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PREVALENCE AND RISK FACTORS OF ANAPLASMOSIS IN CATTLE SLAUGHTERED AT CENTRAL ABATTOIR BAUCHI, BAUCHI STATE, NIGERIA

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Abstract

This study was conducted to determine the prevalence and risk factors of Anaplasmosis affecting cattle in Bauchi state. The study was conducted between the months of May 2021 and January, 2022. Samples obtained were screened for *Anaplasma specie* by examining Giemsa stained thin blood films. An overall prevalence of 42.4% was recorded out of the 384 cattle sampled. Different risk factors which include age, sex, breed, management system and ticks infestation were considered during sample collection. Among these factors, management system {158(96.9%)}, season {129(79.1%)}, and ticks infestation {133(81.6%)}, were found to be significantly associated with positivity for anaplasmosis ($p < 0.05$) while age, sex and breed were found to have non-significance ($p > 0.05$) effects on the occurrence of the disease. The highest prevalence of anaplasmosis was recorded in adult animals 123(75.5%) followed by young animals 30(18.4%) and old animals 10(6.1%). The prevalence of anaplasmosis based on sex of the study animals was found to be insignificantly higher in female 133(81.6%) than in male 30(18.4). Findings from this research

Keywords:
Anaplasmosis, Risk factors, Prevalence, Cattle, Nigeria

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shows that Anaplasmosis is prevalent in Bauchi state and several risk factors were found to be associated with the disease in the state. This is of great public health importance as morbidity and mortality in the affected animals leads to great economic loss in the cattle industry. More stringent and effective control measures should therefore be put in place to reduce to the barest minimum the occurrence and high prevalence of the infection in the study area.

Introduction

Anaplasmosis, formerly known as gall sickness, traditionally refers to a disease of ruminants caused by obligate intraerythrocyticparasite of the order Rickettsiales, family *Anaplasmataceae*, genus *Anaplasma*. Anaplasmosis in cattle was first reported by Patnaik (1963) in Odisha, India, and subsequently, the pathogenic species *A. marginale* and *Anaplasma bovis* have been identified affecting cattle (Nair *et al.,* 2013; Sharma *et al.,* 2015; George *et al.,* 2017).The disease is characterized by malaise, emaciation, fever, severe anemia, pale mucous membranes, lethargy, icterus and decreased milk production and often death in animals older than two years (Kocan *et al*., 2003).

Junsiri *et al*. (2020), reported that bovine anaplasmosis primarily caused by *A. marginale*, is considered as one of the most prevalent and costly tick-borne diseases of cattle globally and Ramabu *et al.* (2018) reported that it is endemic in most of the cattle-farming areas in Africa.

The prevalence rate of Anaplasmosis reported around the world varies depending on geographic locations. Widespread distribution of *Anaplasma marginale* may be associated with the tropical and sub-tropical climate common in Africa which supports the vector ticks *Rhipicephalus (booophilus)* species (Radostits, *et al*., 2007). The *Anaplasma* genus is comprised of six species that exhibit versatility in cell tropism and in the preferential selection of hosts (Dumler *et al*., 2001). The red blood cells of cattle and wild ruminants are chosen by *A. centrale and A. marginale* as a site of infection, while small ruminants presenting the same cells to be infected are encountered by *A. ovis*. *Anaplasma bovis* causing Anaplasmosis, targets small mammals and ruminants, which results in the infection of monocytes. Infection is prevalent in different regions of the world with a variable prevalence rate of 3.94 to 39.80% and 9 to 15% in domestic ruminants and wild cervids respectively and the prevalence rate is dependent on the type of species infected and the diagnostic method used (Belkahia *et al*., 2015).

Both Abiotic and biotic factors can be risks factors which influences the occurrence of anaplasmosis. The abiotic factors include seasonality, geographic location, climatic conditions and management practices while biotic factors are age, breed, sex, tick infestation and physiological status (Said *et al*., 2018). Some of the abiotic factors

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influence distribution of the tick vectors and thereby the associated pathogens (Tembo *et al*., 2018). Important management factors in smallholder dairy farms include housing, sources of feeds, parasite control and biosecurity measures (Ybanez *et al*., 2013). Management factors especially stressors due to housing and nutrition have been shown to influence the animals' immunity thereby the response to infection (Abuelo, 2020). Mugambi *et al*. (2012), reported that Acaricide application, frequency of application as well as the presence of the tick vectors have an influence on the occurrence of Anaplasmosis. Belkahia *et al*. (2015) also reported that increased *Anaplasma* infections in farms with poor management practices, animal movement and presence of wildlife are also potential risk factors for the infection.

