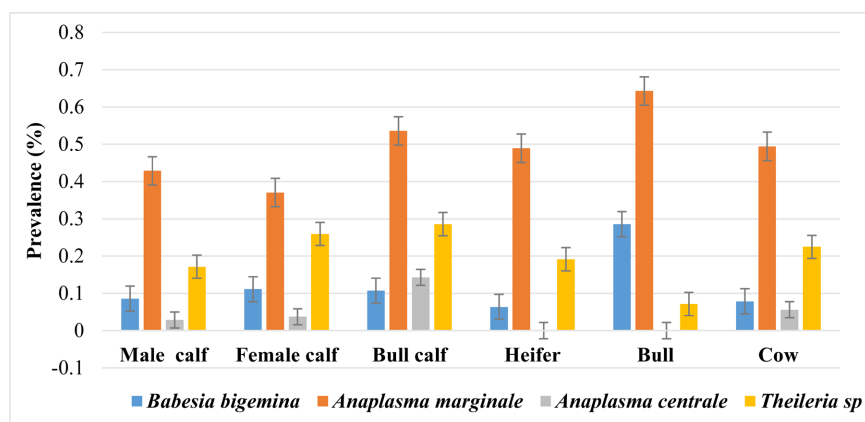
class of the cattle sampled. *A. marginale* infected more cattle identically regardless of their physiological stage followed by *Theileria spp* *Babesia bigemina* and *A. centrale* weakly infected cattle. The prevalence of *A. marginale* infection in these categories of cattle was 51.46% in adults, 50.66% in juveniles and 40.32% in young cattle.



**Figure 4.** Prevalence of parasite species according to animal age class.

### 3.4. Parasite Prevalence According to the Physiological Stage Cattle

All blood parasites identified during this study were found in cows, with high prevalences of over 49.44% for *A. marginale*, 22.47% for *Theileria spp*, 7.86% for *B. bigemina*, and 5.61% for *A. centrale*. *A. centrale* was not encountered in heifers and bulls. The prevalence of parasites encountered according to the physiological stage of the cattle sampled are presented in **Figure 5**.



**Figure 5.** Variation in parasite prevalence according to the physiological stage of the cattle sampled.

### 3.5. Seasonal Variation in the Prevalence of Hemoparasites Found in Cattle

The influence of the season on the prevalence of hemoparasites was studied. The diversity of hemoparasite species found in cattle farms in the city of Bouaké dur-

ing the rainy season and the dry season remains completely identical. Overall, a decreasing trend in the prevalence of all parasites during the dry season was observed (Figure 6) except for *A. centrale* and *B. bigemina*. *A. marginale* responsible for bovine anaplasmosis recorded prevalences of 31.67% during the dry season against 65% during the rainy season. Prevalences of 3.33% and 39.17% were recorded during the dry and rainy seasons respectively for *Theileria spp.*

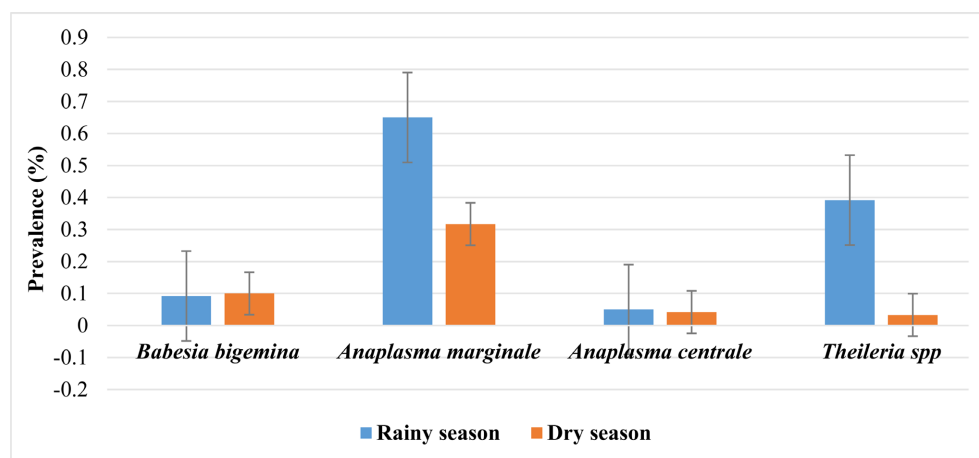


Figure 6. Variation in parasite prevalence depending on the sampling season.

