Original Research Article

Haematological Profile of Sheep Declared Healthy for Slaughtering in the Commune of Korhogo (Côte d'Ivoire).

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Abstract

In order to establish a better diagnosis of sheep slaughtered in the municipal slaughterhouse of Korhogo, this study was finally carried out to appreciate the variation of their hematological parameters. All in all, 85 sheep, from Djallonké breed were recruited. The assessment of the various hematological indicators was done by suitable kits for the URIT-2900 automata Analyzer. The results of our investigations showed that the mean age value of the sheep was 1.54 ± 0.17 years. These results revealed that abnormities in the mean values of the hematological parameters were observed in the hemoglobin, Mean Corpuscular Value (MCV), leukocytes, neutrophils, lymphocytes and monocytes levels. According to gender, females had a significantly higher rate of anemia (25.37 %) than males (5.56 %). In addition, 98.82 % and 75.29 % of subjects had macrocytosis and hypochromia respectively. The study reported high prevalence of leukocytosis by sex, 7.76 % in males and 77.61 % females and by age (79.31 % and 76.79% respectively in young people and adults). In addition, thrombocytopenia and thrombocytosis were observed in 25.88 % and 29.41% of sheep, respectively. The result of this is that the hematological profile of sheep intended for consumption in the commune of Korhogo is disrupted with many abnormities.

Keywords: Sheep, abnormalities, hematological parameters, Korhogo (Côte d'Ivoire).

INTRODUCTION

In most countries of sub-Saharan Africa, sheep breeding is a regular activity, source of income for rural people today. According to their importance, the quality of meat (prized meat) and their role on farms, sheep require more careful attention. In Africa, test on domestic animals blood, in particular that of sheep, has not so far attracted much interest, whereas in Europe, hematology and biochemical profiles of domestic animals are so well known.

Indeed, the veterinarian in Africa was mainly concerned with the prophylaxis of dangerous pathologies and zootechnical improvement of domestic animals [1]. Also, studies carried out in some African countries such as Burkina Faso, Djibouti and Chad showed that sheep suffer from much pathology in sheep, in particular brucellosis, babiesosis, anasplasmosis, Q fever, chlamydia or even trypanosomiasis [2-6]. According to Yé [7], animal pathologies constitute a real barrier to improving the yield of sheep flocks in Africa.

However, animals' hematological and biochemical parameters assessment is necessary interest for establishing the diagnosis of many diseases, in particular subclinical forms, as well as for establishing a real prognosis. Studies dealing with the infestation of animals by various pathogens, the management and development of animal resources clearly show the need for reliable hematological and biochemical standards [8].

Both blood and gastrointestinal parasites, nutritional deficiencies, which condition the productivity of the herd and their ability to use natural resources, can be validly assessed by blood parameters [7]. Thus, studies carried out in Djibouti, Burkina Faso and Chad showed that the variation of some biological blood parameters depending on the age, sex or even the breed of the animal due in part to nutritional status or environmental variations [9].

In Côte d'Ivoire, the livestock sector combined with agriculture constitute the pillar of the country's economic development, however sheep breeding is unfortunately managed in a traditional way [6]. In addition, covering the population's animal protein needs remains largely dependent on foreign markets and import, which represent a real challenge for poor countries [10].

Most of investigations carried out in the slaughterhouses of small ruminants in the commune of Korhogo showed that the diagnosis of animals before their slaughter focused on their weight and their appearance. These outcomes are limited to stand a good diagnosis, only blood parameters assessment of these animals would determine their health before authorizing their slaughter.

So, the study of hematological and biochemical parameters must be carried out for the welfare of animals and consumers.

However, to our knowledge, most of the work carried out in Côte d'Ivoire on sheep concerned only food and pathologies, few studies were focused on blood parameters assessment and effort at addressing the prevalence of animal pathologies in Côte d'Ivoire is hampered by paucity of data on biological indicators [1, 10]. Therefore, this present study aims to assess the biological blood parameters in sheep intended for consumption in the commune of Korhogo. Specifically, it is a matter of determining the hematological profile of the sheep intended for slaughter.

