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Zoonotic Haemoparasites and Haematological Status of Cattle Slaughtered in Three Abattoirs in Kogi State, Nigeria



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ABSTRACT

Zoonotic diseases are diseases that can be transmitted from animals to humans and humans to animals. Cattle is the highest source of animal protein consumed in Nigeria. This study investigated the prevalence of zoonotic parasites and determined the association between parasitemia and the haematological status of cattle slaughtered in three abattoirs in Lokoja, Kogi State. Blood samples were collected from 196 cattle of both sexes and varying ages and subjected to microscopy using thin blood smears. From the 196 samples examined, 52(26.53%) were infected with one or more haemoparasites. Haemoparasite results showed prevalence for *Babesia* spp., *Trypanosoma* spp., *Theileria* spp. and *Anaplasma* spp. to be 13.27%, 6.63%, 6.12% and 4.08% respectively. Haematological analysis was done using an automated haemo-analyser. There was a significant difference ($P < 0.005$) in the prevalence of haemoparasites across the three abattoirs. Felele abattoir (29.89%) had the highest prevalence, followed by the Barracks abattoir with 27.50%, then the Ganaja abattoir had the lowest prevalence of 21.7%. Female cattle were more inundated with parasites (31.46%) than male cattle (22.43%). Younger cattle showed a higher positivity rate (28.57%) than older (25.21%) cattle. Felele abattoir recorded the highest haematological values across all parameters (PCV; 35%, WBC; $12.25 \times 10^9/l$, Hemoglobin level; 13g/dl and the RBC; $7.1 \times 10^6/l$). However, there were no statistically significant difference ($P > 0.005$) between the haematological values of cattle from abattoirs. Male cattle recorded higher mean PCV value (34%) than female cattle (31%). Although not statistically significant, the haematological parameters recorded higher values in younger than in older cattle. There was a significant association ($P < 0.005$) between parasitemia and haematological status of the cattle examined. This study revealed a high prevalence of haemoparasites in cattle slaughtered in the three abattoirs in Lokoja, Nigeria. The presence of these parasites showed that the public is at risk of a potential outbreak of their corresponding zoonotic diseases. There is a need for more studies on the epidemiology of parasitic zoonoses in Lokoja, Kogi State and how to appropriately control the parasites in these economically viable animals for improved productivity.

Keywords: Prevalence, Abattoir, Cattle, Haemoparasites, Haematology, Nigeria.

INTRODUCTION

In Nigeria, cattle which are the primary source of animal protein in most households, had a mean population of 21.2 million in 2021 (FAOS, 2021), of which herders or farmers kept 82% of this population under a pastoral system (Ayodele, 2022). Since most of these cattle are in the hands of pastoralists who take their cattle on free-range grazing, the cattle are being subjected to a wide range of pathogens, including protozoans, which can cause numerous diseases (MacGregor, et al., 2021).

Zoonosis is a polyetiological disease that includes a wide variety of parasites such as helminth and haemoparasites that results in mortality and significant financial losses. The occurrence of infections caused by hemoparasites in humans and animals is a worldwide phenomenon that is more prevalent in tropical and subtropical regions, such as Nigeria (Weny et al., 2017; Ola-Fadunsin et al., 2018).

Studies in Nigeria have reported incidences of haemoparasites to include; *Trypanosoma* species, *Babesia* species, *Ehrlichia* species, *Theileria* species and *Anaplasmosis* species (Oluwadamilare et al., 2022; Ola-Fadunsin et al., 2018). The blood is a fluid matrix comprising many cellular components like the erythrocytes, leucocytes and platelets (Schwartz and Conley, 2024) and variations in the average blood values are indicators of the health status of animals (Aro, 2019).

Abattoirs which are slaughter platforms are actually used to monitor for zoonotic diseases in an effort to safeguard humans and other animals from the pathogens. Therefore, it is impossible to overstate the value of abattoir records in analyzing prevalence rates and developing strategies for animal disease control (Shitta and James-Rugu, 2013). Thus, the purpose of this study was to determine the prevalence of zoonotic parasites and the haematological condition of cattle that were slaughtered for meat in three abattoirs located in Lokoja, Kogi State.

