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Original Article

Breeding ecology and physicochemical properties of mosquito breeding sites in Awka South Local Government Area, Anambra State, Nigeria

Kindness C. Irikannu[1,*], Angus E. Onyido[1], Pauline U. Umeanaeto[1], Anthony C. Onyebueke[2], Chibumma I. Nzeukwu[1], Confidence U. Ogbonna[3], Dorothy A. Ezeagwuna[1,4], Justina C. Ogaraku[1] and Kingsley K. Asogwa[5]

[1]Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka, Nigeria; [2]Department of Biology Education, Federal College of Education (Technical) Umunze, Anambra State, Nigeria; [3]Department of Biology, Alex Ekwueme Federal University Ndufu-Alike Ikwo, Ebonyi, Nigeria; [4]Department of Medical Microbiology and Parasitology, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria; [5]Department of Applied Biochemistry, Nnamdi Azikiwe University, Awka, Nigeria.

ABSTRACT

A study to investigate the breeding habitats of larval mosquitoes and the physicochemical factors that influence their abundance was conducted in Awka South Local Government Area, Anambra State, Nigeria, between October, 2017 and September, 2018. Mosquito larvae were collected from breeding sites by dip and emergence methods. Physicochemical properties of breeding habitats were studied by analyses of water samples from the sites. Physicochemical parameters analysed include pH, water surface temperature, water depth, total dissolved oxygen, salinity and conductivity. Temperature and water depth were measured in the field using mercury thermometer and meter rule, respectively. Total dissolved oxygen was obtained by titration, while other parameters were determined using Myron L6psi Multiparameter water kit. A total of 815 larval mosquitoes were collected in the study. There was no significant difference in the number of mosquitoes collected using different methods ($p = 0.734$, $p > 0.05$). Six mosquito species namely, *Anopheles gambiae* (73 (8.95%)), *An. funestus* (34 (4.17%)), *Aedes aegypti* (100 (12.26%)), *Ae. albopictus* (93 (11.41%)), *Culex tigripes* (41 (5.03%)) and *C. quinquefasciatus* (474 (58.15%)) were collected in their larval stages. *Culex quinquefasciatus* larvae (474 (58.15%)) was the most abundant while *An. funestus* larvae (34 (4.17%)) was the least. There was a significant difference in mosquito species collected from the breeding sites ($p = 0.000$, $p < 0.05$). Mosquito larvae were collected in the mean monthly pH range values of 6.2-6.7 and total dissolved oxygen 8.2-15.5 mg/L. Only mean monthly total dissolved oxygen of breeding sites had a significant relationship to the abundance of mosquito larvae ($r = 0.581$). Integrated control of mosquitoes targeted mainly at the larval stages was recommended.

KEYWORDS: mosquitoes, breeding, ecology, physicochemical, Awka.

INTRODUCTION

Mosquitoes are vectors of many parasitic and viral diseases of man and livestock [1]. They reproduce by laying their eggs on the open surface of stagnant water collections or attaching them to some partially submerged objects depending on the species. Examples of stagnant pools of water are

*Corresponding author: kc.irikannu@unizik.edu.ng

fresh water swamps, edges of rivers, marshes, rice fields, slow flowing streams and irrigation. Others include water collections in small ponds, tree holes, plant leaf axils, crab holes, puddles and rock pools [2, 3]. Man-made water breeding sites include water collections in vehicle tyres, tin cans, man and animal foot prints, coconuts shells, plastic containers, bamboo stumps, animal feeding bowls and concrete slabs, water holding cisterns and tanks, and cassava fermentation pots [4].

