



Research Article

Prevalence and Risk Factors of *Trypanosoma* Infection in Cattle and Sheep Slaughtered at Katsina Abattoir, Nigeria

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ABSTRACT

African Animal Trypanosomiasis (AAT) is a major constraint to livestock production in sub-Saharan Africa, causing anaemia, reduced productivity and economic losses in cattle and sheep. Its burden among slaughtered livestock in Katsina State, Nigeria, remains poorly documented, as earlier studies focused mainly on live grazing animals. This study determined the prevalence and risk factors of *Trypanosoma* infection in cattle and sheep slaughtered at Katsina Modern Abattoir. A six-month cross-sectional study sampled 400 animals (250 cattle and 150 sheep). Blood was examined by wet mount, thin film and Giemsa-stained thick film microscopy, while structured questionnaires captured demographic and risk-factor data. Data were analysed using descriptive statistics, chi-square tests and logistic regression, with significance set at $p < 0.05$. Five animals tested positive, giving a prevalence of 1.25%. Prevalence was higher in cattle (1.60%) than in sheep (0.66%), although the difference was not significant ($\chi^2 = 0.820$, $df = 1$, $p = 0.365$). White Fulani cattle recorded the highest breed-specific prevalence (1.72%), whereas Sokoto Gudali cattle, Balami sheep and Uda sheep had no infections. Prevalence was four times higher in the rainy season (2.00%) than in the dry season (0.50%; OR=4.08, 95% CI: 0.45–36.84), and young animals (≤ 2 years) had the highest age-related prevalence (2.63%; OR=2.60). None of the risk factors examined reached statistical significance. AAT prevalence among slaughtered cattle and sheep at Katsina abattoir is low but persistent, with season and age emerging as the most notable, though non-significant, predictors. Larger molecular-based studies are recommended to better characterise trypanosomiasis burden and risk factors in the area.

Keywords: Abattoir; Cattle; Katsina; Nigeria; Risk factors; Sheep; Trypanosomiasis

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INTRODUCTION

African animal trypanosomiasis (AAT) is a vector-borne parasitic disease caused by protozoa of the genus *Trypanosoma*, transmitted cyclically by *Glossina* species (tsetse fly flies) and mechanically by biting flies such as *Stomoxys* and *Tabanus* (Giordani *et al.*, 2016). It remains one of the most significant constraints to livestock production in sub-Saharan Africa, contributing to anaemia, reduced fertility, decreased milk yield, weight loss and mortality in cattle and sheep, with consequent losses to food security and rural livelihoods (Swallow, 2000;

Giordani *et al.*, 2016). *Trypanosoma congolense*, *T. vivax*, *T. brucei* and *T. evansi* are the species of greatest veterinary importance in Nigeria, and their distribution follows that of the tsetse fly and other biting-fly vectors. The northern region of Nigeria, including Katsina State, carries a high livestock population and is therefore an important area for surveillance of AAT prevalence and its risk factors (Odeniran and Ademola, 2018).

Slaughterhouses and abattoirs offer a practical point for disease surveillance, allowing the health status of animals drawn from a wide catchment area to be

assessed at a single site. However, most epidemiological studies on AAT in Katsina State had focused on live animals within grazing systems, leaving the burden of infection among slaughtered cattle and sheep, and the risk factors that drives it are poorly characterised. Understanding seasonal, host and management-related risk factors is essential for designing evidence-based, targeted control interventions. This study therefore determined the prevalence of *Trypanosoma* species infection in cattle and sheep slaughtered at Katsina Modern Abattoir, compared infection between the rainy and dry seasons, and identified the host, management and clinical factors associated with infection.

MATERIALS AND METHODS

Study Area

The study was conducted at Katsina Modern Abattoir, Katsina State, in north-western Nigeria (approximately 12.9974°N, 7.6171°E). Katsina lies within the Sudan Savannah vegetation zone and experiences a tropical wet-and-dry climate, with a rainy season from May/June to September/October and a dry, harmattan-influenced period from November to February. Annual rainfall ranges from 600–1000 mm and temperatures range from 14 °C to 41 °C. Cattle, sheep, goats, camels, donkeys and horses are integral to the local economy (Odeniran and Ademola, 2018).

