CRYPTOSPORIDIUM INFECTION IN CATTLE, GOAT AND RAM IN YENAGOA ABATTOIR BAYELSA STATE, NIGERIA

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ABSTRACT

Cryptosporidium infection is of significant public health importance and its transmission is principally anthroponotic as a result of close contact between humans and animals. This study investigated Cryptosporidium infection in cattle, goats, and ram in Yenagoa, Bayelsa State, Nigeria. A total of 211 faecal samples from cattle, goats, and rams were collected and examined for the presence of Cryptosporidium oocyst using modified Kinyoun's acid-fast staining method. The overall infection was 57.82 % with an infection rate of 58.00 % in cattle, 57.00 % in goats, and 63.64 % in rams respectively. There was no statistical significant difference (x^2 = 0.18, p = 0.91) among the various animals. Cattle and rams sampled were all adult males, while the goats were male and female with different age groups. An infection rate of 56.16 % in adult goats of 4 – 5 years and 59.26 % in young goats within the age range of 0 – 3 years. There was no statistical difference (X^2 = 0.08; p = 0.78) between the age groups. More males (59.09 %) were infected than females (52.94 %). There was no statistical difference (X^2= 0.35; p = 0.56) between the sex distribution. The study has shown that cattle, goats, and rams in Yenagoa abattoir harbour Cryptosporidium oocysts which have a zoonotic consequence if not controlled as the meats from animals are eaten freely as a source of protein. Strict sanitation by proper sewage and animal dung disposal is required to prevent and control the spread of this infection.

Keywords: *Cryptosporidium* infection, Goats, Cattle, Rams, Zoonosis, Nigeria

INTRODUCTION

Cryptosporidium Tyzzer, 1907 (Eucoccidiorida: Cryptosporidiidae) is an obligate intracellular protozoan parasite of medical and veterinary significance that infects all classes of vertebrates (Odeniran and Ademola, 2019). It is of great public health significance and causes cryptosporidiosis in animals and humans which infect the gastrointestinal tract. The infection causes severe diarrhoea in an immune-compromised host (Huang and White, 2006).

Cryptosporidium is ranked the second cause of severe diarrhoea globally, and a prominent cause of mortality in young children, with estimated 800, 000 deaths yearly and approximately three million infections detected, most happening in sub-Saharan Africa and South Asia (Liu *et al.,* 2012; Kotlof *et al.,* 2013; Sow *et al.,* 2016). *Cryptosporidium* is rated fifth among the 24 most significant foodborne parasites (FAO/WHO, 2012).

Some of the zoonotic *Cryptosporidium* species usually cause self-limiting diarrhoea in human and animals and could be of a great health concern worldwide (Castro-Hermida *et al.,* 2002; Cacciò *et al.,* 2005). Studies have revealed that there are two main species commonly detected: *Cryptosporidium hominis* Morgan-Ryan *et al.* (2002) (Eucoccidiorida: Cryptosporidiidae) and *C. parvum* Tyzzer, 1912 (Eucoccidiorida: Cryptosporidiidae) infecting

humans of which *C. parvum* is more ubiquitous (Fayer and Xiao, 2007). The most susceptible species of animals to *Cryptosporidium* infection is cattle and they are an established source of zoonotic cryptosporidiosis (Kinross *et al.,* 2015).

In Nigeria, *Cryptosporidium* has been reported to be a significant agent of diarrhoea among immune-competent patients in our hospitals (Tariuwa *et al*., 2007; Abdullahi *et al.,* 2020). The infectious stages of the organism oocytes are shed in the faeces of infected animals and it is typically an acute short-term infection. *Cryptosporidium* infection is spread through the faecal-route, often through contaminated water and food (Gerace *et al*., 2019). Hence detected in surface water in Abakaliki (Uneke and Uneke, 2007), among children who were in contact with stream in Ogun State (Egberongbe *et al*., 2010), contamination of various vegetables in Kaduna State (Maikai *et al*., 2013), and in soil from Ibadan, Oyo State (Adekeye *et al*., 2016).

In Africa, cryptosporidiosis is a major contributor to paediatric morbidity and mortality, and evidence suggests transmission is principally anthroponotic. This is as a result of the frequent close contact between humans and animals, but human-to-human transmission also occurs (Robertson *et al*., 2020).