The breeding habitats of mosquitoes vary by species. *Aedes* species prefer to lay eggs in containers which include discarded old tyres of vehicles, flowerpots, gutters, trash cans or natural containers such as leaf axils and treeholes that can hold water [5]. However, *Aedes* species such as *Ae. aegypti* and *Ae. albopictus* which are the primary vectors of arboviruses worldwide, prefer to breed in containers. *Aedes albopictus* display opportunistic behaviour, inhabiting both artificial and natural containers. *Aedes triseriatus*, *Ae. sierrensis* and *Ae. geniculatus* prefer to breed in tree holes while *Ae. japonicus*, and *Ae. atropalpus* breed in rock pools [5, 6]. *Aedes africanus* breeds in moist treeholes in tropical rain forests and also lays eggs in bamboo stumps, and tree forks [7]. *Aedes vittatus* breeds in rock holes, hoofprints, boats, wells, tree trunks, treeholes, bamboo cups and pots and occasionally at the peak of the breeding season, in open concrete floodwater drains [3]. *Culex* mosquitoes breed in various types of stagnant water and lay their eggs in raft-shaped batches on a variety of standing water surfaces which may be found in sewage systems, drainage systems and container sources. These preferred oviposition habitats may include rainwater barrels, catch basins, storm drains, and septic tanks that are rich in decaying organic materials [8]. *Culex pipiens* and *C. quinquefasciatus* prefer to breed in sewage systems and drainages and containers. *C. molestus* and *C. restuans* breeds in dranaiges while *C. tarsalis, C. nigripalpus, C. salinarius, C. modestus, C. annulirostris, C. sitiens* breed in open habitats [5]. *Anopheles* mosquitoes breed in ground pools. *Anopheles gambiae*, which is the most efficient vector of malaria in sub Saharan Africa, breed in muddy sunlit ground pools of water of various sizes, animal foot prints and motor-vehicle tyre prints. It is occasionally found in man-made containers such as wheel barrows, motar pans, open tanks, canoes and abandoned concrete mixers [9].

Mosquito distribution depends largely on ecological and environmental factors such as rainfall pattern, relative humidity, temperature, turbidity and vegetation amongst others. For example, rainfall generally brings new opportunistic breeding places. Nonetheless, rainfall can also destroy existing breeding places; heavy rains can change breeding pools into streams, impede the development of mosquito eggs or larvae or simply flush eggs or larvae out of the pools [10]. Also it has been observed that mosquito populations decrease in the dry season due to high temperatures and lack of breeding places [11]. For an effective mosquito control programme, a detailed ecological work on the habitats and influence of the ecological factors on the abundance of the larval mosquito species in the study area is vital. The objectives of this study are to determine the breeding habitats of different mosquito species and the physicochemical factors of the aquatic habitats that influence larvae abundance.

MATERIALS AND METHODS

Description of study area

The study was done in Awka-South Local Government Area (L.G.A) of Anambra State, South-eastern Nigeria. Awka South L.G.A is situated between Longitude 7º 04'E and Latitude 6º 10'N. Awka is in the tropical rainforest zone of Nigeria and experiences two distinct seasons of eight months of heavy rains between March and October and four months of dryness (November-February). The temperature range in Awka is generally 27-30 ºC between June and December but rises to 32-34 ºC between January and April. The relative humidity of the area is about 70% in the dry season reaching 80% during the wet season. The annual rainfall is between 2000-3000 mm. The community is about 150 m above sea level. Awka South L.G.A has a population of 189,049 inhabitants [12], living in nine communities, namely, Amawbia, Awka, Ezinato, Isiagu, Mbaukwu, Nibo, Nise, Okpuno and

Umuawulu. The towns could be subdivided into urban, semi-urban and rural areas. The urban areas include Awka and Amawbia, the semi-urban Areas include Nibo and Okpuno and the rural areas include Mgbakwu, Nise, Ezinato, Isiagu and Umuawulu. The inhabitants of the area are predominantly farmers, civil servants, traders, and blacksmiths.

Study design

The study was an ecological survey of mosquito breeding sites and laboratory analysis of the physicochemical factors influencing larval survival in their environment. The study was conducted for a period of twelve months starting from October, 2017 to September, 2018.

Advocacy visits and community sensitisation

Advocacy visits with an introductory letter from the Head of the Department of Parasitology and Entomology to the opinion leaders of the communities were used to obtain permission to carry out the study. Members of the communities were sensitized and the project significance was explained to them. Their consent was obtained for the use of their environment for the study.