MATERIALS AND METHODS

Study Area

This study involved three (3) abattoirs in the Lokoja metropolis namely; Felele abattoir, the Army Barracks abattoir and the Ganaja village abattoir.

Lokoja lies at the confluence of the Niger and Benue rivers and is the capital city of Kogi State with the coordinates of latitude 07°48'07"N and longitude 06°44'39"E of the Meridian. Lokoja is in Nigeria's tropical Wet and Dry savanna climate zone, and temperatures remain hot year-round.

Experimental Design

Using random sampling technique, one hundred and ninety-six (196) cattle were selected from three different abattoirs in Lokoja for twelve weeks for this study. A random sampling technique was used to select cattle for the study. Blood samples of the cattle were used for both the parasitological and the haematological analyses. The animals were identified and labelled with the abattoir locations, sex, and age [young; below 24 months old or adult; above 24 months] using the cattle dentition (FSIS, 2013).

Sample Collection

During the study period from July to September, visits were made to the abattoirs, with one abattoir visited each day for sample collection starting as early as 6:00 am. A total of 5 ml of blood sample was collected from the jugular vein of each of the animals and transferred into prelabelled sterile ethylene diamine tetra acetic acid (EDTA) tube (Shabbir, 2013). All the collected samples were placed in ice packs and transported to the Department of Biology, Federal University Lokoja laboratory for parasitological analysis and Kogi State Specialist Hospital, Lokoja for haematological analysis.

Sample Analyses

The blood parasitological analysis was done using a microscopic examination of thin blood smears. Thin blood smears were prepared according to standard techniques (Cheesbrough, 1987) and stained using Giemsa stain. The Red Blood Cell (RBC) Counts, Packed Cell Volume (PCV), Haemoglobin (Hb) concentration, and White Blood Cell (WBC) Counts were estimated by an automated haematological analyser as prescribed by Kubkomawa *et al.* (2016).

Identification of Parasites

Parasites were identified using the microscope keys provided in Soulsby's reference (Soulsby, 1982).

Data Analysis

Results were analyzed using SPSS version 20 software. Chi-square test and ANOVA were used to test for the association between the prevalence of blood parasites and the different sample locations as well to evaluate the relationship between the prevalence of the disease and the haematological status of the cattle slaughtered in the three different abattoirs in Lokoja at an alpha value of $p < 0.05$.

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RESULTS

Prevalence of Haemoparasites based on Location, Sex and Age of Cattle Slaughtered in Three Lokoja Abattoirs

Out of one hundred and ninety-six (196) cattle that were screened for haemoparasites, a total of 52 (26.53%) tested positive for haemoparasite infections (Table 1). 29.89% of the cattle slaughtered in Felele had one haemoparasite or the other; this was closely followed by Barracks abattoirs,

where 27.50% prevalence was recorded (Table 1). The lowest infection rate was recorded in the Ganaja abattoir (21.74%). This prevalence difference across the three locations is statistically significant ($P < 0.05$). The haemoparasites encountered during this study in order of prevalence were *Babesia bigemina* (13.27%), *Anaplasma marginale* (6.63%), *Theileria annulata* (6.12%) and *Trypanosoma brucei* (4.08%). When data were analysed by sex, female cattle recorded a higher infection rate for haemoparasites (31.46%) than males (22.43%). There was significant difference between the sexes ($p < 0.05$) (Table 1). The prevalence of hemoparasites based on age is presented in Table 3. The younger age group (28.57%), recorded a higher prevalence than the older age group (25.21%), and the difference in the prevalence was found to be statistically significant ($p < 0.05$).

