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Full Length Research Article

# PREVALENCE AND DENSITIES OF TSETSE FLIES AND THEIR INFECTION RATE IN KAGARKO LOCAL GOVERNMENT AREA, KADUNA STATE, NIGERIA

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**ABSTRACT**
The study on tsetse flies and trypanosomes was carried out within Kagarko Local Government Area, Kaduna State to determine the prevalence and density of tsetse flies and their infection rate in the study area. The study was carried out between March and May, 2018. A total of four sampling sites were considered, these include Katugal, Kubacha Forest Reserve, Maganda Kagarko and Fantaki. Seven (7) traps were deployed in each sampling site for tsetse flies trapping, and a total of twenty eight (28) biconical traps were used during the study period. One hundred and forty four (144) biting flies were caught, these include one hundred and thirty (130) tsetse flies and fourteen (14) other biting flies. Twenty one (21) non teneral tsetse flies were dissected using dissecting pins and microscope. All the tsetse flies caught were *Glossina palpalis,* this comprises of 76 males and 54 females. The tsetse flies mean apparent density was 1.55 flies per trap per day (F/T/D). The result of tsetse flies dissection indicated 2(9.5%) flies were infected with trypanosome infection and *T. vivax* was known to be the infecting trypanosome. Both male and female tsetse fly had equal infection rate of 4.8%. This survey revealed data on tsetse flies abundance and other biting flies with potential as mechanical transmitters of *T. vivax,* which also indicates the possibility of trypanosomiasis in the study area. Therefore, studies to determine trypanosome prevalence in human and livestock should be conducted in the area for active trypanosomiasis control programs.

**Keywords:** Tsetse flies*, Glossina palpalis,* flies apparent density*, Trypanosomes*.

**INTRODUCTION**
African animal trypanosomiasis is a major cause of under development in rural areas in sub Saharan Africa (Brun *et al*., 2009), and a major constraint to livestock production in 40 sub-Saharan African countries (Kim van de, 2016). About 50 million cattle and 70 million small ruminant are annually at risk of coming down with the disease (Autyi *et al*., 2012). The disease is caused by a Kinetoplastida protozoan parasite of the genus *Trypanosoma* and transmitted cyclically by tsetse (*Glossina*) and mechanically by other hematophagous flies such as *Tabanus*, *Haematopota*, *Stomoxys*, and *Chrysops* (kone *et al*., 2011, Cecchi *et al*., 2015). The word tsetse was originated from the tswana (Botswana) language which means "fly that kills livestock and it occurs in 37 sub-Sahara countries covering more than 9 million km2, an area which corresponds roughly to one third of Africa's total land area (Dadah *et al*., 2017). Infected tsetse flies transmit the parasite (trypanosome) during feeding with the blood meal to various host species. The concentration of the vector and the prevalence of trypanosome infections in the host is ascribed to intricate contacts among humans, domestic animals, wildlife, trypanosomes, tsetse flies, and diverse economic and ecological factors (Duguma *et al*., 2015). Its epidemiology and effects on farm animals (particularly cattle) production are determined mostly by prevalence and dispersal of the parasites and its vectors (*genus Glossina*) in the areas that are affected (Oluwafemi *et al*., 2007). The limitation established as a result of tsetse flies and trypanosomes setback continue to frustrate efforts and delay growth in livestock and crop production, therefore contributing to poverty, hunger and the suffering of entire communities in Africa (PATTEC, 2002)
The economic losses as a result of African Animal Trypanosomiasis are estimated to be over 1.5 billion dollars annually (Bitew *et al*., 2011). In cattle production alone Tsetse infest about 10 million km$^2$ of fertile land in Africa extend across 37 Countries with approximately 7 million km$^2$ of the infested land being suitable for agricultural activities if the disease was controlled (Bitew *et al*., 2011). It has been estimated that out of 165 million cattle found in Africa only 10million are found within the tsetse region (belt) as a result of the disease constraint (Oluwafemi *et al*., 2007). African Animal Trypanosomiasis causes about 3 million deaths of livestock annually with 50 million animals at risk of infection (Dadah *et al*., 2017, Egbe-Nwiyi *et al*., 2015) while approximately 35 million doses of trypanocidal drugs are administered (Dadah *et al*., 2017).
Out of the 23 known tsetse flies species found in Africa, 11 species are found in Nigeria (Dadah *et al*., 2017). And all of the 11 species are potentially recurring vectors of trypanosomes, but in nature, the infection is carried mostly by *Glossina fuscipes, G. Palpalis and G. Morsitan* (Franco *et al*., 2014)
In Nigeria, tsetse flies still infest 80% of the nation's land mass (Egbe-Nwiyi *et al*., 2015). Successful control strategies against tsetse flies and parasites were taken during colonial administrations over the years, but unfortunately, the success achieved was not continued mainly due to infrastructural break down, political insecurity, conflicts, carelessness, etc. (Abubakar *et al*., 2015)

