**ABSTRACT**

House flies (Musca domestica) are nuisance pest because of their ubiquitous nature in the mechanical transmission of parasites to man. This study identifies the pathogenic parasites associated with house fly in Jalingo, Nigeria. A total of 200 flies were collected from 4 locations (Abattoir, Jalingo Main Market, Kasuwan Bera and Mile-Six Market) within Jalingo metropolis between August, 2019 and November, 2019. Three species of flies were identified during the study namely; Musca spp, Sacophage spp and Stomoxys spp. The house flies were analyzed for the presence pathogenic parasites using standard laboratory techniques. The results showed that the parasites E. histolytica 25(28.74 %), Taenia spp 25(28.74 %), A. lumbricoides 20(22.99 %), Giardia lamblia 8(9.20 %) and Trichuris trichiura 9(10.34 %) are associated with the house flies. The results showed no significant variation $(X^2 = 0.61, p>0.05)$ between the parasitic species. It can be concluded that house flies in Jalingo harbor pathogenic parasites on their bodies. The fact that houseflies have been incriminated to be mechanical transmitters of pathogenic diseases to man because of their anthropogenic lifestyles, measures must be taken to control fly population in order to avert both the present and future outbreak of disease conditions emanating from the flies activities.

**Keywords:** Ascaris lumbricoides, Entamoeba histolytica, Giardia lamblia, Taenia spp, Trichuris trichiura.

**INTRODUCTION**

The housefly, Musca domestica, is a common domestic fly found worldwide and lives in close proximity to humans (Paterson, 2009; Sanchez-Arroyo and Capinera, 2017). Because of their association to dirty environments caused by poor sanitary conditions by humans with facees, garbage etc., as well as their anthropogenic activities, which allows them pick up pathogens on their body parts, they pose a serious threat to public health (Oghale et al., 2013; Oyeyemi et al., 2016; Onyenwe et al., 2016). The ability of houseflies to mechanically transmit human intestinal parasites and pathogens have been well documented (Dipeolu, 1977; Oghale et al., 2013; Balla et al., 2014; Oyeyemi et al., 2016; Onyenwe et al., 2016). Houseflies have also been reported as mechanical vectors of pathogenic organisms among humans and animals (Vazirianzadeh et al., 2008).

House flies are strongly suspected of transmitting at least 65 diseases to humans, including typhoid fever, dysentery, cholera, poliomyelitis, yaws, anthrax, tularemia, leprosy and tuberculosis (Oghale et al., 2013; Balla et al., 2014; Oyeyemi et al., 2016; Onyenwe et al., 2016). Also, because of their indiscriminate mode of feeding, they have also been described as potential vectors of more than 100 serious pathogens which includes virus; bacteria like Vibrio cholerae, Staphylococcus and Rotavirus; fungi; enteric protozoans cyst and trophozoites like Entamoeba histolytica, Cryptosporidium parvum, Entamoeba coli, Sacrocytis spp, Taxoplasma gondii, Isospora spp, Giardia spp, Trichomonas spp, Hymenolepis spp, Dipylidium spp and Diphyllolothrium spp; and nematodes like helminthes eggs, Toxocara spp; Ascaris lumbricoides, Trichuris trichiura, Enterobius vermicularis, Anycystoma caninum, Strongyloides stercoralis, Larvae of Harbormena musca and Taenia spp, which they transport on their feet and hairy legs (Dipeolu, 1977; Vazirianzadeh et al., 2008; Oghale et al., 2013; Balla et al., 2014; Oyeyemi et al., 2016; Onyenwe et al., 2016).

In Nigeria, house flies have been reported to harbor parasitic pathogenic parasites and bacteria on their bodies and internal parts (Dipeolu, 1977; Oghale et al., 2013; Balla et al., 2014; Oyeyemi et al., 2016; Amaechi et al., 2017; Deakpe et al., 2018). Houseflies have also been reported as mechanical vectors of pathogenic organisms among humans and animals (Vazirianzadeh et al., 2008).