Selection of sampling area

Six of the nine communities that made up Awka-South L.G.A, namely Amawbia, Awka, Okpuno, Nibo, Nise, and Mbaukwu, were judgementally selected [13]. This was done to properly represent the urban, sub-urban and rural communities in equal numbers. Thus Amawbia and Awka communities represented the urban, Okpuno and Nibo represented sub-urban while Mbaukwu and Nise represented rural communities.

Collection of mosquito larvae

The breeding habitats of the mosquitoes were determined through collection of mosquito immature stages from standing water pools using a previously described method [14]. Mosquito larvae were collected from the six selected communities in the study area. Six breeding sites were selected from each community. Mosquitoes breeding in septic tanks were collected using locally made emergence traps. The larvae in ground pools and large domestic water containers were collected with the aid of ladles into a white plastic bowl. The larvae in discarded used automobile tyres were collected with the aid of large pipettes with rubber teat. The larvae in small containers were completely overturned into the sampling bowls. Coarse debris like sticks and plant leaves were handpicked and thrown away. A sieve of about 0.55 mm mesh size (kitchen sieve) was used to separate the larvae from debris. Mosquito larvae in treeholes and leaf axils were collected with long pipettes into a white bowl. At the end of each collection, larvae from different sampling sites were kept in separate transparent and well-labeled bottles (Jam jars) and transported to the Entomology Laboratory of the Department of Parasitology and Entomology, Nnamdi Azikiwe University for rearing to adult stage and identification using an insect box.

Morphological identification

All larval collections were reared to adults before identification. The morphological identifications were later confirmed at the Laboratory of National Arbovirus and Vectors Research Centre, Enugu. The mosquitoes were identified using the gross morphology of the species, especially the body colour, patches of scales on the palps, antennae, proboscis, patches of pale and black scales on the wings and legs and the terminal abdominal segments using standard keys [15, 16].

Analysis of the physicochemical properties of water from the mosquito breeding sites

Water samples were collected from selected mosquito breeding sites in the study area and the physicochemical properties were analyzed at the Natural Product Research and Development Laboratory, Faculty of Physical Sciences, Nnamdi Azikiwe University, Awka. The water samples were collected once every month during mosquito collections for a period of 12 months. The water samples were kept in clean white jerrycans [17]. The surface water temperature was measured in the field using a mercury thermometer while the depth of the breeding sites were measured using a meter rule. Total dissolved oxygen was obtained by titration while pH, conductivity and salinity were analysed using the Myron L6psi Multiparameter water kit [18]. The Myron L multiparameter was calibrated using standard

solutions of potassium chloride (KCl), sodium chloride (NaCl) and buffers of pH 4.0, 7.0 and 9.0. The sample cup and the pH/oxidation reduction potential (ORP) sensor were rinsed three times with the sample to be analyzed. The sample was then placed in the sample cup and sensor of the kit. Each parameter was measured by pressing the respective parameter buttons on the kit and the reading on the screen was recorded after 30 seconds.

Data analysis

Data collected from the study were analysed using the Statistical Package for Social Sciences (SPSS) version 2.10. Analysis of variance (ANOVA) at 5% significant level was used to compare the larval mosquito populations across breeding sites. Pearson correlation was used to determine the relationships between mosquito larvae populations and physico-chemical properties of breeding sites.

RESULTS

A total of 815 mosquito larvae (Table 1) were collected from six types of breeding sites in the study area. The highest number of larvae 202 (24.78%) were collected from septic tanks and the least 41 (5.03%) were from treeholes. There was no significant difference in the numbers of mosquito larvae collected from different breeding sites ($p = 0.734$, $p > 0.05$). Six mosquito species were collected. *Culex quinquefasciatus* larvae (474 (58.15%)) was the most abundant while *An. funestus* larvae (34 (4.17%)) was the least. There was a significant difference in mosquito species collected from the breeding sites ($p = 0.000$, $p < 0.05$).

Of the 815 larvae collected, the highest number of larvae (178 (21.84%)) was collected from Amawbia community and the least (106 (13.00%)) from Mbaukwu (Figure 1).

