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### RESEARCH ARTICLE

## SHEEP AND GOATS TOXOPLASMOSIS PREVALENCE IN NORTHERN BORDERS AREAS OF CÔTE D'IVOIRE: CASE OF BAGOUÉ AND TCHOLOGO REGIONS.

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#### Abstract

In order to evaluate the seroprevalence of toxoplasmosis in small ruminants (sheep, goats) marketed in the north of Côte d'Ivoire, an epidemiological survey was carried out from March to September 2018 in Bagoué and Tchologo regions. For that purpose, a total of 300 animals including 152 sheep and 148 goats were sampled in the study area. The sera obtained after treatment of collected blood samples were analysed with a latex particle agglutination test. The results revealed that the overall toxoplasmosis prevalence in small ruminants was 13.33%. Goats antibodies anti-*Toxoplasma gondii* prevalence was 18.24% (95% CI: 12.02-24.47) versus 8.55% (95% CI: 4.11-13) in sheep. The difference observed those prevalences was statistically significant ( $p < 0.05$ ). In contrast, the toxoplasmosis prevalence according to region, department, sex and age in this study all showed nonsignificant differences ( $p > 0.05$ ). Goats are more infected than sheep in Bagoué and Tchologo regions.

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#### Introduction

Toxoplasmosis is a contagious parasitic infection affecting warm-blooded animals including humans [1, 2]. This disease is caused by *Toxoplasma gondii*, an intracellular parasite belonging to sporozoites class [3]. Toxoplasmosis is a zoonotic disease that is often asymptomatic but may be fatal in both humans and animals [4]. In humans, it can cause pulmonary, ocular or even cerebral lesions in immunocompromised persons. On the other hand, contamination of perigravidic women can cause foetal loss or severe brain damage to the new-born [5]. Some authors estimate that about one-quarter to one-third of the human population has toxoplasmosis [6, 7]. In Africa, this disease prevalence remains high in many countries. In South Sahara countries, pregnant women toxoplasmosis prevalence varies from one country to another. It is 34.5% in Senegal [8], 60% in the Central men and

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In animals, this disease is one of the main causes of abortion or stillbirth [11, 12, 13]. It causes significant economic losses, particularly in domestic small ruminants [14, 15]. Numerous studies have shown that animals are one of the main sources of human contamination [16, 17]. In view these epidemiological data and its impact on public health, many countries in the world carry out epidemiological surveillance of this zoonosis both in humans and animals. However in Africa, this surveillance in animals is not always systematic because this disease is not always a priority disease.

In Côte d'Ivoire, epidemiological investigations are frequent in humans but poor in animals. The most recent studies on animal toxoplasmosis date back to 1996. According to this survey realised with 60 small ruminants sampled at Abidjan slaughterhouse, the overall prevalence of toxoplasmosis was estimated at 68% [18]. The present study provides an overview of the current status of this disease in small ruminants in northern Côte d'Ivoire, taking into account the risk factors as animal species, sex, age and location.

## Material And Methods

### Sampling

The sample size used in this survey was determined from the following formula proposed by OMS [19]:

$$n = \frac{t^2 \times p(1-p)}{e^2}$$

n = sample size; t = 1.96 for a confidence level of 95%; p = estimated toxoplasmosis prevalence. p = 25% in this study; e = margin of error set at 5%.

Based on this formula, the calculated sample size was n = 288. This number has been rounded up to 300 samples taking into account possible sample losses. These samples were evenly distributed across the 2 regions. Thus, in each region, two departments were selected: the department of the regional capital and the border department of Mali and/or Burkina Faso. In each department, 75 small ruminants constituted by 37 goats and 38 sheep were sampled. These animals were selected from local small ruminant markets regardless of gender, age and race. On each animal, 10 ml of blood was collected from the jugular vein and centrifuged for 15 min at 4000 rpm. The sera thus obtained were stored at -20 °C until the serological tests were carried out.

### Serological test

Detection of the presence of anti-Toxoplasma gondii antibodies was performed using the latex agglutination test (Toxocell latex, BIODIA, S.A. BARCELONA -SPAIN). This test was used according to the manufacturer's instructions.

### Data Processing and Analysis

The risk factors considered in this study are age, sex, specie, region's and department's locations. The prevalence (P) was calculated using the following formula:

$P = (n / N) * 100$ , with n = number of positive samples and N = total number of samples analyzed.

The analysis of the data was carried out by the chi-square independence test or Fisher's exact test of the R version i386 3.2.4 software. Differences in prevalence were considered significant for p value <0.05.

## Results

### Sampling results

The distribution of sampled animals by age group, sex, specie and location is shown on Table I. Globally, the predominance of small ruminants' male older than 1 year was observed in the sampled animals. In sheep, more males than females were observed, whereas this trend was reversed in goats. With regard to age, animals belonging to the age group of more than 1 year were less sampled in goats, which was the reverse in sheep.