Therefore, with the abundant multiple recorded roles of flies as potential vectors, there is dearth of knowledge on their role as mechanical transmitters of parasitic diseases to man because of their anthropogenic lifestyles; measures must be taken to control fly population in order to avert both the present and future outbreak of disease conditions emanating from the flies activities.

**MATERIALS AND METHODS**

**Study Area**

This investigation was carried out in Jalingo metropolis, Taraba State Nigeria, that is located on latitude 8.8929° North and longitude 11.3771° East and it is situated at elevation 349 meters above sea level, Jalingo's climate is classified as tropical savanna. In winter, there is less rainfall in Jalingo than in summer. The climate in Jalingo is classified as Aw (winter dry season) by the Köppen-Geiger system (https://en.climate-data.org/africa/nigeria/taraba-371/). The average annual temperature is 27.9 °C in Jalingo. In a year, the average rainfall
is 958 mm. Precipitation is the lowest in January, with an average of 0 mm. With an average of 217 mm, the most precipitation falls in August. At an average temperature of 32.2 °C, April is the hottest month of the year. December has the lowest average temperature of the year. It is 25.9 °C. Between the driest and wettest months, the difference in precipitation is 217 mm. During the year, the average temperatures vary by 6.3 °C.

**Study Sites**
The study was conducted in four different sites namely; Jalingo Main Market, Jalingo Abattoir, Kasuwan Bera Market and Mile-Six Market. These sites were chosen because the products sold there, such as meat, fish etc. attract the activities of flies.

**Housefly Collection**
Houseflies were captured using the sweep net method over the surfaces where flies visits from Garbage dumps, vegetable stand, meat stands, “Burkutu” (Local brewed beverages) drinking places, restaurants and shops. A purposive sampling technique of 50 flies per location was adopted in the research design for ease. The houseflies were placed in well sterilized plastic containers and transported to the laboratory of Biological Sciences Department of Taraba State University Jalingo for further procession as described by Lane and Crosskey (1993).

**Parasitological Analysis in the Laboratory**
About 2ml of normal saline was added into each universal bottle containing the houseflies and shaken vigorously using manual technique to dislodge the parasites from the exoskeleton (body) especially hair of the houseflies. The fluid was be transferred into a conical tube and centrifuged at 300rpm for about 300 sec. The tube was tilted and all supernatant fluid discarded. A drop of Lugol's iodine was added to the sediment and then re-suspended by tapping the bottom of the tube gently. A drop of the re-suspended deposit is placed on a clean free slide. A cover slip is then placed over the drop. Finally the preparation is examined under the microscope using ×10 and ×40 objectives. The parasites were identified by their ova or cyst (Cheesbrough, 2005; Amaechi et al., 2017).

**Statistical Analysis**
Data collected were entered into Excel work sheet and transported into SPSS version 19.0 for windows. Descriptive statistics using cross-tabulations of variables were employed to generate tables. Chi-square (X²) test was used to compare occurrence of parasites among species of Houseflies within Jalingo.

**RESULTS**
Table 1 presents the relative abundance of flies sampled at Jalingo metropolis (Jalingo main market, Jalingo abattoir, Kasuwan Bera and mile 6 market). Musca domestica had the highest number of occurrence followed by Sacrophaga spp while Stomoxys spp had the least number of occurrence at the Jalingo main market. Parasites identified at the main market were E. histolytica, Taenia spp, Trichuris trichiura and Giardia lamblia. E. histolytica had the highest number of occurrence as shown.

Table 2 shows the prevalence of parasites recovered from the study sites. According to the research carried out, Jalingo abattoir and Kasuwan Bera had the highest numbers of flies infested with parasites on their body surfaces with 16 (32%) out of the 50 flies sampled, Jalingo main market had 13 (8%) out of 50 flies infested with parasites while mile six market had 11 (6%) out of the 50 flies infested.

