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Trypanosomes Infection in Field-Captured Tsetse Flies of the Subgenus: Nemorhina In Southern Guinea Savanna Zone of Nigeria

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Abstract: An investigation aimed at assessing the Trypanosomes infection in the Palpalis group was conducted between January and December of 2007 at Kamuku National Park, using Biconical and Nitse traps. Flies were trapped along riverine vegetation for two trapping days each month and were harvested daily. Out of 213 tsetse flies examined, 14 (6.6%) were infected with trypanosome. Infection rate in *G. tachinoides* 9.4% (11) out of 117 were statistically ($p<0.05$) higher than *G. Palpalis* 3.1% (3) out of 96 flies examined. Also, infection rate were higher in males 5.2% (11) than females 1.4% (3). Infection due to *Trypanosoma vivax* 5.2% (11) dominated, followed by *T. congolense* 0.9% (2) then *T. brucei* 0.5% (1). The Mean Hunger Stages of 3.5 and 3.6 for *G. tachinoides* and *G. palpalis* respectively indicated a hungry population. Infections were highest in the month of May. The presence of Tsetse and Trypanosome infection in the park may pose public health risk.

Keywords: Mean hunger stage, palpalis group, sex, trypanosome infection, tsetse flies

INTRODUCTION

Across sub-Saharan Africa a variety of *Trypanosoma* species transmitted by tsetse flies (*Glossina* spp) cause Human and Animal Trypanosomiasis (Hargrove *et al*., 2012). Transmission occurs largely among rural populations, where activities such as agriculture, fishing and pouching expose people to the bite of the tsetse fly (Muturi *et al*., 2011). In Nigeria Tsetse and Trypanosomiasis problem is still widely distributed in all the agro-ecological zones and states. The disease has protracted effects on human and livestock production systems, with a negative impact on the economy.

Members of the subgenus Nemorhina (The Palpalis group) are principally vectors of human sleeping sickness in Nigeria (Onyiah, 1997). Their distribution is strictly within the forest galleries along riverine vegetation and permanent pools of water except in the wet season when they disperse outside their habitat following increase in humidity (Bouyer *et al*., 2005; Ahmed, 2004).

Studies on trypanosomes infection rate have revealed that they vary with sex, age, species of trypanosome and the tsetse fly; hunger state of the fly and season (Ahmed *et al*., 2000; Mohammed-Ahmed, 1993; Owaga, 1981; Davies, 1977; Baldry, 1969). This investigation was aimed at assessing the trypanosomes infections in the Palpalis group in relation to sex, species of trypanosome and their physiological status.

MATERIALS AND METHODS

Study area: The study was conducted in Kamuku National Park located in Birnin Gwari Local Government Area of Kaduna State, Nigeria. It lies within the northern edge of the Southern Guinea Savanna Zone (Keay, 1953) from latitude 10°25'-11°N and longitude 006°-006°30'E. The area is 1,120 sq.km and vegetation typically of the savanna woodland type. Map and description of study area is described in Okoh *et al.* (2011).

Entomological analysis: Tsetse flies were sampled from January to December, 2007 using Biconical (Challier and Laveissiere, 1973) and Nitse (Omoogun, 1994) traps. Twenty traps were deployed at about 100 m apart along riverine vegetation each month for two trapping days and were harvested every day; the temperature and relative humidity of each trap points was recorded using the Whirling Hygrometer (Davies, 1977).

All flies caught were identified to species level, sexed and grouped into teneral and non-teneral (Pollock, 1982; Potts, 1970). The non-teneral flies were classified into different physiological categories (Jackson, 1933) and the Mean Hunger stage was computed by method of Potts (1970). The Proboscis, Midgut and Salivary gland of non-teneral flies were dissected and examined for trypanosome infection (LIoyd and Johnson, 1924).

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Table 1: Infection rate in tsetse species by sex in 2007 at kamuku national park

		Sex		Infection rate		
Species	No examined	♂	♀	♂	♀	Total (%)
G. tachinoides	117	67	50	8.5% (10)	0.9% (1)	9.4% (11)
G. palpalis	96	48	48	1.04% (1)	2.1% (2)	3.1% (3)
Total (%)	213	115 (54%)	98 (46%)	5.2% (11)	1.4% (3)	6.6% (14)

Table 2: Trypanosomes infection in tsetse species in 2007 at kamuku national park

		Trypanosomes type			
Species	No examined	*T. vivax*	*T. congolense*	*T. brucei*	Total (%)
G. tachinoides	117	6.3% (8)	1.7% (2)	0.9% (1)	9.4% (11)
G. palpalis	96	3.1% (3)	-	-	3.1% (3)
Total (%)	213	5.2% (11)	0.9% (2)	0.5% (1)	6.6% (14)

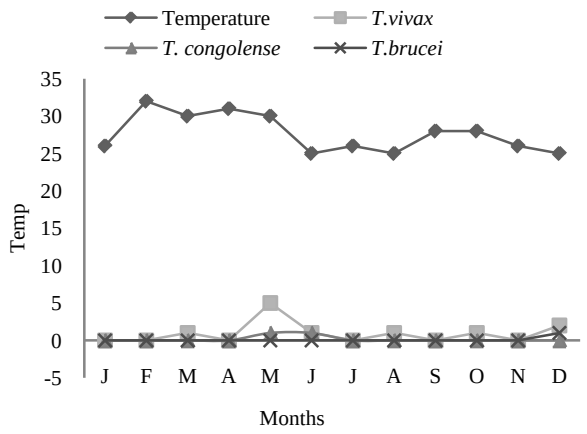

Fig. 1: Monthly trypanosome-type infection with temperature at kamuku national park

Data were analyzed statistically using Chi square (χ^2) and student unpaired *t*-test.