MATERIAL AND METHODS
Site and Study population
This cross-sectional, analytical, descriptive and comparative study was carried out in the small ruminant slaughterhouse at Korhogo in the north of Côte d'Ivoire. It took place over a period of 6 months from January to June 2019. It required the recruitment of 85 healthy sheep authorized for slaughter by veterinarian.

The study population consisted of 18 males (21, 18 %) and 67 females (78, 82 %). Among these 85 sheep, 29 (34, 12 %) were young (less than 1 year) and 56 (65, 88%) were adults (more than 1 year). It was from these 85 sheep that the blood samples were collected.

Blood samples and blood parameters assessment
In each of the sheep recruited, blood is taken from the jugular vein on test tubes with anticoagulant (EDTA). The samples collected on these EDTA tubes were used to determine the hematological parameters with an automatic hematological analyzer URIT 2900 Plus.

Statistical exploitation of hematological parameters
The results were then compiled and registered in tables. Data generated from the study were analyzed using several statistical tests. Descriptive statistics were used and results were presented in percentages, means and standard error.

Analysis of variance (Anova 1) was used to compare the hematological parameters means with significance set at $p < 0,05$. Also likehood G test or test likehood ratio was used to compare the proportion of different biological parameters with software R.2.0.1 windows [11].

RESULTS AND DISCUSSION
Results
Characteristics of the study population
Table 1 presents different characteristics of the subjects included in that study. The findings revealed that the sheep selected for that study (85 sheep) were exclusively from Djallonké breed. This sample of sheep was consisted of 67 females (78.82 %) and 18 males (21.18 %). The mean age value of the animals was 1.54 ± 0.17 years, with 31, 12% less than a year old considered as young and 65, 88 % those who were one year or more than a year considered as adults. This table also showed that adults presented a high proportion (65.88 %) compared to young people (34.12 %).

Table-I: Characteristic data for sheep

Characteristics	Total sheep (N = 85)	
	n	%
Age (years)		
<1	29	34.12
1 ≥	56	65.88
Sex		
Males	18	21.18
Females	67	78.82
Race		
Djallonké	85	100

N: Total number of sheep; n: Number observed for each characteristic; %: Percentage.

Distribution of the main biological blood parameters in all sheep

Erythrocyte parameters

Table II shows the mean values of hematological parameters in sheep. The results indicated that the mean blood cells values were normal except for the hematocrit level which was higher than the reference values. In this same table II, the erythrocyte parameters showed that 39 % of the sheep presented lower values of red blood cells under the normal values against 50 % of the subjects who presented a normal rate. Furthermore, 11% of the sheep presented values higher than normal values. Concerning hemoglobin level, 78.82 % of sheep had normal levels compared to 21.18% of subjects which were anemic (Hb < 8 g/dl). The findings showed that 5.88% of sheep presented a lower level of hematocrit comparatively to 71.12 % which presented a normal level in comparison to the recommended values.

As for the Mean corpuscular volume (MCV), normocytosis and macrocytosis were observed in 1.18% and 98.82 % of the subjects respectively. In the case of the average corpuscular hemoglobin (MCH) content, hypochromia was observed in 75.29 % of sheep against 24.71 % of normochromia.

Leukocyte and thrombocytic parameters

Table III shows the mean values and proportions of leukocytes results and thrombocyte parameters. The mean values of leukocytes, neutrophils, lymphocytes and monocytes were higher than the recommended values except the values of eosinophils, basophils and thrombocyts.

The proportions of the leukocyte and thrombocytic parameters in all sheep are given in Table III. These results indicated the prevalence of leukopenia and leukocytosis was respectively in 4.71 % and 72.94 % of sheep. On the other hand, 22.35 % presented a normal level of leukocytes. Concerning neutrophils, 57.65 % showed neutropenia while 42.35 % presented a normal rate. Moreover the findings revealed that 41.18% and 10.59 % of the subjects presented lymphopenia and lymphocytosis respectively. Furthermore, 48.24 % of the sheep presented a normal rate of lymphocytes. Concerning monocytes, the mean value was normal in 43.53% of sheep, whereas 56.47 % of sheep developed monocytosis. Regarding thrombocytes, thrombocytopenia and thrombocytosis were observed in 25.88 % and 29.41 % of sheep, respectively. Also, 44.71 % of the subjects presented a normal mean value.