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## MATERIALS AND METHODS

### Study Area

Kagarko Local Government is situated in the southern part of Kaduna State Nigeria**.** Its geographical coordinates are 9° 27' 0" North, 7° 41' 0" East and have an area of 2,356 km² and a population of 239,058 according to 2006 census (City population, 2020). The people of Kagarko Local Government are mostly Koro and Gbagyi by tribe and are mostly farmers. The rainy season in the area lasts for six (6) months (May-October) with a mean of annual rainfall of 1536mm, temperature of 28$^{o}$c-34$^{o}$cand relative humidity of 40-92%. The Kagarko LGA area is bounded by Jaba LGA in the east and Kachia LGA in the north. It is also sharing boundary with FCT in the south and in the west by Niger (fig.1).
The field work was organized with the survey team of Nigerian Institutes for Trypanosomiasis Research (NITR) Kaduna staff, and four field sites were considered in suitable districts within Kagarko LGA. These sites include Katugal, Kubacha, Maganda Kagarko.

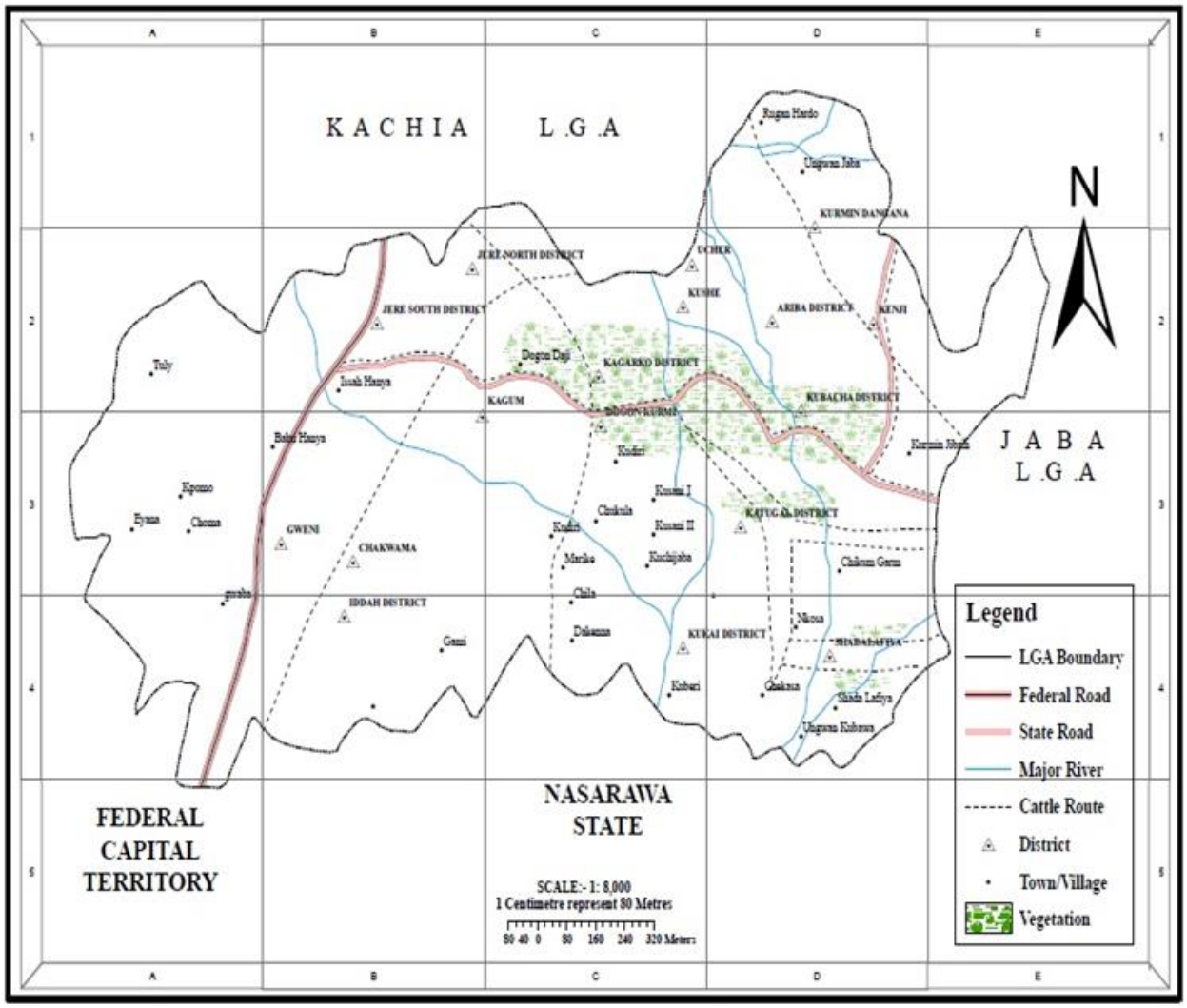
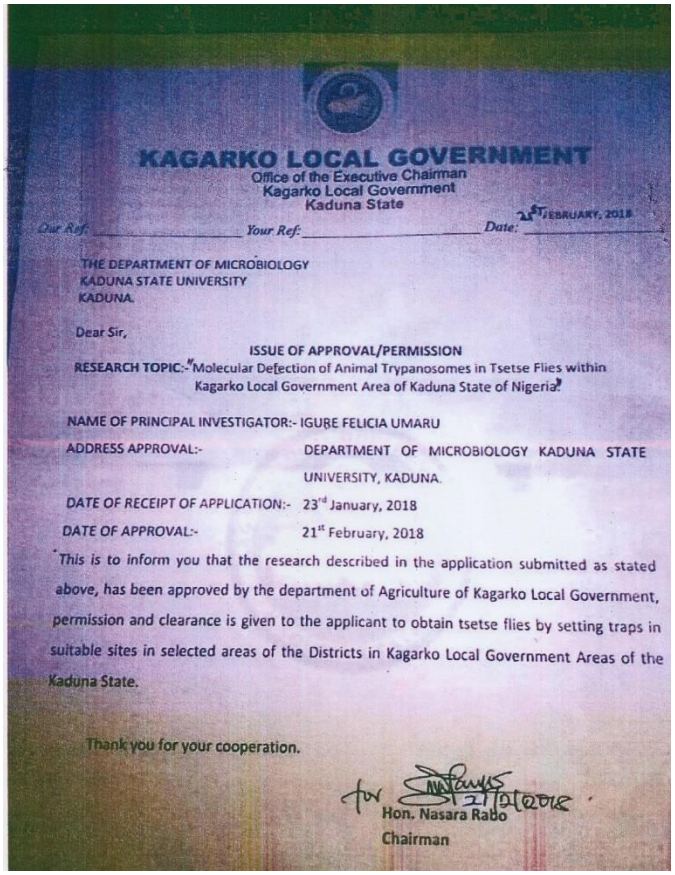



**Figure 1:** Map of Kagarko Local Government Area Showing the Study Sites (Source: Adopted from Actionnet Consult, Kagarko LGA, 2007).