RESULTS

An overall infection rate of 6.6% (14) was observed out of 213 flies examined. *G. tachinoides* had a significantly ($p<0.05$) higher infection rates of 9.4% (11) out of 117 flies examined than *G. palpalis* 3.1% (3) out of 96 flies. Infection rates were higher in males 5.2% (11) out of 115 male flies examined than females 1.4% (3) out of 98 female flies. Infections were higher in *G. tachinoides* male flies 8.5% (10) than females 0.9% (1), whereas in *G. palpalis* infections in females 2.1% (2) were higher than males 1.04% (1) (Table 1). Infections due to T. vivax 5.2% (11) were higher than *T. congolense* 0.9% (2) and *T. brucei* 0.5% (1) (Table 2).

The overall mean hunger stage of male flies examined was 3.6; *G. tachinoide* was 3.5 while *G. palpalis* was 3.6. 70.4% (81) out of 115 examined were physiologically categorized as hungry, 22.6% (22) intermediate, and 6.1% (7) replete and 0.9% (1) gorged. Infection was highest in the month of May with temperature of 30ºC as indicated in Fig. 1.

DISCUSSION

Tsetse flies studies within Kamuku National Park have indicated the abundance of two species of the Palpalis group (*G. tachinoides* and *G. palpalis*) in low densities (Okoh *et al*., 2011). Their presence however low may bear semblance to trypanosomiasis, majorly because they have been reported to importantly transmit human trypanosomiasis. Although, a preponderance of female tsetse flies is favored (Buxton, 1955), yet in this study, more male flies were caught ($p>0.05$), these may be attributed to fly activity such as searching for mating partners and quest for blood meal. This observation supports earlier findings by Omoogun (1994) and Mohammed-Ahmed (1993).

Various studies (Bouyer *et al*., 2007; Potts, 1970) have indicated that *G. tachinoides* feeds on a wide variety of host and as such exhibits opportunistic feeding behavior. This feeding behavior which may predispose the fly to trypanosomes infection may have accounted for the significantly higher ($p<0.05$) infection rate obtained from this study; more so, *G. tachinoides* are important transmitter of *T. vivax* particularly during the dry season when animals come to graze and drink around permanent pools, thereby allowing for frequent fly-host contact. Besides, the developmental pathway and period for *T. vivax* is easier and shorter compared to other Trypanosomes. Generally, the riverine species have lower infection rates, however, the pooled trypanosomes infection rate of 6.6% obtained was high, and may be as a result of higher infection due to *T. vivax* obtained from the study (Table 2).

It is apparent that male tsetse flies were more susceptible to trypanosome infection in this study; this is possibly so because, male tsetse flies are the most active segment of the population and so expend more

Table 3: Physiological stages of male tsetse species caught in 2007 at kamuku national park

			Physiological categories (%)			
Species	No of flies	MHS	Gorged	Replete	Intermediate	Hungry
G. tachinoides	67	3.5	-	5	15	47
G. palpalis	48	3.6	1	2	11	34
Total (%)	115	3.6	1 (0.9%)	7 (6.1%)	26 (22.6%)	81 (70.4%)

energy for flight action (these flight activities have been demonstrated to be an expensive metabolic activity in tsetse flies (Hargrove, 1975); which may result in frequent feeding and thus pre-dispose the fly to trypanosome infection. The physiological status of the tsetse population sampled were hungry (Table 3) and since hungry flies feed more often, they have greater chances of becoming infected (Davies, 1977). Besides, extreme starvation in tsetse flies have been reported by Kubi *et al*. (2006) to lower the developmental barrier for a trypanosome infection and thus enhancing their ability to acquire trypanosome infection.

The frequency of trypanosome infection with *Trypanosoma vivax* dominating, followed by *T. congolense* and then *T. brucei* may be due to the short and simple developmental period and pathway of *T. vivax* within the fly as compared to the other trypanosome types. This observation agrees with the findings of Owaga (1981) who observed a higher trypanosome infection with *T. vivax* than *T. congolense* and no brucei infection. In contrast, Jamonneau *et al*. (2004) and Dagnogo *et al*. (2004) observed in *G. palpalis palpalis* a higher trypanosome infection with *T. congolense* followed by *T. vivax* and the least was *T. brucei*.

The detection of brucei-type infection in wild tsetse fly is a rare occurrence in Nigeria (Onah *et al*., 1985; Madubunyi, 1987; Kalu, 1991; Ahmed *et al*., 2000). In this study, Only 1 (0.5%) *T. brucei* was encountered and this agrees with the findings of Ahmed (2004) who also observed one *T. brucei* in *G. palpalis palpalis.* Even though, this was not characterized, its presence out of 14 infections recorded may be an indication of a possible adventitious host.

Kamuku National Park is a protected area like most Game Reserves/National Parks with no current control intervention. Even though tsetse fly density within the Park may be low, the above data showing a hungry population of tsetse flies with infection rates higher in males and in *G. tachinoides* and *T. vivax* type infection dominating may impose trypanosome challenge to nomadic cattle grazing around periphery of the park if the population builds up. More so, the presence of brucei-type trypanosome infection, however low, is capable of supporting human trypanosomiasis in the park if not checked.

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