Sokoto Journal of Medical Laboratory Science 2024; 9(3): 255 - 263

SJMLS - 9(3) - 027

The Abundance and Diversity of Dipteran flies in Cattle at UngwarNungu, Lafia Metropolis, Nasarawa State, Nigeria

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Abstract

The insect order Diptera, commonly known as true flies include familiar insect such as mosquitoes, blackflies, houseflies, midges, fruit flies, blowflies, tsetse flies. Dipterous flies are important insects in terms of their impacts on veterinary medicine, and agriculture. Therefore, the incidence and population dynamics of different species of dipterans flies as well as testing the efficiency of Biconical traps in estimating the populations of different species of dipterans flies and behavioral studies within the cattle farm in Ungwar Nungu, Lafia, Nasarawa state, was conducted between August and September 2019. Two cattle farms were sampled for dipteran flies. Adult flies were collected using biconical traps. They were immobilized using ethyl acetate. After sampling, the flies were counted and identified using several taxonomic keys. Of the dipterans collected from Usman's farm and Saleh's farm, 84.2% were haematophagous while 15.8% were non-haematophagous. There was a very high significant difference (^{2}=56.033, df=1, p<0.0001) in prevalence of dipteran flies in relation to their mode of feeding. Prevalence of dipterans in relation to study location records that dipterans were more abundant in Sale's farm (62.5%) than in Usman's farm (37.5%) which shows a very high significant difference (^{2}=231.03, df=6, p<0.0001). *Haematopota* species were more abundant followed by *Tabanus* species. The least encountered dipteran flies were *Muscafannia*. There was a very high significant difference (^{2}=69.389, df=6, p< 0.0001) in abundance of dipterans the study area. Hence, there is an urgent need for improved hygiene conditions and proper waste management.

Keywords: Diptera; Hematophagous; Non-haematophagous; *Tabanus; Muscafannia*

Introduction

The insect order Diptera, commonly known as true flies include familiar insect such as mosquitoes, blackflies, houseflies, midges, fruit flies, blowflies, tsetse flies. Flies are generally common and can be found all over the world except polar regions (Muenworn *et al*., 2010). Dipterous flies are important insects in terms of their impacts on veterinary medicine, and agriculture (Biu *et al*., 2012). Many species are important vectors of diseases. The role of insects, as evident public health nuisance has long been known in Nigeria and many other tropical African countries (Biu *et al.,*2012). Particularly the haematophagous flies such as S*tomoxys calcitrans* can attack several large mammals including horses and have also been implicated as mechanical vector of *Trypanosoma evansi* (surra). Heavily infestation by the biting and bloodsucking insects accounts for sleeplessness irritations (blood loss and anaemia in various host animal). They play an important role in the transmission of diseases such as malaria, dengue, yellow fever, filariasis, Leishmaniasis, Trypanosomiasis. Techniques for sampling biting flies have received little attention. With most information derived indirectly from studies. It can easily be recognized by their conspicuous proboscis biting and sucking blood (Williams *et al.,* 2009).

In Africa, the transmission of pathogenic Trypanosomes prompted the early development of many efficient trapping device (Cuisance,

1989) and baits (Green, 1994) for sampling and control of tsetse flies and other biting flies as vectors of one of these, the NITSE trap named after the National Institution of Trypanosomiasis Research Kaduna. Nigeria for the effective trapping of *Glossina* species (Green, 1994). Outside Africa, researchers have designed many traps for biting insects (Green, 1994), but detailed behavioral studies are few (Cuisance, 1989), these are only rare examples of their use for control. Hence, much of what is known about host and trap-oriented behavior is derived from the studies of tsetse flies (Cuisance, 1989).

This study is aimed at determining the incidence and population dynamics of different species of dipterans flies within the cattle farm in Ungwar Nungu Lafia and to test the efficiency of Biconical traps in estimating the populations of different species of dipterans flies and also for behavioral studies. They also play an essential role the ecosystem and serve as an experimental animal. Numerous traps for tse-tse flies (Glossinidae; *Glossina* species) and other biting flies (Muscidae, Stomoxyinae, Tabanidae*,* and Stable flies) have been developed by researchers studying insects in different continents (Mulandane*et al.,* 2020).

