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Prevalence of African trypanosomosis in cattle and sheep in Bassa local government area of Plateau State, Nigeria

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Abstract

A cross-sectional study to determine the prevalence of trypanosomosis in Bassa Local Government Area of Plateau State was carried out on 462 animals (361 cattle and 101 sheep) purposively selected. Blood samples were examined for trypanosomes and the packed cell volume was determined. Biconical traps were set to catch biting flies which were later dissected. The body condition scores of the selected animals were also noted. Out of the 462 blood samples examined, 22 (4.8%) tested positive for trypanosomes. Sheep had higher trypanosome prevalence of 6.9% than cattle 4.2%. The most prevalent species encountered was *Trypanosoma vivax* (86.4%) followed by *T. brucei* (13.6%). *Trypanosoma vivax* was also more predominant in cattle 13 (86.7%) than sheep 6 (85.7%). White Fulani and Red Bororo cattle had 4.2% and 0.0% prevalence, respectively while Yankasa sheep, the only sheep breed sampled, had 6.9%. Male cattle and sheep were more infected with the prevalence rates of 5.0% and 7.4%, respectively than their female counterpart (3.6% for cattle and 6.8% for Sheep). Young cattle (< 3yrs) and sheep (≤ 2yrs) had higher trypanosome infection rates of 5.4% and 9.4% than the adult cattle (≥ 3yrs) and sheep (>2yrs) having the prevalence rates of 3.1% and 4.2% respectively. Poor body conditioned animals had higher trypanosome prevalence (7.3%) than the good body conditioned ones (3.8%). Age, sex, breed and body condition score of animals examined did not influence the infection rate of trypanosome species ($p>0.05$). The mean PCV ± standard deviation of infected animals (21.73 ± 4.81) was significantly lower than non-infected animals (26.89 ± 4.37) $p < 0.05$.The study revealed an overall relative low fly density of 0.39 flies/trap/day and flies dissected were negative for trypanosome infection. This present study revealed trypanosome and their vectors are present in the study area. Therefore, improved Veterinary extension services and education should be implemented.

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Introduction

African animal trypanosomosis (AAT) is a protozoan parasitic disease that causes devastating and serious economic losses to livestock production. The disease is also among the neglected tropical disease affecting human across 36 Sub-Saharan African countries including Nigeria (Ruberto *et al.,* 2013).

Trypanosoma congolense, *T. brucei brucei*, *T. vivax and T. evansi* are the most important species that infect livestock in Nigeria. These trypanosomes are found where its biological vector (tsetsefly) and other biting flies (*Stomoxys, Tabanids*) exist (Juyal *et al*., 2005; CFSPH, 2009). The host preferences of each trypanosome species vary but *T. vivax* are known to infect wide host range including cattle, goat, sheep, horses and donkeys as they can be transmitted both cyclically by tsetse flies and mechanically by other biting flies (Duffy *et al.,* 2009) resulting in a distribution of infection beyond the "tsetse fly belt". Recently, there were reported cases of human infective trypanosomes (*Trypanosoma brucei gambiense*) isolated from domestic animals (Yanan, 2008; WHO, 2014). These poses a public health risk to livestock rearers, hunters, rural dwellers, farmers and veterinarians who are often in close contact with these animals and its biological vectors. Mariam (2006) has reported an economic loss of 70 million US dollars annually due to trypanosome infection of cattle in six northern states of Nigeria.

Bassa Local Government Area (LGA) has a conducive environment for rearing large population of livestock but recent influx of animals from neighboring states of Kaduna and Bauchi, known to be endemic foci for trypanosomosis poses a threat to livestock production and the rural dwellers.

Hence, this study was aimed at investigating the current prevalence of trypanosomosis in cattle and sheep in Bassa LGA of Plateau state, Nigeria.

Materials and Methods

The study area

The study was conducted in Bassa Local Government Area (LGA) of Plateau state. Bassa LGA is located in the northern part of the state and lies between 9^{o} 56'N and 8^{o} 44'E. It has a rainfall value of 1400-1500m and altitude over 1200m above sea level with a combination of grassland, forest and stream running through it. Three districts namely, Zabolo, Kachrika and Rafiki were randomly selected for the investigation.