Despite being emerging diseases worldwide with increasing number of cases and the substantial economic burden with livestock infection, Anaplasmosis have not been well investigated and there is paucity of information available regarding the disease in Bauchi state. Anaplasmosis has been overshadowed by other haemoparasitic diseases like Babesiosis and Trypanosomiasis and therefore it is a neglected haemoparasitic infection in the state. Livestock industry is an integral part of the economy, and despite the fact that a major proportion of the human population in Bauchi state is involved in the livestock industry, detailed information regarding disease prevalence, risk factors as well as prevention, management practices and control strategies is lacking. Because of the developing pathogenicity in farm animals and to a lesser extent in people, among other *Rickettsiales*, the genus *Anaplasma* demands special attention. This study aims to detect *Anaplasma specie* in blood samples of cattle slaughtered in the Bauchi state and to determine the prevalence and risk factors of Anaplasmosis in the study area. The results of this study provides information on the prevalence of *Anaplasma spp*. infections in cattle in Bauchi state Nigeria

METHODOLOGY

Sample Collection

The study was conducted between the months of May 2021 to January 2022 at the Bauchi central abattoir. Most of the cattle slaughtered in this abattoir were from neighbouring towns; Alkaleri, Gadan Maiwa, Mararraban Liman Katagum, and Soro. However, some were often supplemented from other rural cattle markets within the state. The abattoir has an average daily sacrifice of 50 cattle.

The sample size for the study was determined by the formula given by Thrusfield (2005).

$$N = \frac{Z^2 P (1 - P)}{d^2}$$

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A total of 384 blood samples were collected from the study animals. Blood samples were collected randomly and aseptically from the severed jugular vein of the cattle slaughtered at point of slaughter at the abattoir. Study animals were selected using simple random sampling method from animals brought to the abattoir for slaughter regardless of their health status.

Relevant data such as age, sex, breed, management system, presence or absence of ticks and season were recorded using a semi-structured Questionnaire before collection of samples. The age of the animals was determined based on owners' information and as described by De-Lahunta and Habel (1986). Ticks present on the animals bodies were also collected and taken to the laboratory for identification. Collected blood samples and the ticks vectors were transported immediately to the Parasitology laboratory, Abubakar Tafawa Balewa University Bauchi for analysis within six hours of collection.

Ticks collection and Identification

Presence of ticks were examined in the sampled cattle. The body of each sampled cattle was thoroughly examined and ticks found to be attached to the cattle were picked taking safety measures not to break the mouth parts. After collection, they were stored in labelled containers containing 10% ethanol before they were transported to the Parasitology Laboratory of the Abubakar Tafawa Balewa University Bauchi. Morphological identification of the ticks was done to specie level based on taxonomic keys by Walker *et al*. (2014) using a dissecting microscope. The taxonomic keys used were; colour, shape, and size of capitalum, eyes, presence or absence of festoons, position of anal groove spur of coxa and presence or absence of adanal shield. Each identified tick was stored in a labelled collection tube containing 10% ethanol.

Parasitological Examination

Anaplasma spp were detected using Giemsa stained thin blood film as described by Cheesbrough (2010). Blood smear was prepared from each blood sample by placing a drop of blood on one end of a clean standard microscope glass slide (75 mm by 25 mm), a spreader was used to spread the blood by allowing the spreader to touch the blood and spread gently but firmly along the surface of the horizontal slide so that the blood is dragged behind the spreader to form the film with a feathered edge, air dried and fixed in methanol for 3-5 minutes stained in 1:10 Giemsa and Buffer dilution stain for 25 - 30 minutes and rinsed with distilled water and then allowed to dry. The smears were examined at x100 objective lens (oil immersion) for presence of parasites and identification of as described by Cheesbrough (2010). A minimum of 50 fields was searched per slide in each of the procedures adopted.

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RESULTS

Prevalence of *Anaplasma spp* encountered from the samples in the study area

Out of the three hundred and eighty four cattle examined, 163 (42.4%) were found to be infected with Anaplasmosis while 221 (57.6%) were negative for the infection (Table 1).

Table 1: Prevalence of Anaplasmosis in cattle in Bauchi state

Sample	No. of samples Examined	No. (%) samples Positive
Blood	384	163(42.4)

Frequency of *Anaplasma* infection according to the months of sample collection in the study area.

Distribution of infection with Anaplasmosis based on the months in which samples were collected shows that prevalence increases from the months of May onwards and it is highest in August after which prevalence rates falls and decreases towards the Months of December and shows the least in January(Figure 1).