### Toxoplasmosis global prevalence in small ruminants

Of the 300 small ruminants sampled, 40 (13.33%) had anti-Toxoplasma gondii antibodies. The seroprevalence of toxoplasmosis in the 2 studied regions was respectively 14.67% (95% CI: 9.01-20.33) and 12% (95% CI: 6.8-17.20) in Tchologo and Bagoué regions (Table II). However, the difference in overall toxoplasmosis prevalence in these areas was not significant (p > 0.05). The same was true for risk factors such as sex, age and localities that did

not show a significant influence on the overall small ruminants toxoplasmosis prevalence ( $p > 0.05$ ). However, this study found higher toxoplasmic seropositivity in goats (18.24%, 95% CI: 12.02-24.03) than in sheep (8.55%, 95% CI: 4.11-13). The difference in toxoplasmosis prevalence of these 2 species was significant ( $p < 0.05$ ).

#### Toxoplasmosis specific prevalence in small ruminants

In this study, female sheep Toxoplasmosis seroprevalence (9.62%; 95%CI: 1.6-17.63) appeared to be higher than in males (8%; 95% CI: 4.11-15). However, this difference was not statistically significant ( $p > 0.05$ ). This same trend was observed in animals older than the year, animals coming from the departments close to the borders. The differences in prevalence observed according to these risk factors were not significant ( $p > 0.05$ ). In other words, no risk factor studied significantly influenced seropositivity in sheep.

In goats, the toxoplasmosis seroprevalence appeared to be higher in females (22.47%; 95%CI: 15.87-32.18) and older animals (21.79%; 95%CI: 12.63-30.96) than in males (11.86%; 95% CI: 5.87-22.52) and younger animals (14.0%; 95% CI: 6.09-22.48). However, these differences in prevalence are not significant. It was the same for caprine toxoplasmosis prevalence according to the regions and the location of selected departments for this study ( $p > 0.05$ ).

**Table 1:** Sample distribution's by sex, age, animal species and locality

REGION	LOCALITY	SPECIE	SEX		AGE	
			Male Nb(%)	Female Nb(%)	≤ 1 AN Nb(%)	>1 AN Nb(%)
Bagoué's Region	Boundiali	sheep	24 (63.15)	14(36.85)	17(44.73)	21(55.27)
		goats	15(40.54)	22(59.45)	22(59.45)	15(40.54)
	Tengrela	sheep	17 (44.74)	21(55.26)	7( 18.42)	31(81.58)
		goats	12 (32.43)	25(67.57)	14(37.84)	23(62.16)
	<b>Subtotal</b>		<b>68 (45.33)</b>	<b>82(54.67)</b>	<b>60(40)</b>	<b>90(60)</b>
Tchologo's region	Ferké	sheep	28(73,68)	10(26,32)	19(50)	19(50)
		goats	15(40.54)	22(59.46)	22(59.46)	15(40.54)
	Ouangolo	sheep	31(81.58)	7(18.42)	9(23.68)	29(76.32)
		goats	22(40.54%)	15(40.54%)	24( 64.86)	13(35.14)
	<b>Subtotal</b>		<b>96(64)</b>	<b>54(36)</b>	<b>74(49.33)</b>	<b>76(50.67)</b>
Study zone	Total	sheep	<b>100 (65.79)</b>	<b>52 (34.21)</b>	<b>52 (34,21)</b>	<b>100 (65,79)</b>
		goats	<b>64 (43.24)</b>	<b>84 (56.76)</b>	<b>82 (55.40)</b>	<b>66 (44.60)</b>
		small ruminants	<b>164 (54.67)</b>	<b>136 (45.33)</b>	<b>134 (44.67)</b>	<b>166 (55.33)</b>

**Table 2:** Overall toxoplasmosis prevalence in small ruminants

Risk Factors	small ruminants			seroprevalence		p value
	sample	%	positive	%	95% CI	
Sex	Female	141	47,00	25	17,73	11,43-24,03
	Male	159	53,00	15	9,43	4,89-13,98
Age	<1 year	122	40,67	12	9,84	4,55-15,12
	> 1 year	178	59,33	28	15,7	10,38-21,08
Specie	sheep	152	50,67	13	8,55	4,11-13
	goat	148	49,33	27	18,24	12,02-24,03
Region	Tchologo	150	50	22	14,67	9,01-20,33
	Bagoué	150	50	18	12	6,8-17,20

<b>Department</b>	Border	150	50	24	16	10,13-21,87	0,23
	No Border	150	50	16	10,67	5,73-15,61	