Study population

A cross sectional study was carried out between March and May, 2016 on 462 animals comprising 361 cattle and 101 sheep purposively selected (Putt *et al*., 1987) as a result of recent influx of livestock from known trypanosomosis enzootic foci of Kaduna, Nasarawa and Bauchi state into the study area once declared free of tsetse fly and trypanosomosis. The sample size was determined using Thrusfield (2005) description and an expected prevalence of 13.08% (Quadeer *et al.,* 2008). Epidemiological variables such as age, sex, breed and body condition scores were carried out according to Nicholson & Butterworth (1986): Good body condition: F, M and M^{+} (non – prominent paralumbar fossa and ribcage). Poor body condition: L^{+} L^{-} and M^{-} (Prominent paralumbar fossa and Rib cage) where F- Fat, M- Medium, L- Lean.)

Sample collection

Three millilitres (3mls) of blood was aseptically collected from the jugular vein of each targeted animal (cattle and sheep). The blood samples were dispensed into Ethylene Diamine Tetra-acetic Acid (EDTA) bottles. They were transported in ice-packed boxes to the Laboratory of the Nigerian Institute for Trypanosomiasis Research, Vom, Plateau State for analysis.

Parasitological examination

Two diagnostic techniques; buffy coat (Woo, 1970) and Giemsa staining method (Wilson, 1969) were employed for trypanosome parasite detection as well as morphological identification and differentiation respectively (Kumar *et al.,* 2012). Stained slides were examined using oil immersion under x 100 microscopic magnification.

Haematology

Packed cell volume (PCV) of each sampled animal was estimated to assess the level of anaemia using haematocrit centrifugation method as described by Woo (1970).

Vector catch

Biconical traps were used for trapping tsetse flies in each districts of Bassa LGA investigated. They were impregnated with acetone as fly attractants. Traps were set at 100 meters apart along river banks, resting place and thicket. The flies were harvested at sun set each day. All the trapped flies were identified to species level (Baldry, 1969; Murray *et al*., 1983). The proboscis, midgut, proventriculus and salivary glands of dissected flies were teased out into 0.9% saline solution on a grease-free slide. These were examined for motile trypanosomes under x40 dissecting microscope.

Statistical analysis

The data obtained from the study were analysed using SPSS 17.0 version. Chi-square test was used to determine association between infection and epidemiological variables while students't-test was used to determine significant difference between

mean PCV of infected and non-infected animals. The prevalence of infection was calculated by dividing number of infected animals by number of animals examined and the result recorded in percentages. The p value was set at p≤0.05.

Results

Out of the total of 462 animals (361 cattle and 101 sheep) examined for trypanosome infection in this study, 22 (4.8%) were infected (Table 1). Sheep had more trypanosome prevalence (6.9%) than cattle (4.2%), although no significant difference (p>0.05) was observed between their prevalence rates. The species of trypanosome found in this study were *Trypanosoma vivax* and *T. brucei. Trypanosoma vivax* accounted for 86.4% (19/22) of all positive cases and is slightly higher in cattle 86.7% (13/15) than sheep 85.7% (6/7) (Table 1). The remaining 13.6% of the positive cases were due to *T. brucei*, *T. Congolense* infection was absent in all the districts of the LGA investigated. Statistical analysis showed no significant difference (p>0.05) in the spread of the trypanosome species in cattle and sheep in all the districts investigated.

Table 2 shows that Yankasa breed of sheep which was the only breed encountered in the study, recorded higher trypanosome infection rate of 6.9% than White Fulani (4.2%) and Red Bororo (0.0%) breeds of cattle. Male cattle and sheep were more Infected, 5.0% and 7.4% respectively than their female counterparts having the prevalence of 3.6% for cattle and 6.8% for sheep. The study also recorded that young cattle (< 3yrs) and sheep (≤ 2yrs) had higher trypanosome infection rates of 5.4%