Study design and sample size

A cross-sectional study was conducted over a six-month period. The minimum sample size was estimated at 385 animals using the standard formula for prevalence studies ($Z=1.96$, $d=0.05$), applying an expected prevalence of 50%, the value recommended when no reliable local prevalence estimate is available (Thrusfield, 2018). A total of 400 animals (250 cattle and 150 sheep) were sampled during the study period, exceeding the minimum requirement.

Collection of Samples and Data

Five millilitres of blood was collected from each animal into EDTA sample bottles, labelled with animal details and transported to the Biology Laboratory at the Department of Biological Sciences, Federal University Dutsin-Ma for analysis. Structured questionnaires were administered to butchers and, where present, animal owners, to obtain data on animal demographics, management history and potential risk factors, including breed, sex, age, body condition, source, prior trypanocidal treatment, grazing practice, proximity to water bodies, tsetse fly exposure, and clinical signs at slaughter.

Parasitological Examination

Wet mounts and thin blood films were prepared as described by Cheesbrough (2006). Thin films were fixed with methanol, air-dried and stained with Giemsa stain for 45 minutes before microscopic examination under oil immersion ($\times 100$). *Trypanosoma* species were identified on the basis of morphology, motility, the presence and position of an undulating membrane and kinetoplast, and the length of the free flagellum (World Organisation for Animal Health [WOAH], 2021).

Data analysis

Data were analysed using SPSS version 20. Descriptive statistics was used to summarize prevalence, while Chi-square tests and logistic regression were used to assess associations between infection status and the candidate risk factors. Odds ratios with 95% confidence intervals were calculated for each factor. A p-value <0.05 was considered statistically significant.

RESULTS

Prevalence by animal type and breed

Of the 400 animals screened, 5 tested positive for *Trypanosoma* species, giving an overall prevalence of 1.25% (95% CI: 0.41–2.88%). Prevalence was 1.60% (4/250; 95% CI: 0.44–4.04%) in cattle and 0.66% (1/150; 95% CI: 0.02–3.60%) in sheep; the difference was not statistically significant ($\chi^2=0.820$, $df=1$, $p=0.365$). Among the six breeds examined, White Fulani cattle recorded the highest number of infection (3/174; 1.72%), followed by Red Bororo cattle (1/4; 25.00%) and Yankasa sheep (1/90; 1.11%). Sokoto Gudali cattle, Balami sheep and Uda sheep had no infections (Table 1).

Seasonal comparison

Two hundred animals were sampled in each season. Overall prevalence during the rainy season was 2.00% (4/200), fourfold higher than the 0.50% (1/200) recorded during the dry season. Within the rainy season, cattle recorded 2.40% (3/125) and sheep 1.33% (1/75); during the dry season, cattle recorded 0.80% (1/125) and no infections were detected in sheep. Although the seasonal difference did not reach conventional significance ($\chi^2=0.820$, $df=1$, $p=0.37$), the odds ratio of 4.08 (95% CI: 0.45–36.84) indicates that animals examined during the rainy season were approximately four times more likely to be infected than those examined in the dry season (Table 2).

Risk factors associated with the infection

Sheep were less likely than cattle to be infected (OR=0.41, 95% CI: 0.05–3.71, $p=0.37$). Red Bororo cattle showed a markedly high point prevalence

(25.00%; OR=18.75, 95% CI: 1.77–198.65) that should be interpreted with caution given the small breed sample (n=4). Females (1.49%) recorded a marginally higher prevalence than males (1.01%; OR=1.49, p=1.00). Young animals (≤ 2 years) recorded the highest age-specific prevalence (2.63%; OR=2.60, 95% CI: 0.27–25.18) compared with adults (1.03%) and older animals (1.39%); the overall age association was not significant (p=0.70). Animals with clinical signs at slaughter (4.00%; OR=3.91) and those with observed

anaemia (3.13%; OR=2.94) showed higher point prevalence than clinically normal animals, and animals with tsetse fly fly exposure (1.74%; OR=1.66) and proximity to water bodies (1.35%; OR=1.20) showed a positive directional association with infection. None of these associations, nor those for source of animal, prior trypanocidal treatment, grazing practice, body condition or emaciation, reached statistical significance, most likely reflecting the small number of positive cases (n=5) (Table 3)

Table 1: Prevalence of *Trypanosoma* infection by animal type and breed

Animal type	Breed	Number of examined samples	Number of positive samples	Number of Negative samples	Prevalence (%)
Cattle		250	4	246	1.60
	White Fulani	174	3	171	1.72
	SokotoGudali	72	0	72	0.00
	Red Bororo	4	1	3	25.00
Sheep		150	1	149	0.66
	Yankasa	91	1	90	1.10
	Balami	33	0	33	0.00
	Uda	27	0	27	0.00
Total		400	5	396	1.25

$\chi^2 = 0.820$, $df = 1$, $p = 0.365$ (cattle vs sheep).

