

Prevalence, of Bovine Trypanosomosis in Cattle Slaughtered at Gombe Township Abattoir, Gombe State, Nigeria

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ABSTRACT

This study determined the prevalence, species distribution, and risk factors of trypanosome infection in cattle slaughtered at the Gombe Township Abattoir, Gombe State, Nigeria. Blood samples were collected from 300 cattle and examined using wet mount, thin smear, thick smear, Haematocrit Centrifugation Technique (HCT/Woo), and the Buffy Coat Method (BCM). Packed Cell Volume (PCV) was measured for all animals. Chi-square and independent samples t-tests were applied for statistical analysis at $p < 0.05$. An overall prevalence of 11.67% was recorded. Three species were identified: *Trypanosoma vivax* (7.33%), *T. congolense* (3.33%), and *T. brucei* (1.00%). Prevalence did not differ significantly by breed ($p = 0.34$) or sex ($p = 0.78$), but adults showed a higher infection rate (13.33%) than young animals (7.78%; $p = 0.06$). Infected cattle had a significantly lower mean PCV ($22.4\% \pm 3.8\%$) than uninfected animals ($30.8\% \pm 4.5\%$; $p < 0.001$). BCM achieved 100% relative sensitivity, substantially outperforming thin smear (25.7%). Bovine trypanosomiasis is prevalent in Gombe abattoir cattle and is significantly associated with anaemia. The BCM and HCT are recommended as the minimum diagnostic standard for field surveillance, and targeted intervention programmes focusing on adult cattle are warranted.

Introduction

Bovine trypanosomosis, caused by protozoan parasites of the genus *Trypanosoma*, remains a major constraint to livestock productivity in sub-Saharan Africa (Giordani *et al.*, 2016; Odeniran *et al.*, 2021). The disease is primarily transmitted by tsetse flies (*Glossina* spp.) across an estimated 10 million km² “tsetse belt” spanning West, Central, and East Africa (Odeniran & Ademola, 2018; Odeniran *et al.*, 2020). In addition, mechanical transmission by biting flies such as *Stomoxys calcitrans*, *Tabanus* spp., and *Haematopota* spp. extends the distribution of species like *Trypanosoma vivax* beyond tsetse-endemic areas (Giordani *et al.*, 2016; Odeniran *et al.*, 2020). The disease imposes substantial economic losses, estimated at about USD 4.5 billion annually due to mortality, reduced productivity, poor reproductive performance, and diminished draught power (Tora *et al.*, 2024). In Nigeria, which hosts one of Africa’s largest cattle populations, bovine trypanosomiasis remains a significant veterinary and public health concern (Enwezor *et al.*, 2012; Ikenna-Ezeh *et al.*, 2020). The Guinea and Sudan savanna zones, including Gombe State, provide favourable ecological conditions for tsetse survival and disease transmission (Chibuogwu *et al.*, 2023; Wada *et al.*, 2020).

The principal trypanosome species affecting cattle in Nigeria are *T. vivax*, *T. congolense*, and *T. brucei*, which vary in pathogenicity, transmission dynamics, and clinical severity (Wilkowsky, 2022; Giordani *et al.*, 2016). *T. vivax* is often the most prevalent due to its dual transmission modes (Idehen *et al.*, 2018; Aliyu *et al.*, 2022), while *T. congolense* is associated with severe anaemia and weight loss, and *T. brucei* may cause acute, often fatal infections (Giordani *et al.*, 2016; Odeniran *et al.*, 2019). Abattoir-based surveillance offers a cost-effective approach for assessing trypanosome prevalence across diverse cattle populations (Enwezor *et al.*, 2012; Dede *et al.*, 2021). However, diagnostic accuracy depends on the method used; conventional blood smears have limited sensitivity, whereas concentration techniques such as the Haematocrit Centrifugation Technique (HCT) and Buffy Coat Method (BCM) improve detection (Desquesnes *et al.*, 2022; Yusuf *et al.*, 2022).

Despite Gombe State's role as a major livestock transit hub in northeastern Nigeria, current data on bovine trypanosomiasis in the area remain limited. This study therefore investigates the prevalence and species distribution of trypanosome infections in cattle at the Gombe Township Abattoir, evaluates risk factors (breed, sex, and age), examines the association with anaemia using PCV, and compares the diagnostic performance of five microscopic techniques to inform control strategies in the region.