Table 1: Prevalence of Trypanosomosis of cattle and sheep in Bassa LGA

Animal species	Total Samples	Number Negative	Number Positive	Prevalence	Trypanosome species Prevalence		
					T. vivax	*T. congolense*	T. *brucei*
Cattle	361	346	15	4.2%	13 (86.7)	0 (0.0)	2 (13.3)
Sheep	101	94	7	6.9%	6 (85.7)	0 (0.0)	1 (14.3)
Total	462	440	22	4.8%	19 (86.4)	0 (0.0)	3 (13.6)

Chi –Square =1.316, df 1 P. Value= 0.51

Table 2: Relationship between infection and epidemiological variables (breed, sex, age, and body condition score) of cattle and sheep in Bassa LGA

Category	Animal Species	Variables	Number of animals examined	Number of positive animals	Number of Negative animals	Prevalence (%)	Chi square (X^2)	P. value
Breeds of animal		White Fulani	341	15	326	4.2%		
		Red Bororo	20	0	20	0.0%		
		Yankasa sheep	101	7	94	6.9%	1.2115	0.95
Sex	Cattle	Male	140	7	133	5.0%	0.137	0.712
		Female	221	8	213	3.6%		
	Sheep	Male	27	2	25	7.4%		
		Female	74	5	69	6.8%	0.013	0.909
Age	Cattle	Adult(≥3yrs)	193	6	187	3.1%	0.645	0.422
		Young (<3yrs)	168	9	159	5.4%		
	Sheep	Adult (>2yrs)	48	2	46	4.2%		
		Young (≤2yrs)	53	5	48	9.4%	0.421	0.517
Body condition of animal examined		Good BCS (F ,M, M^+)	339	13	326	3.8%		
		Poor BCS (M^- L^- L^+)	123	9	114	7.3%	1.706	0.191

Table 3: Mean Packed cell volume (PCV) of parasitaemic and aparasitaemic cattle and sheep in Bassa LGA

Animal	Condition	Number examined	Mean PCV ± STD	P Value
Cattle	Infected	15	21.93 ± 5.50	<0.001
	Non infected	346	27.02± 4.39	
Sheep	Infected	7	21.29 ± 3.14	
	Non infected	94	26.41 ± 4.30	0.003
Total	Infected animal	22	21.73 ± 4.81	<0.001
	Non infected	440	26.89 ± 4.37	

P value is set at ≤ 0.05

Table 4: Distribution of tsetse and other biting flies Trapped in Bassa LGA

Districts	Biting Flies Caught				Total
	G. palpalis	*G.morsitan*	*Tabanids*	*Stomoxys*	
Zabolo	2	0	1	0	3
Kakricha	1	1	0	0	2
Rafiki	0	0	2	0	2
Overall Total(%)	3(42.9)	1(14.3)	3(42.9)	0(0.0)	7

and 9.4% respectively than older cattle (3.1%) and sheep (4.2%). The poor conditioned animals showed higher trypanosome infection (7.3%) than the good conditioned ones (3.8%).

Table 3 shows that infected cattle had lower mean PCV value (21.93±5.50) than the non-infected cattle (27.02± 4.39). Likewise, infected sheep also recorded lower PCV values of 21.29±3.14 when compared to the non-infected ones (26.41± 4.30).

There was a statistically significant ($p<0.05$) difference between the PCV of the infected animal and non- infected ones in the study area.

A total of 7 flies were trapped in the study comprising 3(42.9%) *Glossina palpalis*, 1 (14.3%) *G. morsitans* and 3 (42.9%) *Tabanid* (Table 4). The overall relative fly density was 0.39 f/t/d. The density of tsetse flies was 0.12 f/t/d for *G. palpalis*, 0.06 f/t/d for *G. morsitan* while other biting flies – *Tabanus* and *Stomoxys* s*pp* recorded 0.12 f/t/d and 0.0 f/t/d respectively. All *Glossina* species dissected were negative for trypanosome infection.