Table 2: Seasonal comparison of *Trypanosoma* infection in cattle and sheep

Season	Animal type	Number of examined samples	Number of positive samples	Prevalence (%)
Rainy	Cattle	125	3	2.40
Rainy	Sheep	75	1	1.33
Rainy (total)	Both	200	4	2.00
Dry	Cattle	125	1	0.80
Dry	Sheep	75	0	0.00
Dry (total)	Both	200	1	0.50
Overall total	Both	400	5	1.25

Table 3: Risk factors associated with *Trypanosoma* infection in cattle and sheep

Risk factor	Number of examined samples	No of positive samples (%)	Odds ratio (95% CI)	p-value
Animal type				0.37
Cattle	250	4 (1.60)	1.00 (ref)	
Sheep	150	1 (0.67)	0.41 (0.05–3.71)	
Breed				0.58
White Fulani	174	3 (1.72)	—	
SokotoGudali	72	0 (0.00)	—	
Red Bororo	4	1 (25.00)	18.75 (1.77–198.65)	0.08
Yankasa	90	1 (1.11)	—	0.70
Balami	33	0 (0.00)	—	
Uda	27	0 (0.00)	—	0.76
Sex				1.00
Male	199	2 (1.01)	1.00 (ref)	
Female	201	3 (1.49)	1.49 (0.25–8.98)	
Age				0.70
Adult (3–5 y)	290	3 (1.03)	1.00 (ref)	
Young (≤2 y)	38	1 (2.63)	2.60 (0.27–25.18)	
Old (>5 y)	72	1 (1.39)	1.35 (0.14–13.25)	
Season				0.37
Dry	200	1 (0.50)	1.00 (ref)	
Rainy	200	4 (2.00)	4.08 (0.45–36.84)	
Body condition				0.61
Good	378	5 (1.32)	—	
Poor	22	0 (0.00)	—	
Source of animal				0.63
Local	391	5 (1.28)	—	
Imported	9	0 (0.00)	—	
Prior trypanocidal treatment				0.61
No	380	5 (1.32)	—	
Yes	20	0 (0.00)	—	
Grazing practice				0.59
Grazed	365	5 (1.37)	—	
Confined	35	0 (0.00)	—	
Proximity to water body				0.45
No	178	2 (1.12)	1.00 (ref)	
Yes	222	3 (1.35)	1.20 (0.20–7.28)	
Tsetse fly fly exposure				0.23
No	285	3 (1.05)	1.00 (ref)	
Yes	115	2 (1.74)	1.66 (0.27–10.05)	
Clinical signs at slaughter				0.14
Absent	375	4 (1.07)	1.00 (ref)	
Present	25	1 (4.00)	3.91 (0.42–36.31)	
Anaemia observed				0.21
No	368	4 (1.09)	1.00 (ref)	
Yes	32	1 (3.13)	2.94 (0.32–27.25)	
Emaciation/wasting				0.57
No	382	5 (1.31)	—	
Yes	18	0 (0.00)	—	

DISCUSSION

The overall prevalence of 1.25% recorded in this study is comparable to, but somewhat higher than, the 0.8% microscopic prevalence reported for cattle along the Jebba axis of the River Niger, Kwara State, where a substantially higher PCR-based prevalence of 3.0% in the same animals underscored the greater sensitivity of molecular diagnostics relative to the conventional Giemsa-stained microscopy used in the present study (Habeeb *et al.*, 2021). Similarly, a meta-analysis of AAT prevalence across Nigerian studies published between 1960 and 2017 reported wide variation according to diagnostic method, host species and ecological zone (Odeniran and Ademola, 2018), consistent with the comparatively low, microscopy-based estimate obtained here in the drier Sudan Savannah ecology of Katsina State, where reduced tsetse fly habitat suitability likely limits transmission intensity relative to wetter, tsetse fly-endemic zones further south.