Table 1: Prevalence of Haemoparasites by Location, Sex, and Age

Location(n)	Number Positive (%)	<i>Anaplasma marginale</i> (%)	<i>Babesia bigemina</i> (%)	<i>Theileria annulata</i> (%)	<i>Trypanosoma brucei</i> (%)
Felele (87)	26 (29.89)	3 (3.45)	14 (16.10)	6 (6.90)	10 (11.49)
Barracks (40)	11 (27.50)	3 (7.50)	6 (15.00)	1 (2.50)	1 (2.50)
Ganaja (69)	15 (21.74)	2 (2.90)	6 (8.70)	5 (7.25)	2 (2.90)
Total (196)	52 (26.53)	8 (4.08)	26 (13.27)	12 (6.12)	13 (6.63)
<i>F. cal.</i>	0.51	0.76	19.50	0.71	0.50
<i>P. value</i>	0.002*	0.03*	0.02*	0.39	0.65
<i>F. crit</i>	18.51	8.52	6.24	9.55	0.32
Male (107)	24 (22.43)	5 (4.67)	11 (10.28)	4 (3.74)	5 (4.67)
Female (89)	28 (31.46)	3 (3.37)	15 (16.85)	8 (8.99)	8 (8.99)
Total (196)	52 (26.53)	8 (4.08)	26 (13.27)	12 (6.12)	13 (6.63)
χ^2	0.72	0.17	0.68	0.43	0.37
<i>P. value</i>	0.003*	0.001*	0.003*	0.02*	0.01*
>2 (119)	30 (25.21)	6 (5.04)	10 (8.40)	9 (7.56)	9 (7.56)
<2 (77)	22 (28.57)	2 (2.60)	16 (20.78)	3 (3.90)	4 (5.20)
Total (196)	52 (26.53)	8 (4.08)	26 (13.27)	12 (6.12)	13 (6.63)
χ^2	0.57	0.32	0.76	0.33	0.46
<i>P. value</i>	0.01*	0.01*	0.04*	0.003*	0.01*

*Significance at $p < 0.05$

Table 2: Haematological Status of Cattle by Location, Sex, and Age

Variables	PCV (%)	Haemoglobin (g/dl)	WBC (x 10/l)	RBC (x 10/l)
Location				
Felele (87)				
Highest	46.00	16.40	21.60	9.10
Lowest	24.00	9.60	2.90	5.10
Mean (\bar{x})	35.00	13.00	12.25	7.10
Barracks (40)				
Highest	36.00	13.50	9.40	7.52
Lowest	22.00	8.40	6.40	4.81
Mean (\bar{x})	29.00	10.95	7.90	6.17
Ganaja (69)				
Highest	44.00	16.30	17.20	9.10
Lowest	18.00	5.60	3.50	2.62
Mean (\bar{x})	31.00	10.95	10.35	5.86
<i>F.cal</i>	0.73	0.59	0.99	0.66
<i>P. value</i>	0.36	0.61	0.01*	0.04*
<i>F. crit.</i>	9.55	9.55	0.21	2.57
Sex				
Male				
Highest	46.00	16.40	21.60	9.10
Lowest	22.00	5.50	2.90	4.30
Mean (\bar{x})	34.00	10.95	12.25	6.70
Female				
Highest	44.00	16.30	20.80	8.50
Lowest	18.00	5.60	3.50	2.62
Mean (\bar{x})	31.00	10.95	12.15	5.56
χ^2	0.41	0.95	2.31	0.22
<i>P. value</i>	0.03*	0.004*	0.13	0.64
Age (years)				
>2				
Highest	44.00	16.30	21.60	9.10
Lowest	18.00	5.60	3.50	2.62
Mean (\bar{x})	31.00	10.95	12.55	5.86
<2				
Highest	46.00	16.40	20.80	8.70
Lowest	22.00	5.80	4.50	4.57
Mean (\bar{x})	34.00	11.10	12.65	6.64
χ^2	0.67	7.15	7.95	0.37
<i>P. value</i>	0.41	0.007*	0.02*	0.003*

*Significance at $p < 0.05$

Table 3: Relationship Between Haemoparasites and Haematological Status by Location