Materials and Methods

Study Area

The study was conducted at the Gombe Township Abattoir in Gombe metropolis, northeastern Nigeria (10°17'N, 11°10'E; ~462 m above sea level). The area lies within the Sudan-savanna zone, characterised by a wet season (May–October) and a dry season (November–April), with mean annual rainfall of ~900 mm and temperatures ranging from 18°C to 41°C. Gombe serves as a major livestock trade corridor connecting the Lake Chad basin to southern Nigeria, resulting in the influx of cattle from diverse origins. Tsetse species, including *Glossina morsitans* and *G. tachinoides*, have been reported in the riverine gallery forests of the state (Odeniran & Ademola, 2018).

Study Design and Sample Size

A cross-sectional abattoir-based survey was conducted from January to June 2025. A total of 300 cattle were randomly selected from animals presented for slaughter. Sample size was determined using Thrusfield (2018), $n = 1.96^2 \times P(1 - P) / d^2$, with $P = 0.12$ and $d = 0.04$, yielding 254 animals; this was increased to 300 to enhance statistical power. Data on breed, sex, and age were recorded, with age estimated by dentition and categorised as young (<3 years) or adult (≥3 years).

Blood Sample Collection

Approximately 5 mL of jugular blood was collected ante-mortem into EDTA vacutainer tubes. Samples were labelled, transported on ice, and analysed within 2 hours. Thin and thick blood smears were prepared, air-dried, and methanol-fixed for Giemsa staining. Capillary tubes were filled for packed cell volume (PCV) determination and buffy coat examination.

Diagnostic Techniques

Trypanosome detection was performed using multiple microscopic techniques. Wet mounts were examined at ×400 magnification for motile parasites within 30 minutes of collection. Methanol-fixed thin and Giemsa-stained thick smears were observed under oil immersion (×1000) for morphological identification following Hoare as cited in Odeniran *et al.* (2019).

The Haematocrit Centrifugation Technique (HCT/Woo) involved centrifuging capillary tubes at 12,000 rpm for 5 minutes, with the buffy coat examined at ×400 magnification for motile trypanosomes (Desquesnes *et al.*, 2022). Similarly, the Buffy Coat Method (BCM) involved expressing the buffy coat onto a slide after centrifugation and examining it at ×400 magnification for concentrated parasites (Murray *et al.*, 1977 as cited in Yusuf *et al.*, 2022).

Species identification was based on morphological features such as body length, kinetoplast position, undulating membrane, and flagellum characteristics (Giordani *et al.*, 2016; Wilkowsky, 2022).

Packed Cell Volume (PCV) Determination

Packed cell volume (PCV) was determined after centrifugation using a haematocrit reader. Anaemia was defined as $PCV < 24\%$ (Constable *et al.*, 2017). Mean PCV values of infected and uninfected cattle were compared using an independent samples t-test.

Statistical Analysis

Data were analysed using SPSS version 26.0 (IBM Corp., Armonk, NY). Prevalence was expressed as percentages. Associations between infection status and categorical variables (breed, sex, age, anaemia) were assessed using Pearson's Chi-square (χ^2) test, while mean PCV differences were evaluated using an independent samples t-test. Statistical significance was set at $p < 0.05$. Diagnostic sensitivity was calculated as the proportion of 35 confirmed positive cases detected by each method, with the Buffy Coat Method as the reference standard.

Results and Discussion

Overall Prevalence and Species Distribution

Out of 300 cattle examined, 35 were positive for trypanosome infection, giving an overall prevalence of 11.67%. Three species were identified: *T. vivax* (7.33%; 62.86% of infections), *T. congolense* (3.33%; 28.57%), and *T. brucei* (1.00%; 8.57%) (Table 1).

The prevalence observed aligns with reports from similar agroecological zones in Nigeria, including 10.3% in Makurdi (Enwezor *et al.*, 2012), 12.5% in Nsukka municipal abattoir (Ikenna-Ezeh *et al.*, 2020), and 13.1% in Asaba (Chibuogwu *et al.*, 2023), suggesting a relatively stable endemic pattern across the savanna region, likely sustained by tsetse presence and continuous cattle movement (Odeniran & Ademola, 2018; Okello *et al.*, 2022). Higher prevalence in more humid areas, such as 18.4% in Bauchi, has been linked to increased *Glossina* density (Jajere *et al.*, 2018; Aliyu *et al.*, 2022).

The predominance of *T. vivax* is consistent with its epidemiological advantage in West Africa (Odeniran & Ademola, 2018; Gurama *et al.*, 2025), largely due to its dual transmission via both tsetse and mechanical vectors such as *Stomoxys*, *Tabanus*, and *Haematopota* (Odeniran *et al.*, 2020; Giordani *et al.*, 2016). In contrast, the low prevalence of *T. brucei* agrees with previous studies (Odeniran *et al.*, 2019; Dede *et al.*, 2021) and may reflect its acute pathogenicity, which reduces the likelihood of infected animals reaching slaughter age (Wilkowsky, 2022).