A clear seasonal pattern was observed, with prevalence fourfold higher in the rainy season than the dry season. This is consistent with the established ecology of tsetse fly-transmitted trypanosomiasis: warm, humid conditions and denser vegetation during the rainy season favour tsetse fly population growth and activity, increasing fly–host contact and the frequency of infective bites (Giordani *et al.*, 2016). A comparable rainy-season peak in trypanosome prevalence has been reported in cattle on the Jos Plateau, Nigeria (Majekodunmi *et al.*, 2013), supporting the biological plausibility of the seasonal trend observed in the present study despite the absence of statistical significance, which likely reflects the small absolute number of positive cases.

Cattle recorded a numerically higher prevalence than sheep, in agreement with the broader pattern in Nigerian AAT literature (Odeniran and Ademola, 2018). Indigenous West African sheep and cattle breeds vary in their degree of trypanotolerance, an inherited resistance shaped by generations of natural selection under endemic disease pressure (Naessens, 2006; Somé *et al.*, 2024). Differences in grazing behaviour may also contribute: cattle are frequently herded over long distances through wooded and riverine habitats favoured by tsetse fly flies, whereas sheep tend to graze closer to homesteads, potentially reducing vector exposure. Host body size may further influence tsetse fly host-seeking behaviour, since tsetse fly flies respond to visual and olfactory cues that scale with target size (Torr *et al.*, 2011), which may partly explain the higher exposure risk in the

larger-bodied cattle. The absence of infection in Sokoto Gudali cattle, Balami sheep and Uda sheep, despite reasonable sample sizes for the first two breeds, is consistent with possible breed-associated trypanotolerance, although this would need confirmation using more sensitive molecular diagnostics and larger breed-specific samples, such as those described by Berthier *et al.* (2015) in their comparison of trypanotolerance across West African cattle breeds.

The higher point prevalence observed in young animals (≤ 2 years) compared with adults and older animals may reflect incompletely developed immunity in younger stock, while the higher prevalence in animals showing clinical signs or anaemia at slaughter is consistent with the expected pathophysiology of trypanosome infection, which characteristically produces progressive anaemia and wasting. None of the risk factors examined reached statistical significance in this study, a pattern attributable to the small number of positive cases ($n=5$) rather than to a genuine absence of association, and one that limits the statistical power of the logistic regression analysis. This underscores a broader methodological point: conventional microscopy, while inexpensive and field-deployable, is likely to underestimate the true burden of AAT in low-prevalence settings, and molecular diagnostic methods such as PCR would be expected to reveal a higher and more precisely characterised prevalence, as has been shown elsewhere in Nigeria (Habeeb *et al.*, 2021).

CONCLUSION

This cross-sectional study found an overall *Trypanosoma* prevalence of 1.25% among 400 cattle and sheep slaughtered at Katsina Modern Abattoir, with cattle (1.60%) showing marginally higher infection than sheep (0.66%). White Fulani cattle recorded the highest breed-specific prevalence (1.72%), while Sokoto Gudali cattle, Balami sheep and Uda sheep showed no infections, suggesting possible breed-associated trypanotolerance. Young animals (≤ 2 years) had a 2.6-fold higher point prevalence than adults, and prevalence was fourfold higher in the rainy season than the dry season. Although none of the risk factors examined achieved statistical significance, owing to the limited number of positive cases, season and age emerged as the most notable predictors of infection in this population.

Veterinary authorities in Katsina State should intensify surveillance and prophylactic measures for cattle and sheep during the rainy season, when

infection risk is highest. Larger-scale, abattoir-based studies employing more sensitive molecular diagnostic techniques, such as PCR, should be conducted to obtain more precise prevalence estimates and adequately powered risk-factor analyses. Young animals (≤ 2 years) should receive targeted attention in surveillance and control programmes, given their comparatively higher infection risk. Entomological surveys should be conducted around Katsina abattoir catchment areas to identify the tsetse fly and other biting-fly species responsible for local transmission and to characterise their seasonal dynamics. A One Health approach that integrates veterinary and public health surveillance should be adopted, given the zoonotic potential of some trypanosome species and the shared exposure of livestock handlers and rural communities.

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Author Contributions

WS conceived and designed the study, collected samples and data, performed the laboratory analysis, analysed the data, and drafted the manuscript. JBO supervised the study, contributed to the study design and data interpretation, and critically revised the manuscript. Both authors read and approved the final manuscript.

Data Availability

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

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