Discussion

This study was conducted in Bassa LGA of Plateau State, Nigeria, a place located on the high land of Jos, once declared free of trypanosomosis and its vectors (Majekodunmi *et al.,* 2013). The present study showed an overall trypanosome prevalence of 4.8% with cattle and sheep recording prevalence rates of 4.2% and 6.9% respectively. The overall trypanosomosis prevalence of 4.8% observed in this study is relatively lower than 13.08% and 5.1% reported by Quadeer *et al.* (2008) in Jos and Obaloto *et al.* (2015) in Bauchi, but higher than the prevalence of 1.9% and 4.1% recorded by Ohaeri (2010) in Abia State and Ameen *et al.* (2008) in Ogbomosho, Oyo State, respectively. The prevalence of 4.2% recorded for cattle and 6.9% for sheep in this study was higher than the findings of Ohaeri, (2010) in Abia State where prevalence of 3.7% and 1.1% were found in cattle and sheep respectively. However, there was no statistical difference ($p>0.05$) between trypanosome infection prevalence in cattle and sheep in this study. This study has also shown that *T .vivax* was the dominant species with a proportion of 86.4% followed by *T. brucei* 13.6%. There was no *Trypanosoma congolense* infection recorded either in the cattle or in the sheep. These reports are consistent with most findings by other workers including Yanan *et al.* (2007) where 6.45% was recorded for *T. vivax* and 2.68% for *T. brucei* and Fasanmi *et al*. (2014) recorded for *T. vivax* 66.67% and 33.33% *T. brucei*. The high ratio of *T. vivax* in the study area may be ascribed to its short developmental cycle in the vectors' proboscis as well as possible mechanical transmission by other biting flies (ILRAD, 1988).

T. congolense specie was not encountered in this study which is evident in the absence of the parasite in *G.morsitan* sp. caught and dissected. These groups of tsetse flies have been incriminated in the transmission of *T. congolense* (Mulligan, 1970; Dagnachew & Shibeshi 2011). This study also showed that the distribution of Trypanosome species among various animal species investigated are not significant ($p>0.05$) even though cattle had

infection rate of 86.7% for *T. vivax* and 83.7% for Sheep. Sex prevalence of animal trypanosomosis was also higher in the male cattle and sheep compared with female cattle and sheep. This is probably because the males are more often in the fore front of the herd while grazing hence exposing them the more to bites by flies than the females. This report is consistent with Sam-Wobo *et al*. (2010) assertion that trypanosome prevalence is higher in male than in female animals but differs from the findings of Kalu *et al*. (1996) that female animals are more trypanosome infected than male animals. Age related prevalence revealed that younger cattle and sheep were more infected than adults which contradicts Sam-Wobo *et al*. (2010) and Fasanmi *et al*. (2014) claims that adult animals were more prone to trypanosome infection than younger ones. This present findings may be due to equal chances of exposure to tsetse fly bite as well as easy penetration of the tsetsefly proboscis through the less dense coat possessed by younger cattle and sheep while grazing outside the study area. Yankasa breed of sheep were more infected than white Fulani breed, while Bororo breed showed no infection, however the differences among the breed were not statistically significant. ($p>0.05$). The finding of higher prevalence of infection in the poor body condition animals (7.3%) than the good body condition ones (3.8%) corroborates the reports of Tafese *et al*. (2012) that good body conditioned animals had less infection with trypanosome when compared with the poor conditioned ones. There was no significant difference ($p>0.05$) between the prevalence of infection in good and poor body conditioned animals. PCV is the most reliable indicator of anaemia in trypanosomosis in the absence of other haemoparasitic infection (Singla *et al.*, 1997; Marcothy *et al*., 2008). In this study, there was a significant difference ($p<0.05$) between mean PCV of infected and non-infected cattle while mean PCV of infected and non-infected sheep showed no significant difference ($p>0.05$). This may be due to the number of samples examined in sheep. However, the findings observed in the infected animals as compared with the healthy ones agree with Anosa & Isoun (1974) and Marcothy *et al*. (2008) that trypanosomosis is accompanied by anaemia. The overall low relative fly density of 0.39 f/t/d obtained in this study could be due to high environmental temperature at the period of the survey, expansion of settlement or farm land. Furthermore, none of the tsetse flies dissected was positive for trypanosome. This zero infection rates explain the relative low prevalence of trypanosomosis observed in this study which corroborates the findings of Ohaeri (2010)**.**

This study might be limited due to the higher number of female animals compared to males as well as the lower number of sheep compared to cattle, might influence its outcome. In conclusion, cattle and sheep are of great economic importance in Nigeria, serving as sources of income, raw material for the leather industry as well as protein for the wellbeing of the people. Hence, the prevalence of 4.8% recorded in the animals as well as the relative density of tsetse fly (0.39f/t/d) observed in this study showed the presence of the disease and its vector in the study area and this could be a source of threat to the livelihood of the people as well as a public health risk. Therefore, improved veterinary extension education, and surveillance programmes on tsetse flies and trypanosomosis among cattle and sheep herds in Bassa Local Government Area should be instituted.