Most of the larvae, 529 (64.79%), were collected between the month of March and October (wet season). Only 286 (35.21%) larvae were collected between November and February, the dry season period (Figure 2). There were no significant difference in monthly abundance of the mosquitoes and between wet and dry season collection ($p = 0.722$, $p > 0.05$).

Table 1. Mosquito larvae collected from different breeding sites in Awka-South L.G.A.

Mosquito species	Breeding sites						
	Dirty gutters	**Domestic containers**	**Discarded tyres**	**Ground pools**	**Septic Tanks**	**Treeholes and plant axils**	**Total (%)**
An. gambiae	0	0	0	73	0	0	73 (8.95)
An. funestus	0	0	0	34	0	0	34 (4.17)
Ae. aegypti	0	67	33	0	0	0	100 (12.26)
Ae. albopictus	0	0	93	0	0	0	93 (11.41)
C. tigripes	0	0	0	0	0	41	41 (5.03)
C. quinque-fasciatus	135	46	0	91	202	0	474 (58.15)
Total	**135 (16.56%)**	**113 (13.86%)**	**126 (15.45%)**	**198 (24.29%)**	**202 (24.78%)**	**41 (5.03%)**	**815 (100)**

p value for the abundance of larval species from breeding sites = 0.734, $p > 0.05$.
p value for the abundance of mosquito larvae in different breeding sites = 0.000, $p < 0.05$.

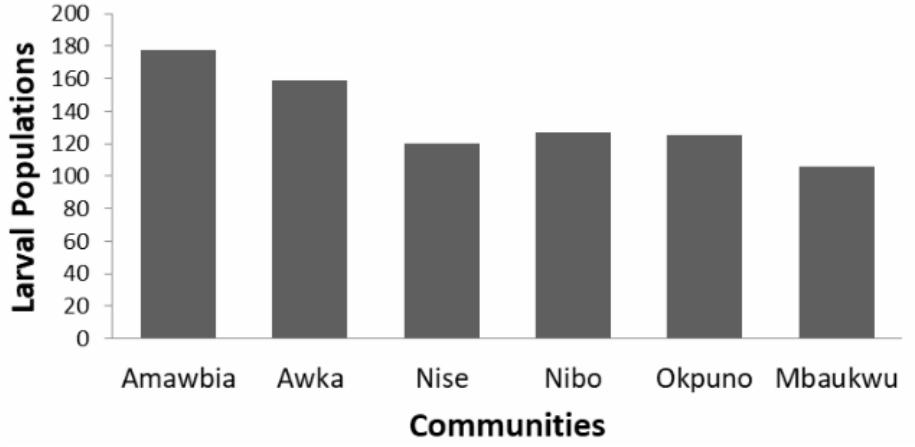

Figure 1. Mosquito larvae abundance from different communities of Awka-South L.G.A.

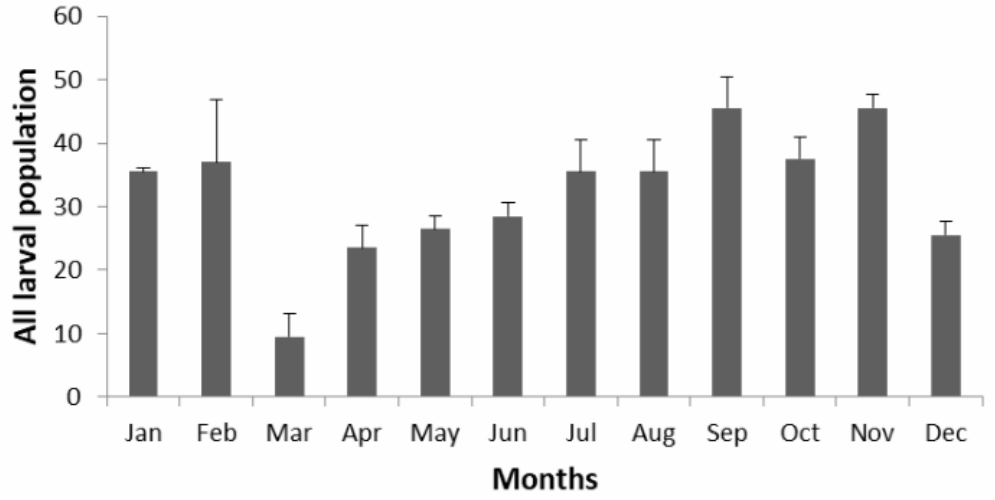

Figure 2. Monthly abundance of all mosquito larvae populations in Awka-South L.G.A.