Table-II: Average values and proportions of the erythrocyte parameters

Erythrocyte Parameters	Sheep N= 85		
	n	M±SEM	%
Blood count			
Red blood cells (10^3/μL)		**9.99 ± 1.08**	
< 9	33		38.82
9-15	43		50.59
> 15	9		10.59
Hemoglobin (g/dl)		**9.47 ± 1.03**	
< 8	18		21.18
8-16	67		78.82
> 16	-		-
Hematocrit (%)		**60.15 ± 6.52**	
< 26	5		5.88
26-42	17		20
> 42	63		74.12
Erythrocyte indices			
MCV (fl)		**58.01 ± 6.29**	
< 28	-		-
28-40	1		1.18
> 40	84		98.82
MCH (pg)		**12.28 ± 1.33**	
< 8 et > 12	64		75.29
8 – 12	21		24.71

N: Total number of sheep; n: Number observed in each group of sheep; M: Mean; SEM: Standard error on the mean; %: Percentage; MCV: Mean corpuscular volume; MCH: Mean corpuscular hemoglobin

Table-III: Average values and proportions of the leukocyte and thrombocyte parameters

Leukocyte and thrombocyte parameters	Sheep N= 85		
	n	M±SEM	%
Leukocyte Parameters			
Leukocyte (10^3/μL)		**15.37 ± 1.67**	
< 4	4		4.71
4-12	19		22.35
> 12	62		72.94
Polynuclear N (%)		**13.68 ± 1.48**	
< 17.5	49		57.65
17.5-50	36		42.35
> 50	-		-
Polynuclear E (%)		**1.22 ± 0.13**	
0-8.3	85		100
> 8.3	-		-
Polynuclear (%)		**0.04 ± 0.001**	
0-2.5	85		100
> 2.5	-		-
Lymphocytes (%)		**49.34 ± 5.35**	
< 50	35		41.18
50-75	41		48.24
> 75	9		10.59
Monocytes (%)		**8.41 ± 0.91**	
0-6.25	37		43.53
> 6.25	48		56.47
Thrombocyte Parameters			
Thrombocytes (10^3/μL)		**633.61 ± 68.72**	
< 250	22		25.88
250-750	38		44.71
> 750	25		29.41

N: Total number of sheep; n: Number observed in each group of sheep; M: Mean; SEM: Standard error on the mean; %: Percentage; N: Neutrophil; E: Eosinophil; B: Basophil.

Study of hematological parameters of sheep according to sex
Erythrocyte parameters according to sex

Table IV shows the mean values and proportions of biological parameters distributes according to sex. In all the subjects, the mean value of red blood cells count ($9.51±1.17$x 10^3/l vs $10.72 ± 0.48$ x 10^3/μL), hemoglobin level ($10.6 ± 0.52$ g/dl vs $9.17 ± 0.29$ g/dl) were normal without any statistical difference respectively between males and females ($p > 0.05$), whereas the mean level of hematocrit ($53.64 ± 7.03$ % vs $61.89±2.99$%), MCV ($56.64 ± 1.68$ fl vs $58.41 ± 0.58$ fl), MCH ($14.91 ± 2.24$ pg vs $11.57 ± 0.90$ fl) were higher than the references values in both males and female without any statistical difference ($p > 0.05$).

However, 61.11 % of males against 32.84% of females presented lower rate of red blood cells count ($p = 0.003$). Also, 25.37% of females against 5.56% of males suffered from anemia (Hb < 8 g/dl) with a significant difference ($p= 0,0002$). In addition, although no significant difference was observed, the prevalence of hypochromia was very high in both males (77.78 %) and females (74.63 %).

Moreover, 16.67 % of males against 2.99% female showed lower mean value of hematocrit under normal rate ($p = 0.001$); and 82.09% of female against 44.44 % of males had higher hematocrit than reference values ($p = 0.00007$).