In Nigeria, there are some zoonotic reports of *Cryptosporidium* species infecting humans and animals (Ayinmode and Fagbemi, 2010; Molloy *et al*., 2010; Adamu *at al*., 2015; Anejo-Okopi, 2016; Odeniran and Ademola, 2019). However, there is a low perception of cryptosporidiosis in Nigeria, and its true burden is under-estimated. The predisposing factors of cryptosporidiosis such as sanitation, the close association of humans and livestock as well as ability of run-off from animal production operations to contaminate water supplies represent an ever-present risk of human infection. Thus frequent update on the prevalence of disease within a particular region is required for the control and management of such diseases. This study aimed to investigate *Cryptosporidium* infection in cattle, goats and rams in Yenagoa abattoir Bayelsa State, Nigeria.

MATERIALS AND METHODS

Study Area: The study area was the Yenagoa-Swali market abattoir (4054144 N, 6016119 E) located in Yenagoa Local Government Area of Bayelsa State, Nigeria (Figure 1).

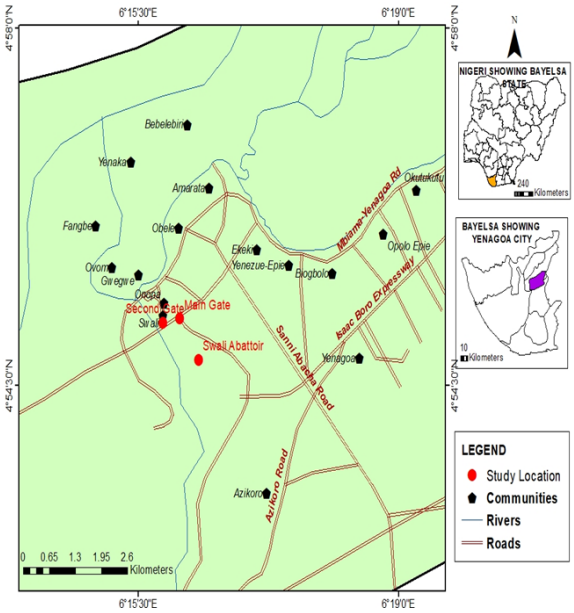

Figure 1: Map of study location in Yenagoa-Swali Mega Market (Cartography Unit, Department of Geography, University of Port Harcourt)

Bayelsa State is in the South Southern part of Nigeria. The state has a riverine and estuarine setting. Many communities are almost surrounded by water. The state has a total area of 10,773 kilometres, with a 2022 projected population of 2,394,725 persons (Wikipedia, 2022). The rainy season normally begins from April to September with its peak in August and dry seasons are from November to March. The annual temperature is about 26° to 31°C.

The abattoir is located in the Swali community very close to the Ekoli Creek. It is the largest abattoir in Bayelsa State where the slaughtered animals are distributed to other smaller markets within the state for sale. Some of the inhabitants make use of the water mainly from the river for bathing, cooking, and other domestic work. The butchers also wash off the blood and intestines of slaughtered animals and dispose the non-valuable parts of the animals in the river.

Study Design/Population: It was a cross-sectional survey involving a total number of 211 animals (100 cattle, 100 goats, and 11 rams) examined during the study which lasted from September to November 2021. The animals examined were all adults.

Sample Collection: Faecal samples were collected from individual cattle, goats, and rams by the use of disposable plastic bags and transferred into universal sample bottles with a tight lid and labelled appropriately. The faecal samples were preserved with 10 % formalin. These were then transported to the laboratory where analysis was carried out immediately.

Formal Ether Concentration Method: One (1) g of faecal sample was emulsified in 10 % formal saline in a universal bottle using an applicator stick. The faecal suspensions were then sieved and allowed to stand for one hour to 24 hours. The supernatant was decanted and a thin smear was made from thoroughly mixed sediment on a clean glass slide and air-dried (Cheesbrough, 2005).

Modified Kinyoun's Acid-Fast Staining Method: A drop of faecal suspension was placed on a clean and dry glass slide and spread to make a thin smear. Slides were air-dried and fixed in methanol for 1 minute and then flooded with carbol Fuchsin for 15 – 20 minutes. Following rinsing, the slides were decolorized in 3 % acid-alcohol for between 15 seconds and 1 minute. Slides were then rinsed and counterstained with methylene blue for 30 seconds, then rinsed again and air-dried (El-Moamly and El-Sweify, 2012).