Table 1. Prevalence and Species Distribution of Trypanosoma in Cattle Slaughtered at Gombe Township Abattoir (n = 300)

Trypanosome Species	No. Positive	Prevalence (%)	Proportion of Infections (%)
<i>T. vivax</i>	22	7.33	62.86
<i>T. congolense</i>	10	3.33	28.57
<i>T. brucei</i>	3	1.00	8.57
Total	35	11.67	100.00

Source: Fieldwork, 2025

Prevalence by Breed

White Fulani cattle (n = 180) showed the highest prevalence (12.78%), followed by Red Bororo (10.67%, n = 75) and Sokoto Gudali (8.89%, n = 45); however, no significant association was found between breed and infection ($\chi^2 = 2.14$; $p = 0.34$) (Table 2). This lack of significance agrees with reports from Kwara and Borno States, where breed had no effect on trypanosome prevalence (Odeniran & Ademola, 2018; Yusuf *et al.*, 2022). The higher prevalence in White Fulani cattle likely reflects their numerical dominance and nomadic management, which increases exposure to tsetse-infested habitats (Odeniran *et al.*, 2021; Okello *et al.*, 2022). In contrast, studies in Ethiopia have shown lower prevalence in indigenous zebu breeds due to trypanotolerance (Habeeb *et al.*, 2021). Although non-significant, the lower prevalence observed in Sokoto Gudali cattle may warrant further investigation into potential adaptive traits (Yusuf *et al.*, 2022).

Table 2. Prevalence of Bovine Trypanosomiasis by Breed of Cattle (n = 300)

Breed	No. Examined	No. Infected	Prevalence (%)	χ^2 (p-value)
White Fulani	180	23	12.78	2.14 (0.34)
Red Bororo	75	8	10.67	—
Sokoto Gudali	45	4	8.89	—
Total	300	35	11.67	

Source: Fieldwork, 2025; — = not applicable

Prevalence by Sex

Male cattle had a slightly higher prevalence (12.20%) than females (11.47%), but the difference was not significant ($\chi^2 = 0.08$; $p = 0.78$) (Table 3), suggesting similar exposure and susceptibility. This aligns with findings from Asaba and Ogun State (Chibuogwu *et al.*, 2023; Okwelum *et al.*, 2021). In extensive systems, both sexes share grazing areas, making equal contact with vectors (Odeniran & Ademola, 2018). The higher proportion of females (72.67%) reflects cultural practices of retaining males for draught and trade, while culling post-reproductive females (Gurama *et al.*, 2025). Although reproductive stress or draught work can influence susceptibility (Kizza *et al.*, 2021; Mathewos *et al.*, 2022; Habeeb *et al.*, 2021), no sex-related difference was observed in this study.

Table 3. Prevalence of Bovine Trypanosomiasis by Sex of Cattle (n = 300)

Sex	No. Examined	No. Infected	Prevalence (%)	χ^2 (p-value)
Male	82	10	12.20	0.08 (0.78)



Female	218	25	11.47	—
Total	300	35	11.67	

Source: Fieldwork, 2025; — = not applicable

Prevalence by Age

Adult cattle (≥ 3 years) had higher prevalence (13.33%) than young animals (< 3 years; 7.78%), with $\chi^2 = 3.52$; $p = 0.06$ (Table 4), slightly above the significance threshold. This trend supports the cumulative exposure hypothesis, as older animals accumulate more tsetse bites and chronic infections (Habeeb *et al.*, 2021; Wada *et al.*, 2020). Similar age-related patterns have been reported in Plateau (Dede *et al.*, 2021) and Taraba States (Gurama *et al.*, 2025). The borderline p-value may reflect the smaller sample of young cattle ($n = 90$) rather than true lack of association (Mathewos *et al.*, 2022). Additionally, younger animals may suppress parasitaemia below microscopic detection limits due to stronger innate immunity, potentially underestimating prevalence in this group (Kizza *et al.*, 2021).