References

Ameen BA, Joshua RA, Adedeji OS, Raheem AK, Akingbade AA & Leigh OO (2008). Preliminary studies on prevalence of Ruminant trypanosomiasis in Ogbomoso area of Oyo State, Nigeria. *Middle East Journal of Scientific Research*, **3**(4): 214

Anosa VO & Isoun TT (1974). Experimental *Trypanosomavivax* infection of sheep and goats: the relationship between the parasitaemia, the growth rate and the anaemia. *Journal of Nigerian Veterinary Medical Association,* **3**: 101 - 108

Baldry DAT (1969). Distribution and trypanosome infection rates of G. M. Submorsitans along a trade cattle route in South Western Nigeria. *Bulletin of Entomological Research*, **58**(3): 537-548.

CFSPH (2009). African Animal Trypanosomiasis, The centre for Food security and public health, College of Veterinary Medicine, www.cfsph.19state.edu, retrieved 09-01-2009.

Dagnachew S & Shibeshi S (2011). Prevalence and vector distributions of bovine trypanosomosis in control (Sibu sire) and non-control (GutoGida) districts bordering upper Anger Valley of East Wollega zone, Western Ethiopia. *Ethiopian Veterinary Journals*, **15**(2): 77 – 86.

Duffy CW, Morrison LJ, Black A, Pinchbeck GL, Christley RM, Schoenefeld A, Tait A, Turner CM & MacLeod A (2009). *Trypanosome vivax* displays a clonal population structure. *International Journal of Parasitology*, **39**(13): 1475 – 1483.

Fasanmi OG, Okoroafor UP, Nwufoh OC, Bukola-Oladele OM & Ajibola ES (2014). Survey for trypanosomiasis species in cattle from three farms in Iddo local government area, Oyo State. *Sokoto Journal of Veterinary Science,* **12**(1): 57 – 61 .

ILRAD (1988). International Laboratory for Research on Animal Disease (ICRAD), New tools for Trypanosomiasis Studies, *Reports* **33**(1): 1-3.

Juyal PD, Singla LD & Kaur P (2005). Management of surra due to *Trypanosoma evansi* in India*:* An overview. In: *Infectious Diseases of Domestic Animals and Zoonosis in India* (V Tandon, BN Dhawan, editors), *Proceedings of the National Academy of Sciences India Section B: Biological Science* **75 (**Special issue). Pp 109-120.

Kalu AU, Uzoukwu M & Ikeme MM (1996). Prevalence of tsetse fly and ruminant trypanosomosis in Katsina – Ala Local Government Area, Benue State, Nigeria. *Romanian Archives of Microbiology and Immunology*, **55**(4): 341 – 352.

Kumar H, Gupta MP, Sidhu PK, Mahajan V, Bal MS, Kaur K, Ashuma, Verma S and Singla LD (2012). An outbreak of acute *Trypanosoma evansi* infection in crossbred cattle in Punjab, India. *Journal of Applied Animal Research,* **40**(03): 256-259.

Majekodunmi AO , Akinyemi F , Charles D, Picozzi K, Thrusfield MV, Welburn SC (2013). A longitudinal survey of African animal trypanosomiasis in domestic cattle on the Jos Plateau, Nigeria. Prevalence, distribution and risk factors. *Parasite Vectors*, **6**:239.

Marcothy T, Simukoko H, Berkvens D, Vercruyesse J, Praet N & Van Den Bossche P (2008). Evaluating the use of Packed Cell Volume as an indicator of trypanosomiasis infection in cattle in eastern Zambia' *Preventive Veterinary Medicine*, **87**(3-4): 288 – 300.