**Tableau 3:** prévalence spécifique de la toxoplasmose chez les petits ruminants

	<b>Risk factor</b>	<b>Sub-population</b>			<b>seroprevalence</b>		<b>P value</b>	
		<b>sample</b>	<b>%</b>	<b>positive</b>	<b>%</b>	<b>95%CI</b>		
sheep	Sex	Female	52	34.21%	05	9.62	1.6-17.63	0.76
		Male	100	65.79%	08	8	4.11-15	
	age	< 1 year	52	34.21%	02	3.85	0.47-13.21	0.22
		> 1 year	100	65.79%	11	11	4.87-17.13	
	region	Tchologo	76	50.00%	07	9.21	4.53-17.81	1
		Bagoué	76	50.00%	06	7.89	3.67-16.17	
	department	border	76	50.00%	09	11.84	4.58-19.11	0.24
		no border	76	50.00%	04	5.26	1.45-12.93	
goat	Sex	Female	89	60.14%	20	22.47	15.04-32.18	0.15
		Male	59	39.86%	7	11.86	5.87-22.52	
	age	< 1 year	70	47.30%	10	14.29	6.09-22.48	0.3
		> 1 year	78	52.70%	17	21.79	12.63-30.96	
	region	Tchologo	74	50.00%	11	21.62	8.51-24.69	0.39
		Bagoué	74	50.00%	16	14.86	13.77-32.27	
	department	border	74	50.00%	15	20.27	11.11-29.43	0.67
		no border	74	50.00%	12	16.22	7.82-24.61	

## Discussion

This study realised in the north of Côte d'Ivoire revealed that the overall small ruminants' toxoplasmosis seroprevalence is 13.33%. The prevalence of *T. gondii* in sheep (8.35%) is significantly smaller ( $p < 0.05$ ) than in goats (18.42%). These results are similar to those obtained in Pakistan [20]. These authors noted a prevalence of 25.4% in goats versus 11.1% in sheep. The difference observed in toxoplasmosis seroprevalence of these species can be explained by a greater sensitivity of local goats breed to the toxoplasmic infection. That can also be due to the essentially extensive rearing system used locally for these animals. Our results are contrary to those observed in Ghana [21] and at El-Gadarif in Sudan [22]. These authors obtained respectively 33.2% and 56.8 to 58.4% of Toxoplasma seroprevalences in sheep versus 26.8% and 45.3 to 48.6% in goats.

Otherwise, the seroprevalence observed in sheep (8.35%) in our study is lower than that reported in Senegal (46.3%) [23], in Ghana (33.2%) [21], in Egypt (43.7%) [24], in Ethiopia (31.59%) [25], in (71%) Libya [26] and in Nepal (36.17%) [27]. However, this prevalence is higher than that observed in South Africa (4.30%) [28], in Nigeria's Borno State (4.6%) [29] and in Tunisia (10.85%) [30].

Regarding goats, the toxoplasmosis seroprevalence observed in this study (18.24%) is higher than that found in Borno State in Nigeria (4.6%) [29] and South Africa (8%) [31]. However our results are inferior to those found in Zimbabwe (68.58) [32], in Ethiopia (19.70%) [33], in Tanzania (19.30%) [34] and in Egypt (64%) [35]. The seropositivity differences observed between those countries or different areas can be explained, on the one hand by the performances (sensitivity and specificity) of diagnostic technics used. On the other hand these differences can be due to the influence of risk factors such as the level of contamination of the environment by *T. gondii* oocysts, climate and/or livestock systems.

The results of this study showed that there is no significant difference ( $p > 0.05$ ) between the toxoplasmosis seroprevalence of small ruminants females than males' although females appear to be more infected than males.

These results are similar to those obtained in Burkina Faso [36]. However, these outcomes differ from those made in Ghana which reported that small ruminants' females are more susceptible to protozoan parasites than males [21]. In the same way, this study showed no significant difference ( $p < 0.05$ ) between the toxoplasmosis seroprevalence according to the different age groups. This observation is contrary to those made in both sheep and goats by many authors. According to the latter, the risk of ingestion of these oocysts increases with the animal's age [21, 37, 38].

## Conclusion

At the end of this study, it appears that the seroprevalence of toxoplasmosis exists in domestic small ruminants marketed in the Bagoué and Tchologo regions. The prevalence of caprine toxoplasmosis was statistically higher ( $p < 0.05$ ) than sheep's. In addition, no significant difference was found between sex, age and location with seropositivity in sheep and goats. These results may be related to the performance of the diagnostic test and the sample size. The anti-*Toxoplasma gondii* antibodies seroprevalence found in this study suggests that goats are widely exposed to toxoplasmosis compared to sheep in northern Côte d'Ivoire. Given the increasing importance of goat meat consumption in Côte d'Ivoire and particularly in the north of the country, it would be wise to carry out more refined complementary studies to accurately determine the prevalence of toxoplasmosis in ruminants. It will be also necessary to evaluate the risk of transmission to humans related to the consumption of this meat.

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