### Ethical Approval

Letter of acceptance to carry out survey in the Local Government area was obtained from the LGA chairman. Pre-surveillance visit was made to the study area on 16$^{th}$ of March, 2018. The visit was to sensitize the district and the village heads of the study area, soliciting for their support, cooperation and securing their consent for the main exercise in the districts



KAGARKO LOCAL GOVERNMENT
Office of the Executive Chairman
Kagarko Local Government
Kaduna State

Our Ref: _____ Your Ref: _____ Date: 21ST FEBRUARY, 2018

THE DEPARTMENT OF MICROBIOLOGY
KADUNA STATE UNIVERSITY
KADUNA.

Dear Sir,

ISSUE OF APPROVAL/PERMISSION

RESEARCH TOPIC:-"Molecular Defection of Animal Trypanosomes in Tsetse Flies within Kagarko Local Government Area of Kaduna State of Nigeria"

NAME OF PRINCIPAL INVESTIGATOR:- IGURE FELICIA UMARU

ADDRESS APPROVAL:- DEPARTMENT OF MICROBIOLOGY KADUNA STATE UNIVERSITY, KADUNA.

DATE OF RECEIPT OF APPLICATION:- 23rd January, 2018

DATE OF APPROVAL:- 21st February, 2018

This is to inform you that the research described in the application submitted as stated above, has been approved by the department of Agriculture of Kagarko Local Government, permission and clearance is given to the applicant to obtain tsetse flies by setting traps in suitable sites in selected areas of the Districts in Kagarko Local Government Areas of the Kaduna State.

Thank you for your cooperation.

for Hon. Nasara Rabo
Chairman

**Figure 2:** Approval Letter

**Entomological Study**

The study was carried out to determine the presence of tsetse flies and trypanosomes in suitable sites within Kagarko Local Government Area of Kaduna State. The study was undertaken between March and May, 2018. Four sampling sites were considered. The same number of standard biconical traps was deployed in suitable sites in four (4) districts of the study area for tsetse fly trapping. They were set approximately 100m apart around riverine forest, animal crossing points and water courses. All the traps were baited uniformly with attractant such as cow urine and Acetone (Welburn *et al*., 2012) to increase trapping efficiency. The traps were set in the morning and allowed at the site of deployment for the period of 72 hours and the flies were harvested every 24 hours (Welburn *et al*., 2012) of deployment, the catches of each trap were sorted by species and then counted.

Identification of tsetse flies species was done by their morphological characteristics such as size, tarsal claws, color and proboscis (Kabal *et al*., 2017). Sex of the harvested male and female tsetse flies were determined by observing the posterior end of the ventral aspect of the abdomen using hand lens and finger palpation. Male flies were identified by their enlarged hypopygium in the posterior ventral end of the abdomen (Desta *et al*., 2013). The apparent density of the tsetse fly was calculated as the number of tsetse catch/trap/day (Desta *et al*., 2013).

The non-teneral flies were dissected using dissecting instrument such as Petri dishes, glass slides, glasses cover slides, dissection pins, fine forceps etc. under dissecting microscope. The wings and the legs of the non-teneral flies were removed from the body using the fine forceps after which the tsetse flies were placed on the Petri dish that contained a drop of 0.9% normal saline solution which helps to keep the flies' organs hydrated. The various parts of the tsetse flies such as proboscis, thorax and the midgut were carefully removed and examined for the presence of the parasite (trypanosomes) infection. The parasite (trypanosomes) were identified by their motility on wet mount preparation during dissection.