Table-IV: Proportions of erythrocyte parameters according to sex in sheep

Erythrocyte Parameters	Males (N=18)			Females (N=67)			p
	n	M±SEM	%	n	M±SEM	%	
Blood count							
Red blood cells (10^3/μL)		**9.51 ± 1.17**			**10.12 ± 0.48**		**0.89 (NS)**
< 9	11		61.11	22		32.84	0.003 (S)
9-15	5		27.78	38		56.72	0.001 (S)
> 15	2		11.11	7		10.45	0.89 (NS)
Hemoglobin (g/dL)		**10.6 ± 0.52**			**9.17 ± 0.29**		**0.75 (NS)**
< 8	1		5.56	17		25.37	0.0002 (S)
8-16	17		94.44	50		74.63	0.13 (NS)
> 16	-		-	-			-
Hematocrit (%)		**53.64 ± 7.03**			**61.89 ± 2.99**		**0.44 (NS)**
< 26	3		16.67	2		2.99	0.001 (S)
26-42	7		38.89	10		14.93	0.0008(S)
> 42	8		44.44	55		82.09	0.0007 (S)
Erythrocyte indices							
MCV (fl)		**56.64 ± 1.68**			**58.41 ± 0.58**		**0.87 (NS)**
< 28	-		-	-		-	-
28-40	1		5.56	-		-	0.005 (S)
> 40	17		94.44	67		100	0.69 (NS)
MCH (pg)		**14.91 ± 2.24**			**11.57 ± 0.90**		**0.52 (NS)**
< 8 et > 12	14		77.78	50		74.63	0.79 (NS)
8 – 12	4		22.22	17		25.37	0.65 (NS)

N: Number of sheep by sex; n: Number observed in each group of sheep; M: Mean; SEM: Standard error on the mean; %: Percentage; MCV: Mean corpuscular volume; MCH: Mean corpuscular hemoglobin; S: Statistically significant difference for p < 0.05; NS: No statistically significant difference for p < 0.05

Leukocyte and thrombocytic parameters according to sex

The mean values and proportions of the leukocyte and thrombocyte parameters are summarized in Table VI. These results indicate that there is no significant difference ($p > 0.05$) between the mean values of the leukocyte parameters, except the mean values of the thrombocytes which were significantly elevated in the males (699.5 ± 56.68 x $10^3/\mu L$) than in females (615.91 ± 25.15 x$10^3\mu L$) ($p < 0.05$).

Concerning lymphocytes and thrombocytes, the mean values were higher in males (61 ± 5.19 %; 699.5 ± 56.68 x $10^3/\mu L$) than females group (46.21 %, 615.91 ± 25.15 x $10^3/\mu L$) these results showed that no significant difference was observed in the prevalence of all the values of the leukocyte parameters between males and females. ($p > 0.05$).

On the other hand, significant differences ($p < 0.05$) were observed in the prevalence of lower than normal values of leukocytes, normal and above normal values of lymphocytes, below and above normal values of thrombocytes between males and females.

These results also indicated that the prevalence of leukopenia was significantly high ($p = 0.004$) in females (5.97 %) compared to the prevalence observed in males. As for the proportions of lymphocytosis, they were significantly high ($p < 0.0001$) in males (27.78 %) than in females (5.97 %). Furthermore, the proportion of thrombocytopenia was significantly very high in females (32.84 %) than that observed in males. In contrast, the prevalence of thrombocytosis was significantly higher in males (50 %) than in females (23.88 %) ($p < 0.0001$).

