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Mosquito Larval Sampling and Identification of Species Types in Gwagwalada, Federal Capital Territory (FCT), Abuja

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ABTRACT

A Study on mosquito larval sampling and identification of species types in Gwagwalada was carried out on the vectors of mosquito borne diseases to explore for alternative control measures to synthetic insecticides. The efficacy of essential oils of Alliums sativum extracts (L) (Alliaceous); was evaluated as larvicides and adulticides against three mosquito species and some non-target aquatic organisms in the laboratory. About 2,696 mosquito larvae comprising Anopheles 1041(38.61%), Aedes 916 (33.97%) and Culex 749 (27.78%) were collected from the study sites within Gwagwalada between 2021 & 2022. It is recommended that with increasing infrastructural development, the Gwagwalada community should opt for proper drainage system.

Keywords: Mosquito; Larval; Sampling; Identification; Species Types; Gwagwalada and FCT-Abuja.

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INTRODUCTION

The ecology, development, behavior, and survival of mosquitoes and the transmission dynamics of the diseases they transmit are strongly influenced by climatic factors (Oduola *et al.*, 2013). Temperature, rainfall, and humidity are especially important, but others, such as wind and the duration of daylight, can also be significant. The same factors also play a crucial role in the survival and transmission rate of mosquito-borne pathogens. In particular, temperature affects their rate of multiplication in the insect. In turn, this affects the rate at which the salivary secretions become infected, and thus the likelihood of successful transmission to another host. The epidemiology of mosquito born diseases in the tropics is even more complex than that in temperate climates and varies greatly with location (Oduola *et al.*, 2013). In much of equatorial Africa, parts of northern India, Indonesia, and South America transmission is termed stable because it is fairly constant from year to year. The disease is endemic, but epidemics are uncommon.

MATERIALS AND METHODS

Study area

Gwagwalada Area Council is located about 55km away from Federal Capital City. It lies on latitude 8° 55', North and 9° 00' North and longitude east and 7°.05' east (Figure 1) (Ishaya, 2013). The area covers a total of 65sq kilometer located at centre of very fertile area with abundance of grasses (Ishaya, 2013). This study area falls in to the guinea savanna vegetation zone of the country which is the broadest of all the vegetation types, constituting about

50% of the land area of Nigeria (Figure 1). There are two seasons within this vegetation zone, dry season that lasts between four to seven months and a rainy season that lasts between four to five months. The rainfall ranges between 1016mm and 1524mm with relative humidity of between 60% and 80%. The guinea savanna is divided into two vegetation zones: - the northern and the southern guinea savanna (Ishaya, 2013). About 60% of this rain falls between the months of July to September. The indigenes are either the *Gbagyi* or *Bassa* ethnic group. Most indigenes of Gwagwalada are farmers, fishers, petty traders, poultry, livestock keeping and civil servants (Wikipedia, 2019) (Figure 1).

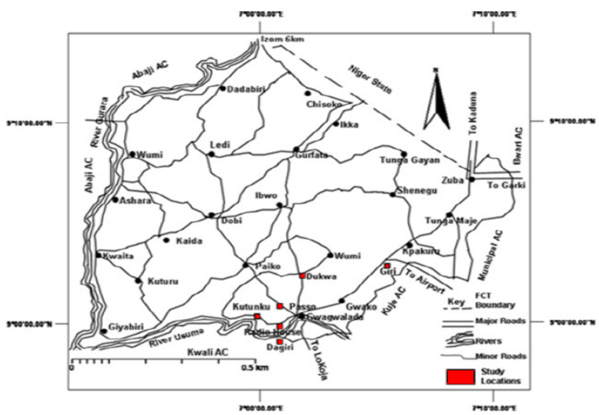

Figure 1: Map of Gwagwalada Area Council F.C.T. Source: Abuja Geographical Information System.

Identification of mosquito larva

The numbers of young larvae, old larvae and pupae were recorded. While it is preferable to separate the mosquito larvae in samples into the four stages, it is also time consuming to do so. Because larval head capsules are sclerotized and change size abruptly at each molt, larvae can be readily separated into stages using the relative size of the head capsule and the width of the head capsule, across the eyes and perpendicular to longitudinal body axis is the most reliable way to distinguish among the larval stages.

Preliminary surveys were conducted in all habitats in all land use types using a standard dipper. All positive habitats were considered for follow-up in the main study.

Each habitat was geo-referenced using a portable geographical positioning system (GPS). The 124 positive habitats which were selected were sampled for mosquito larvae once a week from 28 July 2009 through 3 March 2011. In habitats with sufficient water volume, a total of twenty (20) dips were made using a standard dipper (350mL, Bioquip Products, Inc. California, USA); for smaller habitats (mostly hoof prints) fewer dips were made. Larval abundance was calculated as the number of larvae per number of dips made in each habitat. Larval surveys were conducted between 10:00 and 13:00 h. All larvae (stages 1 to 4) sampled from each habitat were identified immediately in the field using morphological keys developed by Gillis and Coetzee (1987). Stage 1 and 2 larval instars were returned to their respective habitats while a small number of specimens of stage 3 and 4 larval instars were taken for molecular identification in the laboratory. The larval specimens were preserved in absolute alcohol (70 %) and kept in a freezer at –20 °C until needed for molecular identification. Some larval specimens belonging to An.gambiae S.l. and the *An.* funestus group were taken for molecular identification of sibling species by polymerase chain reaction (PCR), following protocols developed by Scott *et al*. (1993) for An.gambiae S.l. and by Ekesiobi et al. (2014) for An. funestus.