The tsetse flies infection rate was also determined using the formula below:

Infection rate (IR) = $\frac{number\ of\ tsetse\ flies\ infected}{\text{total number of tsetse flies dissected}} x\ 100$ (Desta *et al*., 2013)

**Data Analysis**

An independent sampled t- test was carried to compare the prevalence of male and female tsetse fly trapped using SPSS version 24 software package at 5% level of significance. Analysis of variance was also carried out to check if there is variation in apparent densities of tsetse flies across the four (4) districts using SPSS version 24 software package.

**RESULTS**

**Vector Distribution**

A total of one hundred and thirty (130) tsetse flies (*Glossina species*) were caught during the study period. All the tsetse flies trapped were *Glossina palpalis,* of which male flies constituted the largest percentage of 76(54.8%) while female had 54(41.5%), although, there was no significant variation on the prevalence of male and female tsetse flies caught during the study (table 3). Among the tsetse flies caught, 10(7.69%) were teneral, 50(38.46%) were non-teneral while 70(53.84%) were dead. Katugal District has the highest number of tsetse flies caught followed by Kubacha and Maganda Kagarko Districts while Fantaki District had the lowest **(table 1)**. Aside from the *Glossina species*, other biting flies were also caught but *Glossina species* were the most prevalent in all the trapping sites (**figure 2**).

**Table 1**: Distribution of Tsetse Flies in the Four Districts (Study Areas)

| District | No. of Flies Caught | No. of Trap | Sex | | *G.p.p* |
|---|---|---|---|---|---|
| | | | Male | Female | |
| Katugal (RK) | 48 | 7 | 32(66.6%) | 16(33.3%) | 48 |
| Kubacha (KFR) | 38 | 7 | 18(47.3%) | 20(52.5%) | 38 |
| Maganda (RB) | 26 | 7 | 12(46.1%) | 14(53.8%) | 26 |
| Fantaki (FT) | 18 | 7 | 12(66.6%) | 6(33.3%) | 18 |
| **Total** | 130 | 28 | 74(56.9%) | 56(43.0%) | 130 |

**Key**: *G.p.p – Glossina palpalis*

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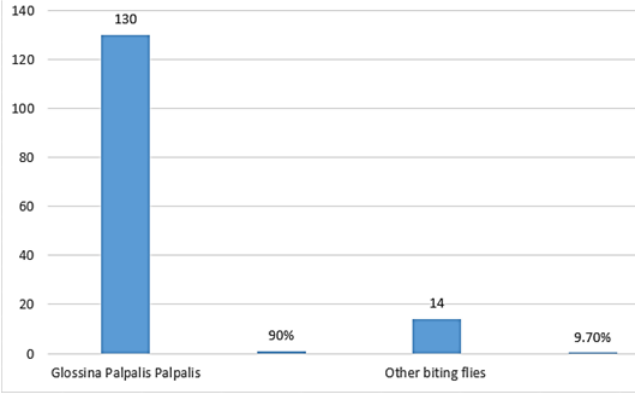


**Figure 3:** Relative Distribution of Total Fly Caught

**Apparent Density of Tsetse Flies**

There was no significant variation in the apparent densities of *Glossina species* caught within the four trapping sites. The mean apparent densities ranged from 0.5 to 2.5 depending on the study sites and the average mean apparent density was 1.55 flies per trap per day (fig. 3)