Table-VI: Proportions of leukocyte and thrombocytic parameters by sex of sheep

Leukocyte and thrombocyte parameters	Males (N=18)			Females (N=67)			
	n	M±SEM	%	n	M±SEM	%	p
Leukocyte Parameters							
Leukocyte ($10^3/\mu L$)		**17.42 ± 1.79**			**14.82 ± 0.70**		**0.65 (NS)**
< 4	-		-	4		5.97	0.004 (S)
4-12	4		22.22	15		22.39	0.98 (NS)
> 12	14		77.76	48		71.64	0.62 (NS)
Polynuclear N (%)		**12.38 ± 1.67**			**14.02 ± 0.88**		**0.75 (NS)**
< 17.5	11		61.11	38		56.72	0.68 (NS)
17.5-50	7		38.89	29		43.28	0.63 (NS)
> 50	-		-	-		-	-
Polynuclear E (%)		**1.38 ± 0.16**			**1.18 ± 0.10**		**0.90 (NS)**
0-8.3	18		100	67		100	1 (NS)
> 8.3	-		-	-		-	-
Polynuclear B (%)		**0.16 ± 0.09**			**0.01 ± 0.01**		**0.69 (NS)**
0-2.5	18		100	67		100	1 (NS)
> 2.5	-		-	-		-	
Lymphocytes (%)		**61 ± 5.19**			**46.21 ± 2.40**		**0.15 (NS)**
< 50	8		44.44	27		40.30	0.65 (NS)
50-75	5		27.78	36		44.78	0.04 (S)
> 75	5		27.78	4		5.97	$9.3\ 10^{-5}$ (S)
Monocytes (%)		**7.38 ± 0.65**			**8.68 ± 0.62**		**0.75 (NS)**
0-6.25	7		38.89	30	44.78		0.52 (NS)
> 6.25	11		61.11	37	55.22		0.45 (NS)
Thrombocyte Parameters							
Thrombocytes ($10^3/\mu L$)		**699.5 ± 56.68**			**615.91 ± 25.15**		**0.02 (S)**
< 250	-		-	22		32.84	$3.3\ 10^{-8}$ (S)
250-750	9		50	29		43.28	0.48 (NS)
> 750	9		50	16		23.88	0.002 (S)

N: Number of sheep by sex; n: Number observed in each group of sheep; M: Mean; SEM: Standard error on the mean; %: Percentage; N: Neutrophil; E: Eosinophil; B: Basophil; S: Statistically significant difference $p < 0.05$; NS: No significant difference $p > 0.05$.

Study of hematological parameters of sheep according to age
Erythrocyte parameters of sheep according to age

Table VII shows the mean value of the biological blood parameters of sheep according to age. These results indicated that no significant difference (p

> 0.05) was observed between the set of mean values of erythrocyte parameters in young people than in adults.

Analysis of the results showed that there was no significant difference ($p > 0.05$) between the proportions of the parameters of the blood count of young people and adults except in terms of the

prevalence of the normal value of the hematocrit which was significantly elevated (p < 0.05) in adults than in young people. Furthermore. These results indicated that no significant difference was observed between the proportions of anemia. macrocytosis and hypochromia in the young and in the adults. On the other hand, the proportions of normocytosis were significantly high (p = 0.03) in young people than in adults (p > 0.05).

Leukocyte and thrombocytic parameters of sheep according to age

The results in Table VIII present the state of the hematological blood parameters of the sheep according to age. These results indicated that no significant difference (p > 0.05) was observed between all the mean values of the leukocyte and thrombocytic parameters.

Regarding the proportions of leukocyte and thrombocytic parameters according to age. The analysis indicated that no significant difference (p> 0.05) between the prevalence of all leukocyte parameters of young people and adults was observed. In contrast, the prevalence of normal monocyte values was significantly (p < 0.05) higher in adults than in young people.

In addition no significant difference (p > 0.05) was observed between the prevalence of higher than normal values of thrombocytic parameters according to age. On the other hand. Highly significant differences (p < 0.001) were observed between the prevalence of normal and below normal values of thrombocytes.

Concerning, monocytes cells, 50 % of adult sheep against 68.97 % of young presented high level of monocytes. Moreover, 37.5 % of adult sheep against 3.45 % of young one, who presented thrombopenia (p = 0,001).