Table 4. Prevalence of Bovine Trypanosomiasis by Age Category (n = 300)

Age Category	No. Examined	No. Infected	Prevalence (%)	χ^2 (p-value)
Young (< 3 yrs)	90	7	7.78	3.52 (0.06)
Adult (≥ 3 yrs)	210	28	13.33	—
Total	300	35	11.67	

Source: Fieldwork, 2025; — = not applicable

PCV Analysis and Anaemia

The mean PCV of all sampled cattle was $28.5\% \pm 5.1\%$. Infected animals had significantly lower PCV ($22.4\% \pm 3.8\%$) than uninfected ones ($30.8\% \pm 4.5\%$; $p < 0.001$) (Table 5). Anaemic cattle (PCV $< 24\%$) showed higher trypanosome prevalence (30.88%) than non-anaemic animals (6.03%) (Table 6), confirming trypanosomiasis as a major contributor to bovine anaemia in Gombe ($p < 0.001$). These results align with reports from Aliyu *et al.* (2022) who documented PCV value of 21.9 % and 20.8% from the findings of Yusuf *et al.* (2022). Trypanosome-associated anaemia arises from erythrophagocytosis, immune-mediated haemolysis, haemodilution, and suppressed erythropoiesis (Wilkowsky, 2022; Giordani *et al.*, 2016). *T. vivax* is particularly implicated via sialidase-mediated erythrocyte destruction (Giordani *et al.*, 2016; Wilkowsky, 2022).

The overall mean PCV (28.5%) is below the tropical African reference range (30–45%; Constable *et al.*, 2017), indicating subclinical herd-level anaemia, as also observed in Asaba with a value of 27.3% (Chibuogwu *et al.*, 2023). The high prevalence among anaemic animals underscores the impact of trypanosomiasis on growth, reproduction, and immunity, amplifying economic losses beyond direct mortality (Tora *et al.*, 2024; Odeniran *et al.*, 2021).

Table 5. Packed Cell Volume (PCV) Values by Trypanosome Infection Status

Infection Status	Mean PCV (%)	Standard Deviation ($\pm$)	p-value (t-test)
Infected (n = 35)	22.4	3.8	< 0.001
Uninfected (n = 265)	30.8	4.5	—

Source: Fieldwork, 2025

Table 6. Prevalence of Trypanosome Infection by Anaemia Status (PCV $< 24\%$)

PCV Category	No. Examined	No. Infected	Prevalence (%)
Anaemic ($< 24\%$)	68	21	30.88
Non-Anaemic ($\geq 24\%$)	232	14	6.03
Total	300	35	11.67

Source: Fieldwork, 2025

Comparative Sensitivity of Diagnostic Methods

Of the five diagnostic techniques, the Buffy Coat Method (BCM) had the highest sensitivity (100%), detecting all 35 positive cases, followed by HCT/Woo (94.3%), thick smear (54.3%), wet mount (40.0%), and thin smear (25.7%) (Table 7). The superiority of BCM and HCT arises from centrifugation concentrating parasites at the erythrocyte-plasma interface, enhancing detection during low or fluctuating parasitaemia (Desquesnes *et al.*, 2022; Yusuf *et al.*, 2022). Similar sensitivities have been reported in Benue (Enwezor *et al.*, 2012) and Plateau States (Dede *et al.*, 2021), supporting the recommendation that BCM or HCT constitute the minimum standard for abattoir and field surveys.

Thin smear sensitivity is low because detection depends on randomly encountering parasites, often missed in chronic infections (Desquesnes *et al.*, 2022; Odeniran *et al.*, 2019). Wet mounts (40%) detect motile parasites but are limited by rapid drying and preparation artefacts (Odeniran & Ademola, 2018). Reliance on smear-based methods alone could underestimate prevalence by 45–74%, with major epidemiological implications. Molecular techniques (e.g., PCR) offer higher sensitivity and detect mixed or sub-patent infections (Giordani *et al.*, 2016; Odeniran *et al.*, 2020; Wilkowsky, 2022), but their use is limited in resource-constrained settings like Gombe.

Table 7. Comparative Performance of Diagnostic Methods for Bovine Trypanosomiasis
Detection (n = 35 positives)

Diagnostic Method	No. Positive	Relative Sensitivity (%)
Wet Mount	14	40.0
Thick Blood Smear	19	54.3
Thin Blood Smear	9	25.7
Haematocrit Centrifugation (HCT/Woo)	33	94.3
Buffy Coat Method (BCM)	35	100.0

Source: Fieldwork, 2025; Relative sensitivity calculated against BCM as reference standard

Conclusion

Bovine trypanosomiasis is prevalent at the Gombe Township Abattoir (11.67%), with *Trypanosoma vivax* as the predominant species. Infection is significantly associated with anaemia, and higher prevalence in adult cattle highlights cumulative tsetse exposure. Breed and sex were not significant risk factors, indicating adults as the main reservoirs for targeted surveillance and control.

Concentration-based techniques, particularly the Buffy Coat Method and Haematocrit Centrifugation Technique, were markedly more sensitive than conventional smears and should serve as the minimum diagnostic standard in abattoir and field surveys. Reliance on thin smears risks underestimating true prevalence, compromising control strategies.

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