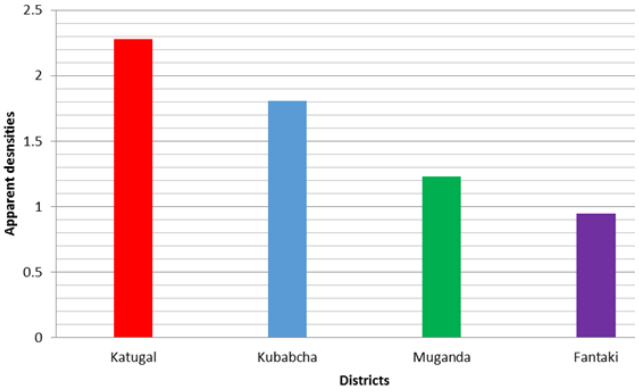


**Figure 4:** Mean Apparent Densities within the four (4) trapping sites (districts)

**Tsetse Fly Infection Rates**

Out of twenty one (21) non-teneral tsetse flies dissected, only two (2) tsetse flies of *glossina palpalis* were positive with trypanosome infection. The infecting trypanosome was known to be *T.vivax* by its site of location in the fly. Both male and female flies had equal infection rate of 4.76% and the overall infection rate was 9.5% **(table. 2).**

**Table 2** Infection Rate of the tsetse flies and Species of Trypanosome Identified in the Study Area

| Districts species | No. of Flies Dissected | No. of flies infected | Infection Rate | Trypanosome |
|---|---|---|---|---|
| Katugal | 3 | 0 | 0 | 0 |
| Kubacha | 9 | 2 | 2(9.5%) | T.vivax |
| Maganda | 7 | 0 | 0 | 0 |
| Fantaki | 2 | 0 | 0 | 0 |
| Total | 21 | 2 | 2(9.5%) | - |
| Sex | | | | |
| Male | 7(33.3%) | 1 | 1(4.76%) | T.vivax |
| Female | 14(44.7%) | 1 | 1(4.76%) | T.vivax |

**Table 3:** shows an independent t-test carried out to compare the prevalence of male and female tsetse flies captured in the study area.

**Table 3**: Independent Sample t- test to compare the Prevalence of Male and Female Tsetse Flies

| Gender | Mean | Standard Deviation | df | T | P-value | Remark |
|---|---|---|---|---|---|---|
| Male | 18.5 | 9.43 | 6 | 0.809 | 0.449 | NS |
| Female | 14.0 | 5.89 | - | - | - | - |

**Key:** NS - Not significant

The above result indicates that there is no significant variation on the prevalence of male and female tsetse flies trapped during the study since the P-value (0.449) is greater than 0.05.

## DISCUSSION

**Vector Distribution.**

This study revealed the abundance of tsetse flies and other biting flies as well as trypanosomes in the study area. *Glossina species* mainly *Glossina palpalis* were the only species of tsetse fly caught during the study and this species is known to occur in other West Africa countries like republic of Congo and Cameroon (Melachio *et al.*, 20211). *Glossina palpalis* are known to be associated with vegetation and water source (France *et al;* 2014) such as forest and riverbanks (France *et al.,* 2014) Kebede *et al.* (2017) and in areas where agricultural activity takes place, like coffee and cocoa farms, which they used for reproduction, resting and also provide opportunities for feeding (Carlos *et al.*, 2010). The study area provided some of these ecological factors which made it suitable for the availability of this fly species.

The similar species of tsetse was reported by Abubakar *et al.* (2015) on surveillance of tsetse and trypanosomosis in North-Western Nigeria. The report is also in line with the work of Dadah *et al,* (2017) on tsetse and other biting flies in kaura Local Government Area of Kaduna State. It also correlates with the works of (Okoh *et al.,* 2012, Dauda *et al.,* 2017 and Kenechukwu *et al.,* 2017) who reported similar species of tsetse fly at Southern Guinea Savannah zone of Nigeria, Maganda and Fantaki and Onicha on prevalence of trypanosome infection from tsetse flies from Oji River, Enugu State of Nigeria