Table-VII: Average values and proportions of erythrocyte parameters according to the age of the sheep

Erythrocyte Parameters	Youth (N=29)			Adults (N=56)			p
	n	M±ESM	%	n	M±ESM	%	
Blood count							
Red blood cells (10^3/μL)		**10.13 ± 0.72**			**9.92 ± 0.58**		**0.96 (NS)**
< 9	11		37.93	22		39.29	0.87 (NS)
9-15	16		55.17	27		48.21	0.49 (NS)
> 15	2		6.90	7		12.5	0.2 (NS)
Hemoglobin (g/dl)		**9.58 ± 0.43**			**9.42 ± 0.33**		**0.97 (NS)**
< 8	6		20.69	12		21.43	0.9 (NS)
8-16	23		79.31	44		78.57	0.95 (NS)
> 16	-		-	-		-	-
Hematocrit (%)		**61.68 ± 4.68**			**59.35 ± 3.50**		**0.83 (NS)**
< 26	2		6.90	3		5.36	0.66 (NS)
26-42	4		13.79	13		23.21	0.12 (S)
> 42	23		79.31	40		71.43	0.52 (NS)
Erythrocyte indices							
MCV (fl)		**57.51 ± 1.33**			**58.27 ± 0.57**		**0.94 (NS)**
< 28	-		-	-		-	-
28-40	1		3.45	-		-	0.03 (S)
> 40	28		96.55	56		100	0.81 (NS)
MCH (pg)		**12.13 ± 1.43**			**12.36 ± 1.08**		**0.96 (NS)**
< 8 et > 12	23		79.31	41		73.21	0.62 (NS)
8 – 12	6		20.69	15		26.79	0.37 (NS)

N: Number of sheep by age; n: Number observed in each group of sheep; M: Mean; SEM: Standard error on the mean; %: Percentage; MCV: Mean corpuscular volume; MCH: Mean corpuscular hemoglobin; S: Statistically significant difference for p < 0.05; NS: No statistically significant difference for p < 0.05

Table-VIII: Average values and proportions of leukocyte and thrombocytic parameters according to age

Leukocyte and thrombocyte parameters	Youth (N=29)			Adults (N=56)			p
	n	M±ESM	%	n	M±ESM	%	
Leukocyte Parameters							
Leukocyte ($10^3/\mu L$)		**16.48 ± 1.17**			**14.80 ± 0.82**		**0.76 (NS)**
< 4	1		3.45	3		5.36	0.52 (NS)
4-12	6		20.69	13		23.21	0.70 (NS)
>12	22		75.86	40		71.43	0.72 (NS)
Polynuclear N (%)		**14.79 ± 1.41**			**13.10 ± 0.92**		**0.75 (NS)**
< 17.5	17		58.62	32		57.14	0.89 (NS)
17.5-50	12		41.38	24		42.86	0.87 (NS)
> 50	-		-	-		-	-
Polynuclear E (%)		**1.17 ± 0.14**			**1.25 ± 0.11**		**0.96 (NS)**
0-8.3	29		100	56		100	1 (NS)
> 8.3	-		-	-		-	-
Polynuclear B (%)		**0.07 ± 0.05**			**0.04 ± 0.03**		**0.93 (NS)**
0-2.5	29		100	56		100	1 (NS)
> 2.5	-		-	-		-	-
Lymphocytes (%)		**49.31 ± 3.59**			**49.36 ± 2.94**		**0.99 (NS)**
< 50	11		37.93	24		42.86	0.58 (NS)
50-75	16		55.17	25		44.64	0.29 (NS)
> 75	2		6.90	7		12.5	0.20 (NS)
Monocytes (%)		**9.24 ± 0.89**			**7.98 ± 0.62**		**0.76 (NS)**
0-6.25	9		31.03	28		50	0.03 (S)
> 6.25	20		68.97	28		50	0.08 (NS)
Thrombocyte Parameters							
Thrombocytes ($10^3/\mu L$)		**666.79 ± 34.77**			**616.4 ± 30.4**		**0.16 (NS)**
< 250	1		3.45	21		37.5	$8.8 \cdot 10^{-9}$ (S)
250-750	19		65.52	19		33.94	0.001 (S)
> 750	9		31.03	16		28.57	0.75 (NS)

N: Number of sheep by age; n: Number observed in each group of sheep; M: Mean; SEM: Standard error on the mean; %: Percentage; N: Neutrophil; E: Eosinophil; B: Basophil; S: Statistically significant difference for p < 0.05; NS: No statistically significant difference for p < 0.05

DISCUSSION

The determination of biological blood parameters in sheep is of utmost importance. It is the main way to appreciate health and better diagnosis of pathologies in sheep. So, a study was carried out of variations in hematological parameters in small ruminants consumed in the commune of Korhogo in order to appreciate the quality of meat sold on the market. The results of this study showed that hematological parameters vary from one age group to another. Also, these variations were also made according to sex within the same species and same breed which is the Djallonké breed.