Sampling frequency

During the monitoring-mosquito control activities, sampling was done twice weekly during the time interval between the egg and adult stages for a particular cohort of mosquitoes. The development rate of immature mosquitoes was observed to be strongly dependent on water temperature; as the warmer the temperature, the faster immature mosquitoes develop to adulthood but however, water temperatures above 34°C are usually detrimental to mosquitoes common in some wetlands and also, low food levels, often associated with high densities of 3rd and 4th instars, can significantly slow immature development.

Maintenance of pupae and adults

The pupae were transferred to containers and placed in entomological cages for adult emergence. Adults were provided with 10% sugar solution in a jar with a cotton wick and an immobilized then was introduced weekly for one night for the female's nourishment. The mass rearing temperatures were kept at (27±2) ºC, 60%-70% relative humidity and a 12:12 photoperiod (Liu *et al.,* 2012).

RESULTS

Table 1 shows the occurrence of mosquito types in the different breeding habitats in Gwagwalada. A total of 2,696 mosquito larvae were encountered in abandoned containers, turbid puddles, old tyres, gutter, vegetated wetlands and marshes. The Frequency of larval occurrence in the positive habitats occurred in the following order of increasing abundance: The distribution of mosquito types in the positive habitats varied considerably. Aedes mosquitoes occurred more frequently

Table 1: Mosquito larval abundance and distribution in breeding habitats in Gwagwalada, during the rainy season of 2022

Containers	Puddles	Tyres	Gutters	Ditch	Vegetated	Wetland	Total
Aedes	17	51	36	467	102	243	916
Anopheles	21	73	23	425	287	212	1041
Culex	10	67	14	345	191	122	749
Aggregate	48	191	63	1024	580	790	2,696

Survey: 2022.
From the data collected, x^2 Cal =4.08
x^2 Tab= 5.99

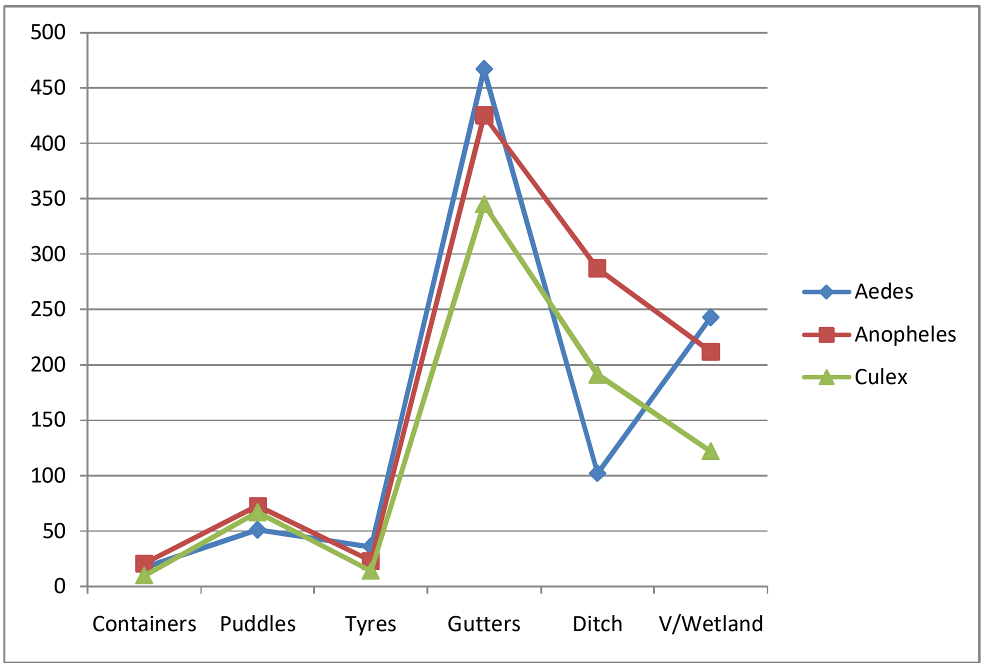

Figure 2: Mosquito larval abundance and distribution in breeding habitats

in Domestic Containers 48(1.8%), with more or equal presence in tyres 63(2.3%), vegetated wetland 790(29.3%). Generally, the *Anopheles* individuals were the most frequently occurring mosquitoes while culex mosquito preferred breeding in puddles 191(7.1%), with some presence in vegetated wetlands but were least encountered in Domestic Containers while Ditch/marsh accounted for 580(21.5%) and Blocked gutters 1024 (37.9%) (Table 1). Based on the calculation, there is no significant difference in mosquito larval abundance and distribution in the breeding habitats and there was no significant variation among the mosquito species abundance and distribution in the breeding habitat in Gwagwalada (Figure 2).