Mariam SH (2006). Country reports in tsetse and trypanosomiasis. *Programme Against African Trypanosomiasis* (PAAT), FAO Rome B. **29**(1): 29-30.

Mulligan HW (1970). The African Trypanosomiasis. George Allenand Unwin, London. Pp 769-770.

Murray M, Trail JCM, Turner DA & Wissosq Y (1983). Livestock production and trypanotolerance. Network training Manual, ILCA, Addis Ababa. Pp 45- 75.

Nicholson MJ & Butterworth MH (1986). A guide to condition scoring of Zebu cattle, *ILCA* Addis Ababa, 235.

Obaloto OB, Shamaki BU, Idehen CO, Eche TA, Balak GG, Dongkum C, Salami O, Akpokodje E, Kelejaiye JO & Igweh AC (2015). Survey of Animal trypanosomiasis and biting flies in parts of Alkaleri Local Government Area of Bauchi State, Nigeria. *Journal of Biology, Agriculture and Health Care*, **5**(9): 16 – 19.

Ohaeri CC (2010). Prevalence of trypanosomiasis in ruminants in parts of Abia State, Nigeria. *Journal of Animal and Veterinary Advances*, **9**(18)**:** 2422 – 2426.

Putt SNH, Shaw APN, Wood AJ, Tyler L & James AD (1987). Veterinary Epidemiology and Economics in Africa. A manual for use in the design and appraisal of livestock health policy. *ILCA Manual,* N0. 3, Addis Ababa. Pp 27-66.

Quadeer MA, Danbirni S, Usman M, Akogun OB, Gundiri MA & Bobbo AG (2008). Prevalence of bovine trypanosomiasis in Bassa local government area, Plateau state. *Nigerian Journal of Parasit*ology, **29**(2): 136-139.

Ruberto I, Szoor B, Clark R & Matthews KR (2013). Investigating mammalian tyrosine phosphatase inhibitors as potential "piggyback" leads to target *Trypanosomabrucei* transmission. *Chemical Biology and Drug* Design, **81**(2): 291 – 301.

Sam–Wobo SO, Igenezoa AJ, Idowu OA, Otesile EB, Ekpo UF & Kehinde OO (2010). Bovine trypanosomiasis and its impact on cattle in derived savannah areas of Ogun State, Nigeria. *Journal of Public Health and Epidemiology*, **2**(3): 43 – 47.

Singla LD, Juyal PD, Roy KS & Kalra IS (1997). Host responses of cow-calves against *Trypanosoma evansi* infection: Haematopathological study. *Journal of Veterinary Parasitology,* **11**: 55-63.

Tafese W, Melaku A & Fentahun T (2012). Prevalence of bovine trypanosomosis and its vectors in two districts of East Wollega

zone, Ethiopia. *Onderstepoort Journal of Veterinary Research,* **79** (1): 385.

Thrusfield MV (2005). *Veterinary Epidemiology*`s, third edition, Blackwell Publishing, Oxford Great Britain. Pp 1-584.

WHO (2014). Trypanosomiasis: Human African Sleeping Sickness. Fact Sheets No. 259/en/WHO, retrieved 25-04-2014.

Wilson AJ (1969). Value of the indirect fluorescent and antibody test as a serological and diagnosis of Glossina-transmitted bovine trypanosomiasis. *Tropical Animal Health Production*, **1**(2): 89-95.

Woo PTK (1970). Evaluation of the haematocrit and other technique for the diagnosis of African trypanosomiasis. *Acta Tropica*, **27**(4): 384-386.

Yanan EG (2008). Collaborative Field Survey on HAT and AAT in Selected LGAs of Plateau State, Wamba LGA Nassarawa State between NITR, Vom, FMOH Abuja and NVRI Vom, Jos.

Yanan EG, Evuti MA, Shamaki BU, Sugun MY, Dongkum C & Ogunsan EA (2007). Epidemiology of small ruminants trypanosomiasis in some communities of Jos – East LGA of Plateau State, A Guinea Savannah zone, north central Nigeria. *Journal Protozoal Research,* **17**: 14 -47.