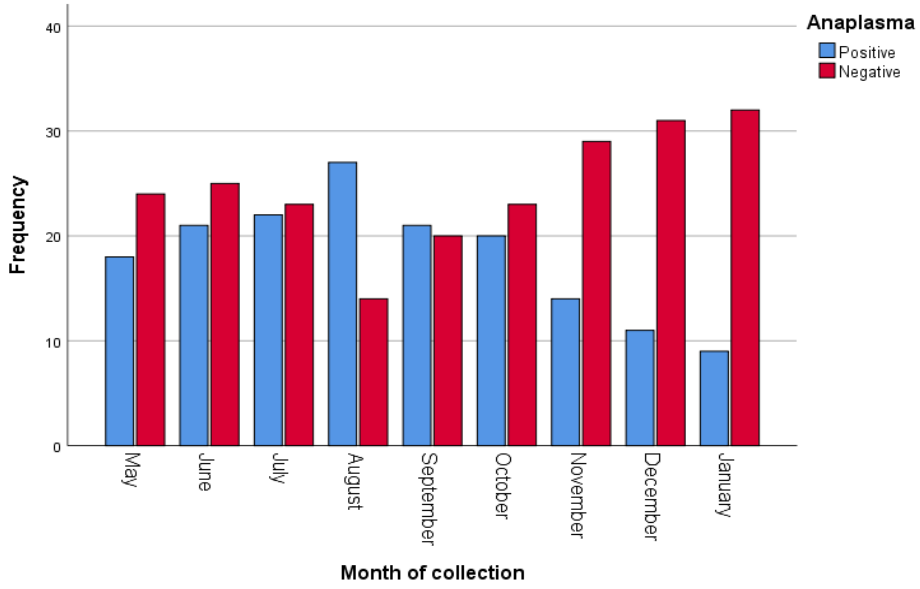


Figure 1: Distribution of *Anaplasma* infection according to the months of sample collection in the study area

Prevalence of *Anaplasma* Infections in Relation to Sex of Cattle Examined.

Three hundred and eleven female (311) and seventy three male (73) cattle were sampled and examined for the presence of *Anaplasma spp.* Thirty (18.4%) male cattle examined were infected while one hundred and thirty three (81.6%) of the female

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cattle examined were found to be infected with Anaplsamosis as shown in table 2. The prevalence of infection among male and female cattle was found not be statistically significant (p>0.05).

Table 2: Prevalence of Anaplasmosis based on sex of cattle examined during the study

Sex	No. Examined (n=384)	No. (%) Positive 163(42.4)
Male	73	30(18.4)
Female	311	133(81.6)

X^2 cal=0.67, pcal= 0.795, p>0.05 *statistically not significant

Prevalence of Anaplasmosis based on age of cattle examined

Age prevalence among cattle examined in this study showed that, the prevalence of *Anaplasma spp* was higher in Adult cattle age 3-5 years (75.5%) and the lowest prevalence was recorded in older cattle aged 6 Above which had a prevalence of 6.1%. while young cattle age less than 3 years had a prevalence of 18.4% as shown in table 3. The prevalence of infection based on the ages of cattle examined was found not to be statistically significant (p>0.05)

Table 3: Prevalence of Anaplasmosis based on age of cattle examined

Age(years)	No. Examined (n=384)	No. (%) Positive 163(42.4)
1-2	62	30(18.4)
3-5	300	123(75.5)
6 above	22	10(6.1)

p>0.05

Prevalence of Anaplasmosis based on breed of cattle studied.

Among the three different cattle breeds examined in this study, the prevalence of *Anaplasma spp* was highest in White fulani (84.7%) followed by Red Bororo (9.2%) and the lowest prevalence was recorded in Sokoto Gudali breed which had a prevalence of 6.1%. as shown in table 4.

Table 4: Prevalence of Anaplasmosis based on breed of cattle in the study area

Age(years)	No. Examined (n=384)	No. (%) Positive 163(42.4)
White Fulani	320	138(84.7)

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Red Bororo	40	15(9.2)
Sokoto Gudali	24	10(6.1)

p >0.05

Risk factors associated with Anaplasmosis in the study area

Different risk factors which include age, sex, breed, management system and ticks infestation considered during sample collection and analysis shows that management system, season and ticks infestation were found to be significantly associated with positivity for Anaplasmosis ($p < 0.05$). On the other hand, age, sex and breed were found to have non-significance ($p > 0.05$) effects on the occurrence of the disease.

The highest prevalence of anaplasmosis was recorded in adult animals (75.5%) followed by young animals (18.4%) and old animals (6.1%).

The prevalence of anaplamsosis based on sex of the study animals was found to be insignificantly higher in female (81.6%) than in male (Table 2).