Location	Parasite Spp.	Prevalence (%)	Haematological Status	F.cal	Pvalue	F.crit
Felele (87)	<i>Anaplasma marginale</i>	3.45	PCV (Mean): 35.00%, Hb (Mean): 13.00 g/dL	0.73	0.36	9.55
	<i>Babesia bigemina</i>	16.10	WBC (Mean): 12.25 x10 ⁹ /L	0.99	0.01*	0.21
	<i>Theileria annulata</i>	6.90	RBC (Mean): 7.10 x10 ¹² /L	0.66	0.04*	2.57
	<i>Trypanosoma brucei</i>	11.49				
Barracks (40)	<i>Anaplasma marginale</i>	7.50	PCV (Mean): 29.00%, Hb (Mean): 10.95 g/dL	0.73	0.36	9.55
	<i>Babesia bigemina</i>	15.00	WBC (Mean): 7.90 x10 ⁹ /L	0.99	0.01*	0.21
	<i>Theileria annulata</i>	2.50	RBC (Mean): 6.17 x10 ¹² /L	0.66	0.04*	2.57
	<i>Trypanosoma brucei</i>	2.50				
Ganaja (69)	<i>Anaplasma marginale</i>	2.90	PCV (Mean): 31.00%, Hb (Mean): 10.95 g/dL	0.73	0.36	9.55
	<i>Babesia bigemina</i>	8.70	WBC (Mean): 10.35 x10 ⁹ /L	0.99	0.01*	0.21
	<i>Theileria annulata</i>	7.25	RBC (Mean): 5.86 x10 ¹² /L	0.66	0.04*	2.57
	<i>Trypanosoma brucei</i>	2.90				

*Significance at p < 0.05

Table 4: Relationship Between Haemoparasites and Haematological Status by Sex and Age

Sex	Parasite Spp.	Prevalence (%)	Haematological Status	F.cal	Pvalue	F.crit	
Male (107)	<i>Anaplasma marginale</i>	4.67	PCV (Mean): 34.00%, Hb (Mean): 10 g/dL	0.41	0.03*	9.55	
	<i>Babesia bigemina</i>	10.28	WBC (Mean): 12.25 x10 ⁹ /L	2.31	0.13	0.21	
	<i>Theileria annulata</i>	3.74	RBC (Mean): 6.70 x10 ¹² /L	0.22	0.64	2.57	
Female (89)	<i>Anaplasma marginale</i>	3.37	PCV (Mean): 31.00%, Hb (Mean): 10 g/dL	0.41	0.03*	9.55	
	<i>Babesia bigemina</i>	16.85	WBC (Mean): 12.15 x10 ⁹ /L	2.31	0.13	0.21	
	<i>Theileria annulata</i>	8.99	RBC (Mean): 5.56 x10 ¹² /L	0.22	0.64	2.57	
Age (years)	>2 years (11)	<i>Anaplasma marginale</i>	5.04	PCV (Mean): 31.00%, Hb (Mean): 10 g/dL	0.67	0.41	9.55
		<i>Babesia bigemina</i>	8.40	WBC (Mean): 12.55 x10 ⁹ /L	7.95	0.02*	0.21
		<i>Theileria annulata</i>	7.56	RBC (Mean): 5.86 x10 ¹² /L	0.37	0.003*	2.57
	<2 years (77)	<i>Anaplasma marginale</i>	2.60	PCV (Mean): 34.00%, Hb (Mean): 11 g/dL	0.67	0.41	9.55
		<i>Babesia bigemina</i>	20.78	WBC (Mean): 12.65 x10 ⁹ /L	7.95	0.02*	0.21
		<i>Theileria annulata</i>	3.90	RBC (Mean): 6.64 x10 ¹² /L	0.37	0.003*	2.57

*Significance at p < 0.05

Haematological Status of Cattle Slaughtered in Three Lokoja Abattoirs by Location, Sex and Age