Detection of *Cryptosporidium* Oocyst: Each slide was examined using a light microscope at x40 and x100 (oil immersion object magnification). The cryptosporidial oocysts appeared as small spherical to oval, bright pinkish-red structures with a halo, against a blue background (El-Moamly and El-Sweify, 2012).

Statistical Analysis: The data were analyzed using the Chi-square test to compare the prevalence of *Cryptosporidium* oocysts between cattle, goats, and rams.

RESULTS AND DISCUSSION

The overall prevalence of the infection in the three different groups of animals in this study was 57.82 %. There was no significant difference ($p>0.05$) between the infection in the different groups of animals ($X^2 = 0.18$, $P = 0.91$) (Table 1).

Table 1: Overall cryptosporidium infection in cattle, goat and ram in Bayelsa State, Nigeria

Animals	Number Examined	Number Infected (%)	χ^2	P
Cattle	100	58(58.00)		
Goats	100	57(57.00)		
Ram	11	7(63.64)		
Total	211	122(57.82)	0.18	0.91

This high percentage of infection was an important factor in cryptosporidiosis infection in Bayelsa State. The result showed that cattle, goats and rams are susceptible to *Cryptosporidium* infection, although there was no significant difference ($p>0.05$) among the various animals. This high prevalence has been shown to have a significant impact on the health of goats' especially neonatal 4 – 15 day-old goat kids, causing diarrhea, dehydration, and electrolyte imbalance (Fayer and Xiao, 2007). Also, the high prevalence is significant because cryptosporidiosis results in economic losses, due to its high morbidity and mortality rates. This finding reinforced the fact that cattle, goats, and rams may serve as reservoirs of *Cryptosporidium* for human infection (Mammeri *et al.,* 2019). More so because outbreaks of infection with *Cryptosporidium* associated with contact with such animals have been reported (Tariuwa *et al.,* 2007).

The overall infection of 57.8 2 % of *Cryptosporidium* in cattle, goats and ram obtained in this study was higher than 23.4 % reported for cattle from the southwest part of Nigeria (Ayinmode and Fagbemi, 2010), 23.3 % reported for cattle from Maiduguri, North Eastern Nigeria (Adamu *et al.,* 2015), and 24.0 % reported in goats from Jos, North Central,

Nigeria (Pam *et al.,* 2013). The variations in the infection may be due to sampling size, climate, age of animals, geographical region, diagnostic methods used, hygiene conditions, and management practices.

From the study, cattle, goats, and rams were shown to harbour the organism or parasite. This suggests a risk potential for anyone that eats raw and partially cooked meats from these animals since it is a source of protein that is required by all especially those that can afford it.

In this present study, 58 % of the examined cattle, 57 % of the examined goats as well as 63.64 % of the screened rams, had *Cryptosporidium* infection. The difference between infections in the animals was not significant, suggesting that none of the animals was more susceptible than the other since they had the same level of exposure and other environmental conditions.

***Cryptosporidium* Infection in Cattle:** Out of 100 faecal samples screened, 58(58.00 %) cattle were found positive for cryptosporidiosis (Table 1). All the faecal samples collected were from an adult and all-male for the period of collection females and young calves were absent. The rate of *Cryptosporidium* infection in cattle obtained in this study was higher than the overall prevalence (23.4 %) of *Cryptosporidium* in cattle surveyed from different farms in Oyo State, Nigeria (Ayinmode and Fagbemi, 2010), 35 % of calves in the United States of America (Santín *et al.,* 2004) and 36 % of cattle in Germany (Joachim *et al.,* 2003). The variations in infection may be due to sampling size, level of exposure, other environmental conditions, and age of animals.

***Cryptosporidium* Infection in Goat:** Out of the 100 faecal samples screened, 57(57.00 %) of the goats were positive for cryptosporidiosis (Table 1). The infection rate with *Cryptosporidium* spp. was higher in adult goats between the age of 4 – 5 years with a prevalence of 41(56.16 %), while in the young goats, between 0 – 3 years of age had prevalence rate of 16(59.26 %). There was no statistical significant difference ($p>0.05$) between the age group ($X^2 = 0.08$, $P = 0.78$) (Table 2).