Materials and Methods

Study Area

The study was carried out in Ungwan Nungu, Lafia, Nasarawa State. Lafia is a town in the middle belt of Nigeria bounded on the north by Akwanga, South by Obi, West by Kokona and East by Awe. Geographically, Lafia, Nasarawa State lies between latitudes 8^{0} $29^{'}$ 38.04’ North and Longitude 8^{0} 30’ 55.15’, East with a population of about 330,712. Residents based on the 2006 Census. The economics activities of the State are; cash crops such as cassava, yam and melon, production of mineral such as salt is also another major economic activities of the state. Livestock farming, especially cattle also practice in the state with large number of cattle herds reside and grazing within and around Lafia and other Local Government area.

Sampling of flies

Two cattle farms were sampled for Dipteran flies. Adult flies were collected using biconical traps. A trap was deployed and left to stand for 48 hours. It was retrieved to Zoology Laboratory of Federal University, Lafia. Trapped flies was harvested daily for two weeks from each cattle farm sampled. They were immobilized using ethyl acetate (AL-Enazi *et al.,* 2018). After sampling, the flies were counted and identified using several taxonomic keys (Shaumar*et al*., 1989; Alikhan *et al*., 2016).

Diversity Index

Shannon-Wiener diversity index according to Begon *et al*. (2003) and Lamead (2011) was used to determine the diversity level of flies in cattle farms (^{2}= 7.5, df = 1, p = 0.00617).

Where: *H”* is the diversity index; *Pi* is the proportion of individual species; *S* is the total number of species in the habitat and i *is* the proportion of *S* species. The diversity index ranges from 0-5. A diversity index of 0-2.4 shows a low diversity, while 2.5-5 shows a high diversity.

Statistical Analysis

Data obtained were analyzed using R Console software (Version 3.2.2). Pearson's Chi-square test was used to compare the abundance between species of flies. The p-value < 0.05 were considered statistically significant.

Results

Composition of Dipteran Flies Trapped in Two Selected Cattle Farms in Lafia

Of the dipterans collected from Usman's farm and Saleh's farm, 84.2% was hematophagous while 15.8% were non-haematophagous (Table 2). There was a very high significant difference (^{2}=56.033, df=1, p<0.0001) in prevalence of dipteran flies in relation to their mode of feeding. Dipterans were more abundant in Sale's farm (62.5%) than in Usman's farm (37.5%). Therefore, there is a very high significant difference (^{2}=231.03, df=6, p<0.0001) in the prevalence of dipterans in relation to study location. Among the dipteran flies encountered*,* *Haematopota* species (33.3%) were more abundant followed by *Tabanus* species (20.0%). The least encountered dipteran flies were *Muscafannia* (0.8%). Thus, There was a very high significant difference (^{2}=69.389, df=6, p< 0.0001) in abundance of dipterans in the study location.

The overall diversity level in the two (2) selected farms was +1.55 and it connotes low flies diversity index (Table 2). The diversity index of Haematophagous species was the highest -0.37 followed by Glossina species -0.35 while Muscafannia had the least diversity level -0.04.

The calculated diversity index of dipterans forb Usman farm was +1.63, which indicates low diversity (Table 3). *Haematopota* and *Glossina* species had the highest diversity of -0.35, followed by *Tabanus* and *muscadomestica* (-0.31) while *Muscafannia* had the least diversity of -0.08.

The calculated diversity index of dipteran flies at Saleh farm was (+1.346) (Table 4). The diversity of flies in Saleh farm showed that *Haematopota* species has the highest diversity of -0.29, *Culex quinquefasciatus* had the least diversity of -0.13.