The haematological status of cattle slaughtered in the Lokoja abattoir varied with respect to location, sex and age of cattle in this study. The highest mean value of PCV was 35.00%,

this was recorded at the Felele abattoir, while the lowest (29.00%) mean value of PCV was recorded at the Barracks abattoir. A similar pattern was observed in the white blood cell level (Table 4). The cattle slaughtered at Felele recorded the highest (12.25 x 10/l) WBC count, followed by Ganaja

abattoir with $10.35 \times 10^6/l$ while the lowest mean WBC count was recorded for the Barracks abattoir ($7.90 \times 10^6/l$). Felele abattoir recorded the highest (13.00 g/dl) haemoglobin level in cattle, while Barracks and Ganaja both had similar value of 10.95 g/dl respectively. The mean counts of Red Blood Cells (RBC) of cattle slaughtered in Felele was $7.10 \times 10^6/l$ as the highest, followed by $6.17 \times 10^6/l$ in Barracks abattoir and the lowest at Ganaja abattoir with a mean value of $5.86 \times 10^6/l$. These differences were statistically significant at $P < 0.05$ (Table 2).

When segregated according to sex, it was observed that male cattle across all sites recorded the highest mean PCV value (34%), while females recorded a mean value of 31.00%. This difference was statistically significant ($P < 0.05$) (Table 2). For the Haemoglobin level however, similar mean values (10.95g/dl) were recorded for both males and females having 10.95g/dl, respectively. The mean values of Red Blood Cell count in males were $6.70 \times 10^6/l$ and $5.56 \times 10^6/l$ in females respectively, there was no statistically significant differences ($P > 0.05$) between sexes (Table 5). The PCV of cattle aged > 2 years recorded the lowest mean value (31.00%), while cattle aged < 2 years recorded the highest with a mean value of 34.00%. Cattle aged > 2 years recorded the lowest mean value of 10.5 g/dl for haemoglobin (Hb), while cattle aged < 2 years had the highest Hb with a mean value of 11.10 g/dl. This difference in Hb values was statistically significant ($P < 0.05$) (Table 2). However, the WBC value of cattle > 2 years was recorded at $12.55 \times 10^6/l$, and the age < 2 years was recorded at $12.65 \times 10^6/l$ as the highest mean value. Cattle aged < 2 years recorded the highest RBC mean counts ($6.64 \times 10^6/l$) while cattle aged > 2 years $5.86 \times 10^6/l$. The difference in RBC counts within the age groups were statistically significant ($P < 0.05$) (Table 2).

Relationship between haemoparasites and haematological status

Cattle from Felele abattoir had the highest prevalence of *Babesia bigemina* (16.10%) and *Trypanosoma brucei* (11.49%). Blood parameters are relatively healthy compared to other locations (e.g., PCV = 35%, Hb = 13 g/dL). Significant influence on WBC ($P < 0.05$), indicating immune response to infection (Table 3). Barracks abattoir's cattle had a moderate prevalence of all parasites, with *Babesia bigemina* at 15.00%. Haematological parameters show reduced averages (e.g., PCV = 29%, Hb = 10.95 g/dL), suggesting possible anaemia. Significant influence on RBC ($P < 0.05$), indicating parasite impact on oxygen transport. Ganaja had a lower prevalence of parasites, except *Theileria annulata* (7.25%). Blood indices (PCV = 31%, Hb = 10.95 g/dL) are

comparable to Barracks but better than Felele. Significant relationship with WBC ($P < 0.05$).

Male cattles had lower prevalence of *Babesia bigemina* (10.28%) and *Trypanosoma brucei* (4.67%). Haematological status was better (PCV = 34%, WBC = $12.25 \times 10^6/L$) than females. There was a significant impact on PCV ($p < 0.05$), indicating reduced blood volume due to parasites (Table 4). Female cattle had higher prevalence of *Babesia bigemina* (16.85%) and *Trypanosoma brucei* (8.99%). Blood parameters showed slight reductions compared to males (PCV = 31%, WBC = $12.15 \times 10^6/L$). There was a significant relationship with haemoglobin ($P < 0.05$), reflecting oxygen-carrying capacity.