Table 3 presents the frequency of occurrence of parasites recovered from all four study sites. The eggs of Entamoeba histolytica and Taenia species had the highest frequency of occurrence with 25 (28.74%), followed by the eggs of Ascaris lumbricoides with frequency occurrence of 20 (22.99%), Giardia lamblia had a frequency occurrence of 8 (9.20%) and Trichuris trichiura had a frequency occurrence of 9 (10.34%) as seen in Table 3.

**TABLE 1:** Relative abundance of house flies species sampled

| House fly species | Abattoir | Jalingo Main Market | Kasuwan Bera | Mile-Six Market | Total |
|-------------------|----------|---------------------|--------------|-----------------|-------|
| Musca species     | 29       | 32                  | 16           | 21              | 98    |
| Sacrophaga species| 17       | 12                  | 18           | 19              | 66    |
| Stomoxys species | 4        | 6                   | 16           | 10              | 36    |

**TABLE 2:** Prevalence of parasites recovery based on study sites

| Study site        | No. flies sampled | No. of flies Infested | Percentage of flies infested (%) |
|-------------------|-------------------|-----------------------|----------------------------------|
| Jalingo Abattoir  | 50                | 16                    | 32                               |
| Jalingo Main Market| 50                | 13                    | 8                                |
| Kasuwan Bera      | 50                | 16                    | 32                               |
| Mile-Six Market   | 50                | 11                    | 6                                |
| Total             | 200               | 56                    | 28                               |

(X² = 36; p > 0.05)
TABLE 3: Frequency of concurrency of parasites species recovered

| Parasite Species      | No. Occurrence | Percentage (%) |
|-----------------------|----------------|----------------|
| E. histolytica        | 25             | 28.74          |
| Taenia spp            | 25             | 28.74          |
| A. lumbricoides       | 20             | 22.99          |
| Giardia lambia        | 8              | 9.20           |
| Trichuris trichiura   | 9              | 10.34          |
| Total                 | 87             | 100%           |

FIGURE 2: Parasite load on houseflies based on study sites

DISCUSSION

Houseflies have been conceived to transmit pathogenic organisms on their body surfaces as well as their guts. This is because they are primarily and largely associated with filthy environments (Onyenwe et al., 2016; Amaechi et al., 2017; Deakpe et al., 2018), and favour their development (Borror, 1989). They are known to easily transmit these pathogenic organisms to humans by depositing them on human foods through their activities (Deakpe et al., 2018). As a result, they can transmit varieties of pathogenic diseases such as dysentery, typhoid, cholera etc. (Onyenwe et al., 2016).

In this study, it was observed that flies carry medically important parasites which include Entamoeba histolytica, Taenia species, Ascaris lumbricoides, Giardia lamblia, Trichuris trichiura as shown in Table 1. These species have been identified by other studies to have a wide spread occurrence in other parts of Nigeria. These parasites are mostly associated with flies and cockroaches that thrive in areas with relative food availability (Maria Alves, and Belo, 2002). Most of these vectors also patronize dirty refuse areas as it was observed in the study. We assume therefore that the parasites adhere to their body surfaces when they leave those sites and come to feed in the open market thereby transferring their parasitic load to any surface they come in contact with.

The result of our findings revealed a high incidence of pathogenic intestinal parasites recovered from the flies in the study areas. This shows that households in the study locations are predisposed to being infected easily with these pathogenic parasites carried by the flies. This also revealed the risk level of exposure to disease carrying parasites by humans. Comparing the results from the four study sites, it was observed that the results were similar, given the fact that there was no significant difference in the number of infectious flies. Although some of the parasites were confined to certain market, for example Trichuris trichiura and Giardia lamblia were found in Jalingo main market and Kasuwan Bera. The similarity of results as observed in the different sites can be attributed to the fact that these markets provide the same commodities and have same anthropogenic activities relating to unruly refuse disposal, commodity display and same climatic condition that promotes the occurrence of flies species and parasites. These results are in agreement with the work of Deapke et al. (2018), who reasoned that pathogenic parasites and bacteria associated with
housfly were undermined or promoted by sanitation practices by the surrounding environment. In a similar study conducted by Amaechi et al. (2017), infection was significantly higher in houseflies collected in refuse dump sites and toilets.