DISCUSSION

A total of 2,686 mosquitoes comprising of the three genera were collected from their larval stages for the purpose of morphometric analysis and prevalence in the study areas. The occurrence of mosquito types in the different breeding habitats in Gwagwalada. A total of 2,696 mosquito larvae were encountered in abandoned containers, turbid puddles, old tyres, gutter, vegetated wetlands and marshes. The occurrence of mosquito types in the different breeding habitats in Gwagwalada. A total of 2,696 mosquito larvae were encountered in abandoned containers, turbid puddles, old tyres, gutter, vegetated wetlands and marshes. The Frequency of larval occurrence in the positive habitats occurred in the following order of increasing abundance: The distribution of mosquito types in the positive habitats varied considerably. *Aedes* mosquitoes occurred more frequently in Domestic Containers 48(1.8%), with more or equal presence in tyres 63(2.3%), vegetated wetland 790(29.3%). Generally, the *Anopheles* individuals were the most frequently occurring mosquitoes while *culex* mosquito preferred breeding in puddles 191(7.1%), with some presence in vegetated wetlands but were least encountered in Domestic Containers while Ditch/marsh accounted for 580(21.5%) and Blocked gutters 10 (37.9%). During the sampling, *Aedes, Anopheles* and *culex* vectors of mosquito-borne disease were observed in maximum. *Aedes aegypti* and *Aedes albopictus* predominantly preferred to breed in artificial container and due to water scarcity, householders stored water in containers and such practices have been often associated with the proliferation of mosquito larvae because of that, these two species were distributed throughout the study period. The abundance of these vectors is associated with biotic and abiotic factors. *Aedes aegypti* prefers the muddy water found in many types of domestic containers inside or near human dwellings, whereas *Ae. albopictus* is more likely to be found in natural containers or outdoor man-made habitats containing a greater amount of organic debris.

Cx. Quinquefasciatus predominantly breeds more in sewage water than other habitats. Most of study places that had open sewage favored the constant distribution of *Cx. Quinquefasciatus,* which were frequently distributed in the study area. Similar observations were studied by Ebuzoeme, (2016) and reported that *Culex Quinquefasciatus* was predominantly associated with urban areas but occurring also in rural. This Cosmo-tropical urban mosquito *Cx. Quinquefasciatus* preferentially breeds in organically rich water but Stagnant pools were the preferred sites of *cx. Quinquefasciatus* and *cx. gelidus*.

Increased environmental temperature likely drove mosquito abundance by increasing metabolic rates, reproductive output, and host-seeking behavior of these vectors (Ammar *et al.,* 2012). The pattern of rainfall also affects larval habitats and vector population size. In some cases, increased rainfall increased larval habitat and vector population by creating new habitats, while excessive rain eliminated habitats through flooding, thus, decreasing the vector population. During the dry season, limited rainfall also formed temporary stagnant water bodies (Oduola *et al*., 2013).

Mosquito distribution and species richness were high during the month of July 2014 and September 2014 and the remaining season showed moderate distribution. This is because of the availability of different kinds of breeding habitats like modern agricultural practices and 'above the ground' water habitats. The same result was reported by (Onyekachi *et al*., 2018) in Mwea, Kenya where the distribution was more during the cultivation season.

Ekesiobi, *et al*., (2014) noted that the minimum and daily average temperatures were the most significant factors associated with short- and long-term vector abundance and suggested the prospective use of meteorological variables in predicting changes in the mosquito vector abundance. According to (Uttah *et al.,* 2013), the spatial distribution and abundance of *Ae. aegypti* are related to the effects of anthropogenic changes on the environment. Conversely, the distribution of *Ae. albopictus* was more associated with the presence of vegetation in urban and rural areas, whereas its abundance was generally limited to spaces modified by human activity. Among the environmental variables, rainfall, temperature, and relative humidity are key determining factors of the presence and frequency of these species (Gimba and Idris, 2014). According to Ishaya, (2013), meteorological factors affect mosquito metabolism, oviposition activity, and consequently, the number of eggs laid by females. While the information presented here contributes to the existing survey of mosquito communities in Gwagwalada, it is important to consider that seasonal fluctuations of mosquito communities are variable across years, affecting both the abundance of individual species and the community composition, and their subsequent response to meteorological variables (Onyekachi *et al*., 2018).

Conclusion

This study has provided an important information on the abundance and breeding habitats of mosquitoes (Anopheline and Culicine *spp.*) in Gwagwalada Area Council of Federal Capital Territory, Abuja. It also indicates the possibility of malaria disease among the community, particularly the inhabitants who are in most cases living outside their premises all the time.

Recommendation

It is recommended that with increasing infrastructural development, the Gwagwalada community should opt for proper drainage system.

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