The study revealed that hemoglobin abnormalities have been observed in males and females group. Females had a significantly higher rate of hemoglobin disorder (25.37 %) than males (5.56 %). In the same way, these anomalies were present in 20.69% of young sheep against 21.43 % in adults without significant difference. Anemia observed in the subjects of this study can be explained by nutritional or pathological isssue. Our findings are in line with those of some teachers such as Silverman *et al.* [12], Hidiroglou [13] and Martin [14] who reported that the causes of anemia in apparently healthy sheep were due to iron, copper and gastrointestinal parasite (*Haemonchus contortus deficiencies, Trichostrongylus axei, Fasciola hepatica, Mycoplasmas. Trypanosoma congolense*).

This iron and copper deficiency leads to weight loss and a disturbance in erythropoiesis which is manifested by iron deficiency anemia. This anemia can be further aggravated in animals heavily parasitized by digestive endoparasites. In addition. Mawuena [15] reported in his study carried out in Togo and Chad respectively that trypanosomiasis was an anemia-causing infection associated with hemolysis. According to Medal [16], hemolysis is a cause of anemia in sheep due to the fragility of their red blood cells.

Furthermore, the effect of age was not really significant even if the hematocrit rate of young people was slightly higher than that of adults. Our results are similar to observations of Ye [7] in Burkina. Indeed, some factors such as the stress of the rainy season and parasitic infestation explain this trend. Our study found that 98.82 % and 75.29 % of subjects had macrocytosis and hypochromia respectively.

This high proportion of macrocytosis would be due to a deficiency in vitamin B12, in vitamin B9 and in a hepatic pathology or in a parasitosis. On the other hand, a lack of iron is the main cause of hypochromia anemia, the study reported high prevalence of leukocytosis by gender (77.76 % and 77.61 % respectively in males and females) and by age (79.31 % and 76.79% respectively among young people and adults).

This high prevalence has been reported by Mawuena [15] and Kenny [17] in sheep. Furthermore, the factors favoring leukocyte changes are the actions of hemoparasites [1].

In contrast, the prevalence of leukopenia was low in the present study both by sex and by age. Similar study has been done in Senegal [1] has reported the same cases of leukopenia.

Regarding thrombocytes, thrombocytopenia and thrombocytosis were observed in 25.88 % and 29.41 % of sheep respectively. This thrombocytopenia is caused by a dysfunction in the bone marrow which does not produce enough platelets. Certain cancers such as leukemia autoimmune diseases, viral infections, and malignant hemopathies can also cause a drop in thrombocytes. As for thrombocytosis. Infectious diseases. Inflammatory diseases. Cirrhosis or pancreatitis is the most obvious causes.

CONCLUSION
This study showed that the hematological and biochemical parameters varied according to the sex and the age group of the animals. In fact, the vast majority of animals were affected by macrocytosis and hypochromia. Also, neutropenia and monocytosis were observed in more than half of the subjects. It also emerges from this work that the variations in certain parameters were more or less appreciable according to sex.

In fact, no significant difference was noted in the erythrocyte or leukocyte parameters except for the thrombocytes whether in the male or the female. In addition, according to age, no significant variation for all blood parameters even if the hematocrit, leukocyte and thrombocyte levels were more marked in young people than in adults.

These observations confirm the idea that the parameters vary according to the sex or age of the sheep. These variations would be due to several factors intrinsic or extrinsic to animals. This study should be continued by determining the hematological reference values of sheep from Côte d'Ivoire with a much larger sampling.

CONFLICT OF INTEREST
The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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