CONCLUSION
In conclusion housefly is found to be a potential mechanical transmitter of parasitic infection and significantly contribute to the spread of food born parasitic diseases. Some microorganism causing bacterial and viral infection has been reported to be transmitted by housefly. Therefore, it becomes imperative to urgently institute control measures of this flies through mass education on improving environmental sanitary condition. There is a need of public awareness and education regarding the possibility of houseflies to be potential vectors of many food-borne diseases in Jalingo and the state at large. There is also a need to identify and embark on the control of housfly population in Jalingo and the entire state in order to curtail the diseases spread by the houseflies.

REFERENCES
Amaechi, A.A., Ukaga, C.N., Iwunze, J.I., Nwachukwu, M.O. and Anumudu, B. (2017). Epidemiological implications of houseflies (Musca domestica) in the dessemination of diseases in Owerri, south-east Nigeria. Nigerian Journal of Parasitology, 38(2): 298-301.

Balla, H.J., Usman, Y. and Muhammad, A. (2014). The role of housefly (Musca domestica) in mechanical transmission of intestinal parasites in Maiduguri metropolis, North Eastern Nigeria. Journal of Natural Sciences Research, 4(8):www.iiste.org. ISBN 2224-3186.

Borror, N. (1989). "Favorability of conditions in the reproduction and development of the common housefly: a controlled study". International Journal of Entomology. 21 (11): 157–181.

Cheesbrough, M. (2005). District Laboratory in Tropical Countries, Part 1. 2nd Edition, Cambridge University Press, Cambridge.

http://dx.doi.org/10.1017/CBO9780511581304

Deakpe, T.E., Manyi, M.M. and Utume, L.N. (2018). Pathogenic parasites and bacteria associated with the housefly (Musca domestica) in Makurdi; a fly-infested area in central Nigeria. Nigerian Journal of Parasitology, 39(1): 111-115.

Dipeolu, O.O. (1977). Field and laboratory investigation into the Musca species in the transmission of intestinal parasitic cysts and eggs in Nigeria. Journal of Hygiene, Epidemiology and Microbiol Immunity, 21: 209-214.

Lane, R.P. and Crosskey, R.W. (1993). Medical Insects and Arachnids. Chapman & Hall, London. 723pp ISBN 0-412-40000-6.

Maria Alves, S., and Belo, M. (2002). Morphometric Variations in the Housefly, Musca Domestica (L.) with Latitude. Genetic. 115:243–251.

https://doi.org/10.1023/A:1020685727460

Oyeyemi, O.T., Aghaje, M.O. and Okelue, U.B. (2016). Food-borne human parasitic pathogens associated with household cockroaches and houseflies in Nigeria. Parasite Epidemiology and Control, 1: 10-13.

Onyenwe, E., Okore, O.O., Ubiaru, P.C. and Abel, C. (2016). Housefly-borne helminth parasites of Mouau and its public health implication for the university community. Animal Research International, 13(1): 2352-2358.

Oghale, O.O., Ebube, C.A. and Oluchi, U.O. (2013). Parasitic load on Musca domestica (Diptera: Muscidae) from different synanthropic environments in Umuhia metropolis. Journal of Public Health and Epidemiology, 5(8): 309-312.

Paterson, H. E (2009). The Musca domestica complex in Sri Lanka. Journal of Entomology Series B, Taxonomy. 43 (2): 247–259.

Sanchez-Arroyo, H. and Capinera, J.L. (2017). "House fly: Musca domestica " . Featured Creatures . Retrieved 20 March 2020.

Vazirianzadeh, B., Solary, S.S., Rahdar, M., Hajhosssien, R. and Mehdinejad, M. (2008). Identification of bacteria which possible transmitted by Musca domestica (Diptera: Muscidae) in the region of Alvaz, South-West Iran. Jundishapur Journal of Microbiology, 1(1): 28-31.