Older Cattle (> 2 years) had Lower prevalence of *Babesia bigemina* (8.40%) but higher prevalence of *Anaplasma marginale* (5.04%). Better haematological health (e.g., PCV = 31%, Hb = 10.95 g/dL) was recorded with a significant relationship with WBC ($P < 0.05$) while the younger cattle (< 2 years) had a higher prevalence of *Babesia bigemina* (20.78%), suggesting increased susceptibility. Slightly better haematological indices (e.g., PCV = 34%, Hb = 11.10 g/dL) were recorded. There was a significant relationship with RBC ($P < 0.05$), indicating parasite-induced anaemia (Table 4).

DISCUSSION

The findings of this study demonstrate that haemoparasitic infections are widespread among cattle populations in Lokoja. The overall prevalence of haemoparasites, recorded at 26.53%, is notably higher than what has been reported in similar studies in Nigeria (Enogiomwan et al., 2019; Bitrus et al, 2021). This elevated prevalence could be attributed to several factors, including the potential for a high tick population in Lokoja, which serves as a primary vector for many haemoparasites. Poor farm management practices, such as inadequate vector control and limited veterinary intervention, likely exacerbate the situation, contributing to the higher infection rates observed in this study (Bitrus et al, 2021; Okonkwo et al, 2023).

Among the haemoparasites identified, *Babesia spp.* exhibited the highest prevalence, which is consistent with findings from Oluwadamilare et al. (2022) in Abeokuta, Nigeria. The prevalence of *Theileria spp.* (6.12%) and *Anaplasma spp.* (4.08%) closely aligns with the work of Ola-Fadunsin et al. (2018) in Ilorin, Kwara State, indicating similar infection trends across different regions of Nigeria. The relatively higher prevalence of *Babesia spp.* is particularly worthy of note given its role in causing anaemia, which could have serious implications for cattle health and productivity.

The highest infection rate (29.89%) was observed in cattle from the Felele abattoir. This higher rate could be linked to less effective veterinary practices or management strategies at the abattoir, possibly including insufficient monitoring of cattle health prior to slaughter. In contrast, the Ganaja abattoir, where cattle are reared for a short period before slaughter with more active involvement of veterinarians, recorded the lowest infection rates. This suggests that better farm management and veterinary oversight can significantly reduce haemoparasite prevalence, further supporting the importance of comprehensive animal health management in controlling these infections.

The findings from this study on age-related susceptibility to haemoparasitic infections corroborate an earlier report (Sarangi *et al.*, 2021), indicating that younger cattle are more vulnerable to haemoparasites. This is likely due to their developing immune systems, which are not as equipped to fend off infections as those of older cattle. For instance, *Babesia spp.* infections were significantly higher in younger cattle (20.78%) compared to older cattle (8.40%). However, *Theileria spp.* (3.90%) and *Trypanosoma spp.* exhibited higher infection rates in older cattle, a pattern supported by previous studies (Selim *et al.*, 2022; Fesseha *et al.*, 2022), suggesting that these parasites might affect older animals more severely. The higher prevalence of *Anaplasma spp.* in older cattle also reflects a similar trend, as these parasites often target mature animals with chronic infections (Katherine *et al.*, 2010). This age-related variation in susceptibility could be influenced by differences in immune responses, exposure history, and environmental factors, highlighting the need for age-targeted management interventions.

In terms of sex-related prevalence, female cattle exhibited higher infection rates for *Babesia*, *Theileria*, and *Trypanosoma spp.*, aligning with findings of other researchers (Opara *et al.*, 2017; Yu *et al.*, 2022; Chibuogwu *et al.*, 2023). This may be due to the physiological stress associated with reproductive activities, which can weaken the immune system and make females more susceptible to infections. On the other hand, *Anaplasma spp.* infections were more prevalent in male cattle, a finding that aligns with Seeritra *et al.* (2023) but contrasts with studies by Enogiomwan (2019) and Badshah *et al.* (2023) that reported higher rates in females. The reason for this discrepancy is not entirely clear but could be attributed to differences in farming practices, environmental conditions, or inherent biological differences between sexes in different regions.