High percentage of flies dead recorded in the present study could be as a result of high temperature experienced during trapping and exhaustion as flies try to escape from the traps as the study was carried out during the dry season in March and may, this period is connected with increase mortality as a result of low humidity and high temperature which reduce fly's dispersion, this finding is in line with the work of Majekodunmi *et al.* (2013) and Vincent *et al.* (2015). Water collection points in forest trail and vegetation near river banks are the possible areas where Animals and People can be bitten by tsetse flies as they go there to bath, drink water and wash clothes. In the present study, more male tsetse flies were caught than female, this could be due to the movement of the male flies in search for breeding partners and food (blood meal), this observation was also made earlier by Omoogun (2011), Mohammed Ahmed (1993) and Okon *et al.* (2012). The presence of other biting flies as shown in (figure 4.1) even though in lowest

percentage, is still a call for concern, as they can spread other trypanosomes like *T.vivax* and *T. evansi* mechanically according to Desquesnes *et al* (2009), they are also responsible for the widespread of these parasites outside the tsetse regions. (Daniel *et al*., 2015).

**Flies Prevalence and Apparent Density**

There was no significant variation in the apparent densities of tsetse flies, captured within the four (4) trapping sites during the study**.** Although the overall apparent density of tsetse flies in the study area was 1.55 flies per trap per day (F/T/D). Comparable was reported by Dauda *et al*., 2017 in Kaduna, Western Nigeria. In contrast, Daniel Mutiso *et al. (*2015) recorded lower mean apparent density of 0.3 flies per trap per day while Yismashewa *et al*, (2017) reported higher densities of 15.1 flies/trap/day in Ethiopia. This different in fly density could be due to the difference in their ecological factors such as weather condition, vegetation cover, and host availability. This indicates that the study areas are endemic for tsetse flies which are the biological transmitters and also reservoir for trypanosome parasites. The number of tsetse flies caught varied from each study site, this could be as a result of discontinue nature of the vegetation, host factor (noise) and human activities (clearing of vegetation for farming) going on in some of the study areas.

**Flies Infection Rate through Dissection**

A total of twenty one (21) tsetse flies (non- teneral) were dissected, 7 (33%) were males and 14 (67%) were females. Two (2) flies of *Glossina palpalis* were positive with trypanosome parasite, and the overall infection was 9.5%. Both males and females tsetse flies had equal infection rate of 1(4.8%) in the present study, as both female and male flies are hematophagous therefore, both are capable of spreading infection during blood meal Franco *et al* (2014). Tsetse flies when climatic condition is unfavorable and there is scarcity of host takes blood meal every 2-4 days according to WHO (2013). The tsetse saliva is injected during the meal to avoid blood clotting and to produce a vasodilation and if the saliva has infective trypanosomes, they are transferred during the blood meal Franco *et al* (2014). Although female tsetse flies are believed to live longer than the males therefore, they are more likely to be exposed to trypanosome infection during their live time (clement *et al*., 2016). Meanwhile, Mulugeta *et al.* (2013) reported higher trypanosome infection rate of 6.4% in female flies while 0.49% in male flies in a study carried out in Southern Ethiopia. The trypanosome identified was *Trypanosoma vivax*. The presence of trypanosome infection with *T. vivax* over other trypanosomes could be as a result of its short life cycle in the fly Okon *et al* (2012). However in Cote d'voire, *T. congolense* was found to be more infectious (90%) compare to *T. simiae and T. vivax* in 50 of 139 microscopically positive flies that were further analyzed using species specific primers for *T. congolense subtypes, T. simiae and T. vivax* (Solano *et at*., 2013). The prevalence of trypanosome infection in the study is low, but it is still a great threat to the animals in the area because according to Dadah *et al.* (2017), one infected fly can infects the entire herd during its life time.

**Conclusion**

This study confirmed the presence of tsetse flies (*Glossina palpalis palpalis)* and flies infection with *T. vivax* in the study area, this shows the study area is a potential place for African tryoanosomiasis since the biological vector and the parasites are present in the area. I therefore recommend that Entomological surveys should be conducted at different seasons to know the seasonal variation of the vectors and the related trypanosomiasis danger in the study area.

Studies to determine trypanosome prevalence in human and livestock should be conducted in this area for active trypanosomiasis control programs.

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