Table 1: Checklist of Dipteran flies in two selected cattle farms

Biting flies	Usman Farm (%)	Saleh Farm (%)	Total (%)
Haematopota species	12(30.0)	28(70.0)	40 (39.6)
Tabanus species	8(33.3)	16(66.7)	24 (23.8)
Glossina species	12(37.5)	20(62.5)	32 (31.7)
Culex quinquefasciatus	2(40.0)	3(60.0)	5 (4.9)
Total (%)	**34 (33.7)**	**67 (66.3)**	**101**
Non-biting flies			
Musca domestica species	8(50.0)	8(50.0)	16 (15.7)
Muscafannia species	1(100.0)	0(0.0)	1 (0.8)
Drosophila species	2(100.0)	0(0.0)	2 (1.7)
Total (%)	**11 (57.9)**	**8 (42.1)**	**19**
Total (%)	**45 (37.5)**	**75 (62.5)**	**120**

$\chi^2 = 7.5$, df = 1, p = 0.00617

H= -(-1.35)
H=+1.35

Table 2: Diversity of flies in the two selected cattl e farms

Flies Species	Total	Pi	ln(Pi)	(Pi) ln(Pi)
Haematopota species	40(33.3)	0.33	-1.09	-0.37
Tabanus species	24(19.7)	0.2	-1.61	-0.32
Glossina species	32(26.7)	0.27	-1.32	-0.35
Culex quinquefasciatus	5(4.2)	0.04	-3.18	-0.13
Musca domestica	16(13.3)	0.13	-2.01	-0.27
Muscafannia	1(0.8)	0.01	-4.79	-0.04
Drosophila	2(1.7)	0.02	-4.09	-0.07
Total	**120**			**-1.55**

H=-(-1.55)
H=+1.55
Therefore, the diversity is low

Table 3: Diversity of flies in Usman Farm

Flies Species	Usman Farm	Pi	Ln(Pi)	(Pi) ln (Pi)
Haematopota species	12(26.7)	0.27	-1.32	-0.35
Tabanus species	8(17.8)	0.18	-1.73	-0.31
Glossina species	12(26.7)	0.27	-1.32	-0.35
Culex quinquefasciatus	2(4.4)	0.04	-1.94	-0.09
Musca domestica	8(17.8)	0.18	-1.73	-0.31
Muscafannia	1(2.2)	0.02	-3.82	-0.08
Drosophila species	2(4.4)	0.04	-3.12	-0.14
Total	**45(37.5)**			**-1.63**

H= -(-1.63) and H=+1.63 (There, the diversity is low)

Table 4: Diversity of Flies in Saleh Farm

Flies Species	Saleh Farm	Pi	In(Pi)	(Pi) ln(Pi)
Haematopota species	28(37.3)	0.16	-1.83	-0.29
Tabanus species	16(21.3)	0.21	-1.55	-0.33
Glossina species	20(26.7)	0.27	-1.32	-0.35
Culex quinquefasciatus	3(4.0)	0.04	-3.22	-0.13
Musca domestica	8(10.7)	0.11	-2.24	-0.24
Total	**75(62.5)**			**-1.35**

H=-(-1.35); H=+1.35

Discussion

The variation observed in the abundance of dipterans in both cattle farms indicate that haematophagous flies were predominant in to the farms examined in this study. This may indicates an improper waste management practice and a general lack of hygiene at both farms studied. A similar observation was made by Njila *et al.* (2015) who stated that haematophagous flies infestation could be due to poor waste management practices and general unhygienic practice at livestock farms. As observed in both farms, animal dungs and dirt were littered all over the farms. This has made the animals susceptible to infestation by haematophagous flies. Du Toit *et al.* (2004) revealed that, animal environment when left unattended encourage the growth of micro-organisms and greatly increases insect's abundance. It has equally been discussed by Donald and Evans (2006) that debris and dirt hide insect pests thus preventing their early detection till real damage has been incurred. This result is akin to that of Abba *et al.* (2011) and Njila *et al.* (2015) who equally observed a high abundance of haematophagous dipterans in their study at Assop Forrest and Jos Museum Zoological Garden, Plateau State, Nigeria respectively. However, the result is similar with that of Aziz *et al.* (2016); and Al-Enazi *et al.* (2018) who reported more abundance of non-haematophagous flies in their study in Saudi Arabia respectively.