Table 2: Distribution of *Cryptosporidium* infection in goats in Bayelsa State, Nigeria based on age

Age Groups	Number Examined	Number Infected (%)	χ^2	P
0 – 3 years	27	16(59.26)		
4 – 5 years	73	41(56.16)		
Total	100	57(57.00)	0.08	0.78

Based on sex distribution, the highest infection was found in males 39(59.09%), while in females, the infection was lower, 18(52.94 %) respectively. There was no statistical significant difference ($X^2 = 0.35$; $P = 0.56$) between the sex of the animal tested (Table 3).

Table 3: Distribution of *Cryptosporidium* infection in goats in Bayelsa State, Nigeria based on sex

Sex	Number Examined	Number Infected (%)	χ^2	P
Males	66	39(59.09)		
Females	34	18(52.94)		
Total	100	57(57.00)	0.35	0.56

The prevalence of *Cryptosporidium* infection found in goats in the Swali Mega Market Abattoir in Bayelsa State, was higher than 17.1 % prevalence reported for goats in Kebbi State (Danladi and Ugbomoiko, 2015), 24.0 % reported for goats from Jos, Nigeria (Pam *et al.,* 2013) and 12.2 % prevalence in calves, lambs and kids from Haramaya, eastern Ethiopia (Regassa *et al.,* 2013), but was lower than 72.5 % recorded in small ruminants from Veracruz, Mexico (Romero-Salas *et al.,* 2016). The differences in the infection rate of *Cryptosporidium* in goats in a different region may be due to the differences in the level of contamination of the environment with oocyst of the parasite. It is also possible that the quality hygienic condition of the lairage section of the abattoir may have influenced the exposure of animals to *Cryptosporidium* infection.

***Cryptosporidium* in Ram:** Out of the eleven (11), 7(63.64 %) rams were found positive for cryptosporidiosis (Table 1). Despite the low number of ram in slaughtered Bayelsa State, Nigeria, the result revealed a higher percentage of *Cryptosporidium* infection. The finding was higher than 16.0 % of infections in sheep reported by Pam *et al*. (2013) and 16.6 % reported by Odeniran and Ademola (2019). Other studies reported infection rates in lambs lower than those reported in this study. Akinkuotu *et al.* (2014) reported 28.7 % among sheep in Abeokuta, Nigeria. Prevalence of 29.8, 30.5 and 49 % respectively were reported by Pritchard *et al.* (2008) in lambs on a farm open to the public in England and Wales. The infection rate in this study was in agreement with Santín *et al.* (2007) who reported 77.4 % prevalence using PCR of *Cryptosporidium* in lambs from Maryland.

***Cryptosporidium* Infection Based on Sex:** The infection rate of *Cryptosporidium* was higher in male goats than in female goats 39(59.09 %) and 18(52.94 %) respectively (Table 2). There was no statistically significant difference ($p>0.05$) between the rate of infection and sex distribution ($X^2 = 0.35$; $P = 0.56$). The study was similar to the findings of Maikai *et al.* (2013), Ragassa *et al.* (2013) and Akinkuotu and Fagbemi (2014). This may be because males are more likely to disperse to other colonies or be moved to other pens especially when the females are in heat thereby promoting the dissemination of the oocysts (Abare *et al.,* 2018).

***Cryptosporidium* Infection Based on Age:** There was no statistically significant difference between the rates of infection in goats based on age distribution ($X^2 = 0.08$; $P = 0.78$) (Table 3). The infection rate was higher amongst the younger goats between the age ranges 0 – 3 years 16(59.26 %) than the adult ones within the age range 4 – 5 years (Table 3). This study was in line with those made by Bollam (2005), Jeyabal and Ray (2005) and Azami (2007) who reported a higher rate of infection among younger ruminants. The high rate of infection among the younger age group may be because *Cryptosporidium* is considered a problem in new-born farm animals (Ayinmode and Fagbemi, 2010).

Conclusion: The study has shown that cattle, goats, and rams in Yenagoa abattoir harbour *Cryptosporidium* oocysts which have a zoonotic consequence if not controlled, as the meats from animals are eaten freely as a source of protein. Strict sanitation by proper sewage and animal dung disposal is required to prevent and control the spread of this infection.

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