### 3.6. Variation in the Prevalence of Hemoparasites Encountered Depending on the Sample Collection Site in Cattle

The overall prevalence of hemoparasites encountered in the different sampling sites is presented in Table 2. It appears that *A. centrale* was not encountered in the southern districts (Air France 3, cemetery and Kongodekro) and the western districts (Tchelekro, CIDT city and Adjeyaokro) of the city. *A. marginale* was found to be more infectious for cattle with a prevalence of 75% for the eastern districts (Olienou, Belleville and Kouassibilekro), 46.7% in cattle in the northern districts (CNRA station and Tollakouadiokro), 41.7% in the southern districts (Air France cemetery and Kongodekro) and 30% in the western districts (Tchelekro, CIDT city and Adjeyaokro). The prevalence of *A. marginale*, *A. centrale* and *Theileria spp.* varied significantly depending on the area ( $p < 0.05$ ).

Table 2. Variation in the prevalence of hemoparasites encountered according sampling site.

Hemoparasites species	Prevalence by collection site				Significability	$X^2$	p (%)
	Southern corridor	Eastern corridor	West corridor	Northern corridor			
<i>B. bigemina</i>	6.7% <sup>a</sup>	15.0% <sup>a</sup>	6.7% <sup>a</sup>	10.0% <sup>a</sup>	NS	4.5663	0.2065
<i>A. marginale</i>	41.7% <sup>a</sup>	75.0% <sup>b</sup>	30.0% <sup>a</sup>	46.7% <sup>a</sup>	***	21.6338	0.00001
<i>A. centrale</i>	0.0% <sup>a</sup>	11.7% <sup>b</sup>	0.0% <sup>a</sup>	6.7% <sup>b</sup>	***	26.8837	0.00001
<i>Theileria spp.</i>	16.7% <sup>a</sup>	31.7% <sup>b</sup>	6.7% <sup>c</sup>	30.0% <sup>b</sup>	***	22.3332	0.00001

\*\*\*: Significant difference; NS: No significant difference. The letters a, b and c indicate a significant difference with a  $p < 5\%$ .

### 3.7. Variation in the Prevalence of Hemoparasites Encountered According to the Breed of Cattle Sampled

The influence of breed on the receptivity of hemoparasites was studied in the study area. **Table 3** shows the prevalence of hemoparasites encountered according to the cattle breeds encountered. *A. centrale* and *Theileria spp* were not found in Méré cattle. *A. marginale* was encountered in all cattle breeds with prevalences of 51.25% in N'dama cattle, 48.48% in zebu cattle and 39.29% in Méré cattle. Comparison of prevalences according to breed revealed no significant difference for *Theileria spp*, *Anaplasma marginale*, *Anaplasma centrale* and *Babesia bigemina* ( $p > 0.05$ ).

**Table 3.** Variation in the prevalence of hemoparasites encountered depending on the bovine breed sampled.

Hemoparasites species	Prevalence by cattle breed			Significability	$\chi^2$	p (%)
	Méré (Zébu × N'dama)	N'dama	Zébu			
<i>B. bigemina</i>	14.29%	8.75%	9.09%	NS	2.369	0.3059
<i>A. marginale</i>	39.29%	51.25%	48.48%	NS	4.526	0.1040
<i>A. centrale</i>	0.0%	5.0%	5.30%	NS	0.0087	0.9255
<i>Theileria spp</i>	0.0%	28.75%	21.21%	NS	1.1423	0.2852

NS: No significant difference  $p > 5\%$ .

## 4. Discussion

The study revealed the presence of hemoparasites of the genus *Babesia*, *Theileria* and *Anaplasma* in cattle farms in the peri-urban area of Bouaké in central Côte d'Ivoire. The presence of these three genera of parasites could be explained by the presence of vectors, particularly ticks, which carry these pathogens. These results corroborate those of [6] in the Department of Kounahiri in Côte d'Ivoire with similar prevalence rates.

Furthermore, among the 240 blood smears collected, none were positive for parasites of the genus *Trypanosoma*. The absence of parasites of the genus *Trypanosoma* could be explained by the absence in the city of Bouaké of islands of forest called "Bois sacré". These sites, which constitute true tsetse landmarks, contributed to maintaining an environment suitable for the survival of these trypanosome vectors. In addition, the samples were taken specifically in the peri-urban area of the city. In [6] had not obtained parasites of the genus *Trypanosoma* (*T. vivax* and *T. brucei*). On the other hand, the presence of parasites of the genus *Trypanosoma* was demonstrated by [7] in an endemic area of Eastern Colombia with a prevalence of 1.30%. The presence of *Trypanosoma* in Colombia was explicated by the presence of the tsetse fly vector.

Of 240 smears collected, 48.33% smears were positive for *A. marginale*, *Theileria spp* (21.25%), *B. bigemina* (9.58%), and *A. centrale* (4.58%).