Table 5: Distribution of Anaplasmosis based on the disease risk factors

Risk Factors	No. Sampled (n=384)	No. (%) Positive 163(42.4)	X^2	P-value
Management system			6.153	0.013
Extensive	358	158(96.9)		
Intensive	26	5(3.1)		
Season			18.357	0.001
Wet	258	129(79.1)		
Dry	126	34(20.9)		
Ticks infestation			6.570	0.010
Ticks present	288	133(81.6)		
Ticks absent	96	30(8.4)		

Most of the cattle in this study, 358 were found to be bred under the Extensive management system while only a few were from the Intensive management system. Analysis showed that the risk of *Anaplasma* infection was significantly highest in extensively managed cattle (96.9%) than in intensively managed cattle (3.1%) ($p<0.05$) (Table 5).

Infection with anaplasmosis was found to be higher in cattle examined during the wet season (79.1%) than in those examined during the dry season (20.9%) which was shown to be statistically significant at $p<0.05$.

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Regarding the prevalence of anaplasmosis in tick infested and non-tick infested cattle the higher prevalence was found in tick infested (81.6%) cattle than non-tick infested (18.4%) cattle. This was statistically significant ($p < 0.05$) (Table 5).

After studying the tick vectors present on the bodies of the cattle, three tick species were found to be associated with Anaplasmosis in the study area, they are *Hyalomma truncatum, Amblyomma variegatum and Rhipicephalus species.*

DISCUSSION

The result showed an overall infection rate of 42.4% due to *Anaplasma spp* from 384 cattle sampled in Bauchi state, Nigeria. This indicates that Anaplasmosis exist among cattle populations within Bauchi and its surroundings. Majority of infection with the disease may be ascribed to a high prevalence of cattle ticks and farm management practices in the study area. Farmers may not appreciate the effects of this infection on their animals, perhaps due to their subclinical nature of presentation or due to their chronic nature on the affected animals, leading to reduction in production and eventual death of the affected animals.

The 42.4% reported in this study suggests a continuous challenge by parasites and the existence of carrier state in most animals. *Anaplasma spp* as observed in the study is in line with the work of Mohammed *et al*. (1989) and Samaila and Musa (2012) which showed that *Anaplasma spp* is the most prevalent haemoparasite among ruminants slaughtered in Bauchi abattoir and reported that the relatively high incidence of the haemoparasite could be ascribed to the favourable environment conditions for the survival and spread of the ticks vector responsible for their transmission.

The high prevalence of Anaplasmosis observed in this study is similar to the work of Abdullahi *et al*. (2014) who found a prevalence of 42% in cattle in Keffi, Nasarawa state, Nigeria and Akande *et al.* (2010) who found *Anaplasma spp* to be the highest prevalent haemoparasite among 200 cattle sampled in Abeokuta, South west, Nigeria. The high occurrence of Anaplasmosis recorded could be as a result of favourable environmental condition for the survival and spread of the arthropod vectors responsible for the transmission of these parasites (Adejinmi *et al*., 2004).

The effects of risk factors such as age, sex, breed, management system, season and ticks infestation on prevalence of Anaplasmosis has been previously reported (Kamani *et al*., 2022; Mannan *et al*., 2021; Ademola and Onyiche, 2013; Okorafor and Nzeako, 2014). Moreover, cattle are usually herded by pastoralists under transhumant conditions which expose them to the vectors of haemoparasites thereby increasing the risk of infection.

Sex-related haemoparasitemia did not vary significantly ($P>0.05$) in the study, however, parasitemia was higher in female (81.6%) than in males (18.4%). The result of

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this study is in line with the work of Okorafor and Nzeako (2014) who found higher haemoparasitemia recorded in cows than bulls and reported that it could be attributed to accumulation of parasites by the females due to the extended breeding for economic reasons such as calving and milk production. He further said that the susceptibility of cows might be attributed to reduced immunity as a result of stress due to pregnancy and lactation. The variability in breed specific parasitemia could be attributed to host specific factors peculiar to individual breeds. This agrees with Kamani *et al*. (2010) who observed a similar trend and attributed their finding to the fact that female animals were generally herded much longer for the purpose of breeding and milk production, thereby prolonging their exposure to challenges of disease. The result of this study does not agree with the work of Sam-wobo, *et al.* (2016) who found male to be more infected than females in Abeokuta, Ogun state, Nigeria and reported that both females and males are susceptible to infection with haemoparasitic infections in areas where tick vectors are endemic.