Even though populations of other dipterans were recorded from both farms at varying compositions, a high variation was observed in the prevalence of dipteran species. This indicates that *Haematopota* species were predisposed to both farms. This could be due to thirst for blood meal which is evident in the injuries observed on the cattle bodies wherever they congregate to feed. This could also be due to the fact that the genus *Haematopota* is known for its global distribution with strong adaptability and acclimation to various environmental conditions. This result is in contrast to the results obtained by Al-Enazi *et al.* (2018) who recorded more *Musca* species in their study in Saudi Arabia. It is also not in tandem with the works of Miller *et al.* (1993); Kaufman *et al.* (2005); Urech *et al.* (2012); Tummeleht *et al.* (2020).

In this study, haematophagous dipterans belonging to *Tabanus, Glossina, Culex, Musca* and *Drosophila* genera were also encountered in varying compositions. Similar findings have been recorded by other researchers (Biu *et al.,* 2012; Al-Shaibai and Al-Mahdi, 2014; Abubakar, *et al.,* 2018).

Non-farm-related species like those belonging to the Culicidae family were detected in this study. The presence of *Culex quinquefasciatus* at the farms could be linked to the presence of hoof prints around the farms. Animal hoof prints have been indicted as one of the possible breeding habitats of mosquito larvae (Tummeleht *et al.,* 2020). Moreover, studies of Liu *et al. (*2019) show that *Culex* mosquitoes prefer to breed in polluted water bodies, thus their presence at these study sites is justified. Mosquitoes are known as successful vectors for several parasites and viruses worldwide.

The house fly, *M. domestica*, is considered globally as the dominant synanthropic fly species in animal production due to the ideal breeding and developing conditions for the flies of this species within and around the farm (Tummeleht *et al.,* 2020). *Musca domestica* has been reported as a mechanical vector for human and animal gastro-intestinal diseases (Marchiori, 2014). Outbreaks of diarrheal diseases are closely correlated with the seasonal increase in abundance of this fly (Abubakar *et al.,* 2018).
The low diversity index of dipterans recorded in both farms could be linked to unfavorable micro and macro-environmental condition of the study sites. Although there was a generally low diversity index from Usman and Saleh farms in this study, *Haematopota* species had the highest diversity which suggests that they have been able to adapt to their environment. It could also be due to the availability of blood meal hosts at both farms since there was an abundance of cattle at the farms.

The widespread presence of several species of blood-sucking dipterans in Ungwar-Nungu, an important livestock producing area portrays a silent danger to the livestock industry in Lafia LGA of Nasarawa State. Their presence all year round may be the route of transmission of various diseases to man and livestock. For example, *Haematopota* species have been suspected as vectors of corynebacterial mastitis of cattle (Sol, 1983). Dirie *et al*. (1990) found trypanosomes in dissected *Tabanusbromius* Linnaeus and *Haematopota pluvialis* in Somalia. The biting menace of haematophagous dipterans has also been shown to hinder normal grazing in cattle (Bose *et al*., 1987; Nedelchev, 1988) resulting in reduced feed intake.

Conclusion

Out of the two selected farms sampled for the abundance and diversity of flies, Saleh's farm had the highest abundance of flies with a total number of 75 flies which maybe as a result of large number of livestock, lack of hygiene, favorable temperature and climate conditions, while Usman's farm had the least abundance and diversity of flies with a total number of 45 flies which could be attributed to proper hygiene practice and few numbers of livestock and unfavorable temperature. Haematophagous flies were the highest recorded dipteran flies.

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Citation: Ayuba, S.O., Khadijah, K., Suleiman, A.I., Silas, G.D., Ombugadu, A., Odey, S.A., Kajibia, D., Ugoeze, Q.C., Umar, A.S. and Mumeen, H. The Abundance and Diversity of Dipteran flies in Cattle at UngwarNungu, Lafia Metropolis, Nasarawa State, Nigeria. ***Sokoto Journal of Medical Laboratory Science*****; 9(3): 255 – 263.** https://dx.doi.org/10.4314/sokjmls.v9i3.27