Table 2 shows the mean monthly larval population and the physicochemical properties of mosquito breeding sites. Only the correlation coefficient (r) of mean monthly total dissolved oxygen with larval mosquito population was statistically significant (r = 0.581).

DISCUSSION

A total of 815 mosquito larvae were collected in all the study area. The number of larvae in this study was lower than 1,180 earlier reported in Obi-Akpor, Rivers State [19]. Also 2,641 larvae were collected in another study in Ohafia, Abia State [20]. In Oba, Anambra State 2,319 larvae were recorded [21]. But a more significantly higher number 3,110 was sampled in Jos, Plateau State [22]. A total of 4,256 were collected in Akure, Ondo State [23] while 4,871 were reported in Azare Bauchi State [24]. The differences in the number of larval collections made in different areas may depend on the length of the period of the studies. Also factors responsible for abundance of larval mosquitoes such as availability of breeding sites, environmental management and poor sanitation may abound in one area than another.

Assorted types of mosquito breeding sites ranging from dirty gutters, old vehicle tyres, ground pools,

Table 2. Response of all mosquito larvae populations to mean physicochemical conditions of all breeding sites in the study area.

Month	Mosquito larvae populations	Mean pH	Mean conductivity (µS/cm)	Mean total dissolved oxygen (mg/L)	Mean salinity (PSU)	Mean water surface temp. (^oC)	Mean depth of breeding site (cm)
Jan	71	6.2	69.2	8.2	0.038	28.3	6
Feb	74	6.2	76.3	9.0	0.040	28.6	6
Mar	24	6.3	90.7	8.1	0.045	28.8	8
Apr	47	6.5	127.2	12.3	0.061	28.5	8
May	53	6.5	130.3	12.9	0.061	28.2	9
June	55	6.6	133.6	13.6	0.061	27.8	13
July	91	6.6	138.1	14.0	0.063	27.8	13
Aug	92	6.6	141.8	14.5	0.064	27.8	12
Sept	91	6.7	150.0	15.5	0.065	28.0	9
Oct	75	6.6	134.6	14.5	0.061	28.2	8
Nov	89	6.3	130.0	13.1	0.056	28.6	7
Dec	52	6.2	78.6	8.5	0.038	28.0	7
Correlation coefficients (r)		0.340	0.430	0.581*	0.374	-0.439	0.221

*Only Pearson correlation of mean total dissolved oxygen is significant at the 0.05 level (2-tailed).

septic tanks, treeholes, leaf axils and domestic containers were identified in the study area. The same types of breeding sites were also observed in different studies in Nigeria [19, 20, 22-24]. This observation agrees with an earlier observer who noted that the preponderance of mosquitoes in Awka metropolis was due to prevailing mosquito breeding habitats in the area [25]. These various sites identified collect and hold waters that form breeding sites for mosquitoes especially during the wet season. Also, it has been observed that in Nigeria and most developing countries, the urban landscapes were often littered with garbage, plastic and tin cans, bottles, disposable cups, discarded vehicle tyres and earthen wares which form breeding grounds for mosquitoes especially during the wet season [2, 3, 26].

The highest number of mosquito larvae (24.78%) was collected from septic tanks. Septic tanks retain sewage water throughout the year and mosquito species such as *C. quinquifasciatus* as was observed in this study, continue to breed in them even during the dry season when other sites have dried up. It has earlier been reported that *C. quinquefasciatus* has preference for polluted water. Thus their breeding in septic tanks is justifiable [27]. Most of the larvae were collected in the months of April to November, corresponding to the wet season. Only a few larvae were collected from December to March corresponding to the dry season period. High prevalence of larvae in the rainy season than in the dry season has also been reported [20]. This is because rainfall creates water collections and flood pools which increase the number of favourable breeding sites for mosquitoes [25]. Also it has been observed that larval collections were least in the dry seasons because most of the breeding sites were dried up [3].