Among the various haemoparasites seen, *Babesia bigemina* was the most prevalent, especially in Felele (16.10%) and female cattle (16.85%). This high prevalence aligns with studies by Ola-Fadunsin *et al.* (2018) who noted the strong association between *Babesia* infections, stress, and the abundance of tick vectors in warm climates. The higher infection rate in females could also be related to stress associated with reproductive processes. On the other hand, the prevalence of *Anaplasma marginale* was lower (2.60%) in younger cattle compared to older cattle (5.04%), possibly reflecting localized vector control measures in Lokoja that may have had more success in controlling the transmission of this particular parasite. The moderate prevalence of *Trypanosoma spp.* (11.49%) in Felele had minimal impact on white blood cell (WBC) or red blood cell (RBC) counts, suggesting that the infection might not have caused significant anaemia or immune activation in the cattle at this site. However, previous studies have shown that *Trypanosoma* infections are more prevalent in pastoral systems, which differ from the semi-intensive farming systems observed in Lokoja (Obadiah & Shekaro, 2012).

The impact of haemoparasitic infections on the haematological status of cattle was evident in the study, particularly with *Babesia bigemina* infections, which were associated with reduced PCV and Hb levels, indicating the development of anaemia. This observation is consistent with earlier reports (Sura *et al.*, 2021; Zygner *et al.*, 2023), who attributed anaemia to the destruction of red blood cells caused by *Babesia* infections. In the Felele abattoir, where the infection rate for *Babesia* was highest, the PCV (35%) and Hb levels (13 g/dL) were notably reduced, suggesting significant parasitic burden. Additionally, significant increases in WBC counts were observed in both males and Felele cattle, with counts as high as $12.25 \times 10^9/L$, indicating an immune response to these infections. This immune activation aligns with the findings of Beletić *et al.* (2021) that have shown elevated WBC counts in response to *Babesia* and *Anaplasma* infections.

These findings highlight the importance of vector control and improved farm management practices in mitigating the impact of haemoparasites on cattle health. Given the significant impact on cattle haematology, targeted interventions such as tick control, vaccination, and better veterinary care are necessary to reduce the prevalence and associated health risks.

CONCLUSION

This study confirms that haemoparasites are endemic among abattoir cattle slaughtered for meat in Lokoja, with a notably high prevalence (26.53%) across the sampled abattoirs. *Babesia* spp. exhibited the highest infection rate, particularly affecting younger cattle, likely due to their lower immunity levels. In contrast, *Theileria* and *Anaplasma* spp. were more prevalent in older cattle, highlighting potential age-related susceptibility dynamics. The higher infection rate of haemoparasites in female cattle suggests a link to stress and reduced immunity associated with reproductive activities. Environmental factors, including high tick populations, inadequate farm management, and location-specific practices, contribute significantly to the observed prevalence rates. For instance, the Felele abattoir recorded the highest prevalence, possibly due to suboptimal veterinary oversight compared to Ganaja. Furthermore, haemoparasite infections were associated with haematological impacts such as anemia, reduced PCV and Hb levels, and elevated WBC counts, aligning with prior research.

The findings emphasize the need for improved vector control, enhanced farm management practices, and targeted interventions to mitigate hemoparasite infections in cattle populations.

The presence of these parasites at the abattoirs (the significant abattoirs for beef sourcing in Lokoja) showed that public health is at risk of potential outbreaks of their corresponding diseases, all of which are zoonotic infections.

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Authors' Contribution

MIO and BJA conceptualized the study. MIO, BJA, AJC and OCI designed the study. MIO, BJA and AJC participated in the experimental work. MIO, BJA, AJC and OCI interpreted the data. MIO prepared the first draft of the manuscript, reviewed by BJA, AJC and OCI. All authors contributed to the development of the final manuscript and approved its submission.

Conflicts of Interest

Authors declare no conflict of interest

Ethics Approval and Informed Consent

Ethical approval for this study was obtained from the Ethical Committee of the Federal University Lokoja with reference number FUL/EC/2024/05.

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