In work on hemoparasites in the central zone in Côte d'Ivoire, [8], observed two species of hemoparasites (*B. bovis* and *Anaplasma marginale*). These studies do not take into account the presence of *Theileria spp* in their different investigation zones. In a nearly similar study on hemoparasites of cattle ticks in Benin in [9], observed 4 hemoparasites which are *Babesia bigemina*, *Theileria spp*, *Anaplasma marginale* and *Anaplasma centrale*. These authors concluded their work by designating ticks of the genus *Rhipicephalus (Boophilus)* as the main vectors of transmission of these blood parasites. [10] designated ticks as the vector agent of parasites of the genus *Anaplasma*, a rickettsian pathogen of cattle. Among the pathogens isolated in this study, *Anaplasma marginale* was the most common. The prevalence of 48.33% observed in the present study. This prevalence is lower than the rate recorded in the central zone in 2014 by [8] this work had made it possible to isolate *A. marginale* and *B. bovis* with respective prevalences of more than 55% and 59% in the central areas of Côte d'Ivoire. Furthermore, the prevalences of the studies were higher than the seroprevalence of *Anaplasma* (23.4%) and *Babesia* (17.3%) obtained by [11] in the Noun and Nde Divisions of the West Region of Cameroon. The results obtained can be explicated by the different sampling regions and the method for identifying blood parasites. Indeed, the microscopic technique for detecting bovine blood parasites remains insensitive. Other methods, including serology and molecular biology, which are more sensitive methods, will enable better identification of blood parasites in cattle.

The prevalences observed in our study were significantly higher than those obtained by [12] in the central area of the humid savannah of Côte d'Ivoire. The observed prevalences would be around 9.71%. The high presence of *Anaplasma marginale* in this study can be explained by the massive presence of the vector tick *Rhipicephalus (Boophilus)* in livestock farms in the peri-urban area of Bouaké. This tick was identified by [13] in livestock farms in northern Côte d'Ivoire. [14] identified *Rhipicephalus (Boophilus) microplus* for the first time in southern Côte d'Ivoire. This tick is widely present in the city's livestock farms. The presence of the parasite of the genus *Babesia* could be explained by the presence of the tick species *Rhipicephalus (Boophilus) microplus*.

Although the sample cattle are present in the peri-urban area of Bouaké, the breeding system adopted in these different farms is of the traditional type. The breeders do not have artificial pastures to feed their cattle. [15] estimated that 5% of breeders have artificial pastures in the northern area of Côte d'Ivoire. To feed their cattle, breeders all turn to the pasture areas scattered in and around homes. In the eastern and western districts of the city, it is not uncommon to see stray cattle grazing in the streets. Peri-urban grazing areas intended for feeding ruminants according to [16], are gradually decreasing due to the rapid urbanization of the city of Bouaké. These grazing areas would represent areas favorable to the transmission of parasitoses. For [17], breeding methods are among the factors most influencing the prevalence of Tick-Transmitted Diseases or TTDs. The high recorded prevalence of *A. marginale* reflects the wide distribution of ticks, vectors

of these parasites. The massive presence of *A. marginale* on all sites could be explained by a distribution of vector ticks on all the city corridors.

The use of acaricides is strongly recommended for breeders to combat ticks that carry these parasites. The high pressure of acaricides used in tick control in the sampled herds could explain the prevalences obtained. Indeed, regular tick removals carried out with appropriate products can significantly reduce ticks and, consequently, according to [8].

During the present study, prevalences were not impacted by the sex of the cattle sampled. [12] made the same observation. For all the hemoparasites encountered, no difference in prevalence according to sex was highlighted. However, for [9], sex may constitute a risk factor because females would present a greater receptivity linked to their lower resistance during gestation and lactation.

Unlike *A. marginale* and *Theileria spp.*, the prevalence of *A. centrale* and *B. bigemina* was not influenced by the seasons of sample collection. This could be explained by the dynamics of the different tick vectors of these parasites. Indeed, [18] showed that *Rhipicephalus (Boophilus) microplus* presents a fairly clear seasonality compared to *Rhipicephalus (Boophilus)*. Further studies, particularly on the seasonal dynamics of ticks in the peri-urban area of Bouaké, are necessary for more effective integrated control. Moreover, the high presence of these hemoparasites in the rainy season is explained by the ticks that carry these parasites developing well in humid conditions. These results corroborate those [11]. Environmental factors, particularly climate influence the prevalence of the infections.

## 5. Conclusion

This study confirmed the presence of different species of blood parasites in livestock farms located in the peri-urban area of Bouaké in central Côte d'Ivoire. *Babesia bigemina* is responsible for babesiosis and *Anaplasma marginale* and *Anaplasma centrale* are the etiological agents of anaplasmosis. *Anaplasma marginale* is by far the most common in the city of Bouaké. A decreasing trend in the prevalence of all parasites during the dry season was observed except for *A. centrale* and *B. bigemina*. Parks located in the eastern districts of the city appear to be the most infected by anaplasmosis. Furthermore, all age groups are affected by blood parasites. It is important to undertake rational control measures against ticks, responsible for the transmission of all the parasites encountered. This will reduce parasite loads and improve the profitability of cattle farms in peri-urban areas. These measures must be combined with preventive and curative actions.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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