The highest number of larvae was collected from Amawbia (n = 178) community and the least from

Mbaukwu (n = 106). This indicates that the larval mosquitoes were not evenly distributed across all the communities. The major factor that would influence the uneven distribution could be the availability of breeding sites and the nature of the settlements of the inhabitants in the different communities. It has also been observed that mosquito distribution and abundance are related to population, land use and human activities [28]. Also researchers have noted that anthropogenic-related factors such as open drainage systems contribute to the increasing abundance of mosquitoes in the breeding sites in highly developed and populated area [23] such as that observed in Amawbia in the study. Therefore rural community such as Mbaukwu that has no such open drainage system and has fewer inhabitants had less number of mosquitoes breeding in their area.

In this study, mosquitoes were observed to breed adequately in the water with surface temperature ranges of 27.8 ºC-28.8 ºC and conductivity ranges of 69.2-150 µs/cm. The observations agreed with those earlier made in another study [23]. Also mosquitoes were observed to breed in the total dissolved oxygen ranges of 8.2-15.5 mg/L and had a positive relationship to mosquito abundance. This suggests that formulation of larvicides that can adversely affect the total dissolved oxygen content of breeding sites can negatively affect the developments of larval mosquitoes leading to their control.

Six mosquito species belonging to three genera (*Anopheles, Aede*s and *Culex*) were collected as larvae. Similarly varying numbers of mosquito larvae have been reported from different study areas in Nigeria. Six species were collected in Bauchi State [24], same as in the present study. But 10 larval species, which are higher when compared with the number collected in this study, were reported in Rivers State [19]. Also in Ondo State 31 species were recorded [23] while only 5 larval species were reported in a study in Abia State [20]. All the mosquito species they collected included the 3 genera: *Anopheles*, *Aedes* and *Culex* observed in this study. *Anopheles gambiae* and *An. funestus* were collected from ground water pools, *Ae. aegypti* from domestic containers and discarded used tyres, *Ae. albopictus* from discarded used tyres, *C. quinquefasciatus* from dirty blocked gutters, domestic containers and ground pools and *C. tigripes* from treeholes and leaf axils. These observations of peculiar breeding sites for different mosquitoes were also reported by some researchers in their studies [19, 20, 22-24]. Specific nutritional and chemical composition needs of different mosquito species may be the determining factor for their choice of peculiar breeding sites. Earlier studies have noted that even though these different species of mosquitoes generally breed in stagnant water, they differ in microecological requirements in their breeding habitats [9].

CONCLUSION

The observations in this study show that mosquito species already established as vectors of parasitic and viral diseases such as malaria and filariasis amongst others breed in the study area. The presence and activities of these mosquitoes are of serious concern as there is risk of disease transmission to the inhabitants. Interventions with integrated mosquito control measures mainly targeted at the larvae and massive health education will help curtail the vectors.

CONFLICT OF INTEREST STATEMENT

All authors declare no conflicts of interest.

REFERENCES

1. Umeanaeto, P. U., Asogwa, A. N., Onyido, A. E., Irikannu, K. C. and Ifeanyichukwu, M. O. 2017, International Journal of Environment, Agriculture and Biotechnology, 2(4), 1551-1556.
2. Irikannu, K. C. and Chuhwuekezie, O. C. 2015, Malaria and man-biting mosquitoes in tropical Africa. Lambert academic publishing.
3. Onyido, A. E., Ezike, V. I., Nwosu, E. O., Ozumba, N. A., Ikpeze, O. O., Obiukwu, M. O. and Amadi, E. S. 2009, Internet Journal of Parasitic Diseases, 4(1), 1-9.
4. Onyido, A. E., Ezike, V. I., Nwankwo, E. A. and Ozumba, N. A. 2006, Nigerian Journal of Parasitology, 7, 140-143.
5. David, B. V. and Ananthakishnan, T. N. 2004, Order Diptera. General and Applied Entomology. 2nd Edition. Tata McGraw Hill Education Private Limited New Delhi.