Among the different breed of cattle examined in this study, the prevalence of *Anaplasma spp* was higher in White fulani which recorded (84.7%) followed by Red Bororo (9.2%) while the lowest prevalence was recorded in Sokoto gudali which had a prevalence of 6.1%. This finding is in contrast with the work of Okorafor and Nzeako (2014) who found that breed-specific parasitemia showed highest prevalence in Sokoto Gudali followed by the Red Bororo and then White Fulani having the lowest prevalence and this varied significantly. The lower prevalence of infection recorded in Red Bororo breed is in contrast with the work of Paul *et al.* (2016) who found a higher prevalence in Maiduguri, Borno state and said that this could be attributed to their adaptation to arid and semi-arid conditions. He also stated that cattle are usually herded by pastoralists under transhumant conditions which expose them to tick vectors thereby increasing the risk of infection.

Age has been frequently reported to be associated with increased TBDs prevalence (Atif *et al.,* 2013 and Maharana *et al.,* 2016). The result of this study showed that age as a risk factor associated with anaplasmosis, is found to be higher in adults than in old and younger animals which was not statistically significant. This result is in disagreement with the finding of the study in Machakos County, Kenya (Wesonga *et al*., (2017), in Punjab, Pakistan (Atif *et al.,* 2013), in Tunisia (M'ghirbi *et al.,* 2016) and in Morocco (Hamou *et al.,* 2012). The lower prevalence of *Anaplasma* infection in young and old animals compared to adults could be attributed to restricted grazing of young animals which tends to reduce their chance of contact with the vectors of these diseases and more sustained exposure of adults to vectors.

Moreover, lower prevalence detected in young animal could be attributed to passive colostrum immunity since in endemic areas, the young animal first acquires immunity

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passively, in the colostrum and, as a result, often suffers only transient infections with mild clinical signs (Mason *et al*., 2017).

The study showed the higher risk of *Anaplasma* infection in extensively managed cattle than intensively managed cattle which was statistically significant ($p<0.05$). This finding is in line with the study of Angwechi (2011) and Wesonga *et al.* (2017) who reported a higher prevalence of infection with tick-borne disease in extensively managed cattle. The management system effect on TBD pathogen positivity emanates from the nature of exposure from the vectors. Thus, this ranges from unrestricted tick exposure in extensive management systems through restricted exposure in intensive, where animals are alternately open grazed and stall fed. This findings is consistent with this phenomenon basically due to these differential exposures since animals raised under open grazing (extensive) management are frequently exposed to infected ticks and thus, are more likely to be positive for tick borne infections.

The availability of tick vectors may also be one of the potential risk factor for *Anaplasma* infections in the study area. The result of this study showed that risk of anaplasmosis was significantly ($p<0.05$) higher in tick infested (81.6%) cattle than non-tick infested (18.4%) cattle and a similar observation was reported by Costa *et al.* (2013). Similarly the higher prevalence of anaplasmosis was also recorded in tick infested cattle. The association of bovine anaplasmosis with presence of ticks was statistically significant and *Anaplasma spp* are known to replicate in the erythrocytes leading to hemolysis and anaemia (Abdullahi, *et al.,* 2014).

The findings from this study is at variance with the work of Ademola and Onyiche (2013) who reported an overall haemoparasite prevalence of 5% in Oyo state, Nigeria. And it also contradicts earlier study by Kamani *et al*. (2010) where 9% prevalence in cattle in North-central, Nigeria was reported. These discrepancies could be attributed to local differences in prevalence of haemoparasites due to variations in geographical location (Velusamy *et al*., 2014) which determines the distribution of the arthropod vectors of the parasites (Ogo *et al*., 2012).

CONCLUSION

This research could be concluded to have found that Anaplasmosis is prevalent in Bauchi state and several risk factors were found to be more associated with the disease in the study area. Among the various risk factors, management system {158(96.9%)}, season {129(79.1%)}, and ticks infestation {133(81.6%)},were found to be significantly associated with positivity for anaplasmosis ($p < 0.05$) while age, sex and breed were found to have non-significance ($p > 0.05$) effects on the occurrence of the disease. The highest prevalence of anaplasmosis was recorded in adult animals

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123(75.5%) followed by young animals 30(18.4%) and old animals 10(6.1%). The prevalence of anaplamsosis based on sex of the study animals was found to be insignificantly higher in female 133(81.6%) than in male 30(18.4). This is of great public health importance because the disease is in existence and it affects the quality and quantity of dairy products as well as that of the meat produced in the study area.

We therefore recommend that stringent control measures should be put in place to effectively reduce to the barest minimum the prevalence of Anaplasmosis in the state and this can be done through aggressive chemotherapy, chemoprophylaxis and control of tick vectors by the use of effective insecticides, acaricides and proper environmental management.

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