6. Talsania, N., Patel, M., Nayak, H., Modi, K. and Shah, T. 2013, Health Agenda, 1(1), 23-26.
7. Huang, Y. 1990, Contributions of the American Entomological Institute, 26(1), 3-90.
8. Adebote, A. D., Oniye, J. S., Ndams, S. I. and Nache, M. K. 2006, Journal of Entomology, 3(2), 180-188.
9. Onyido, A. E., Ndezia, N., Obiukwu, M. and Amadi, E. S. 2008, Internet Journal of Health, 9(2), 13-22.
10. Bruce-Chwatt, L. J. 1991, Essential Malariology. Heinemann Medical Books Ltd. London.
11. Service, M. W. 2008, Medical Entomology for Students Mosquitoes (Culicidae). Liverpool Science of Tropical Medicine 4th Edition.
12. Nigeria Population Commission. 2007, Special FRN, on 2006 population census. Gazette No. 23.
13. Onuoha, J. K., Okparaeke, G., Kalu, I. N., Bassi, B. P., Onyeke, I., Okparaku, U. D., Ozoh, J. E., Okpanku, H. O. and Nkwocha, C. 2011, Research Methodology for Behavioural Science. Cape publishers Int'l Ltd.
14. Onyido, A. E., Ezeani, A. C., Irikannu, K. C., Umeaneto, P. U., Egbuche, C. M., Chikezie, F. M. and Ugha, C. N. 2016, Ewemen Journal of Epidemiology and Clinical Medicine, 2(1), 14-20.
15. Gillies, M. T. and De Meillon, B. 1968, South Africa Institute of Medical Research, 54, 343-344.
16. Gillet, J. D. 1972, Common African Mosquitoes and their Medical Importance. William Heinemann Medical Books Limited, London.
17. Oyewole, I. O., Momoh, O. O., Anyasor, G. N., Ogunnowo, A. A., Ibidapo, C. A., Oduola, O. A., Obansa, J. B. and Awolola, T. S. 2009, African Journal of Environmental Science and Technology, 3(12), 447-452.
18. Ramakanta, P. and Tusharkanti, B. 2013, Laboratory manual for environmental engineering Laboratory. Department of Civil Engineering, Centurion Institute of Technology publication.
19. Eze, N. C., Ezihe, E. K. and Chukwu, M. C. 2018, International Journal of Entomology Research, 3(2), 85-90.
20. Egwu, O., Ohaeri, C. C., Amaechi, E. C. and Ehisianya, C. N. 2018, Cuadernos de Investigación UNED, 10(2), 379-385.
21. Okonkwo, N. J., Obiechina, I. O., Ugha, C. N., Irikannu, K. C., Obianumba, S. N., Okoye-Uzochukwu, C. I., Iwuora, O. I. and Chinweoke, J. O. 2014, Researcher, 6(8), 51-56.
22. Goselle, O. N., Amobi, L. O., Ojile, J. O., David, A., Nanvyat, N., Adulugba, I. A., Kumbak, D., Udeh, E. O., Mbaya, Y. A. and Mafuyai, H. B. 2017, International Journal of Mosquito Research, 4(4), 119-125.
23. Afolabi, O. J., Simon-Oke, I. A. and Osomo, B. O. 2013, Journal of Parasitology and Vector Biology, 5(10), 132-136.
24. Abdulrasheed, D., Aliyu, A. O. and Hafsa, B. 2016, IOSR Journal of Pharmacy and Biological Sciences, 11(6), 105-109.
25. Mbanugo, J. I. and Okpalaononuju, C. N. 2003, Nigerian Journal of Parasitology, 24, 185-190.
26. Onyido, A. E., Azubuike, J., Amadi, E. S., Obiukwu, M. O., Ozumba, N. A. and Ikpeze O. O. 2011, New York Journal, 4(9), 34-39.
27. Mafiana, C. F., Anaeme, L. and Olatunde, G. O. 1998, Nigerian Journal of Entomology, 15, 136-143.
28. Simon-Oke, I. A., Afolabi, O. J. and Olofintoye, L. K. 2012, FUTA Journal of Research in Sciences, 1, 83-88.