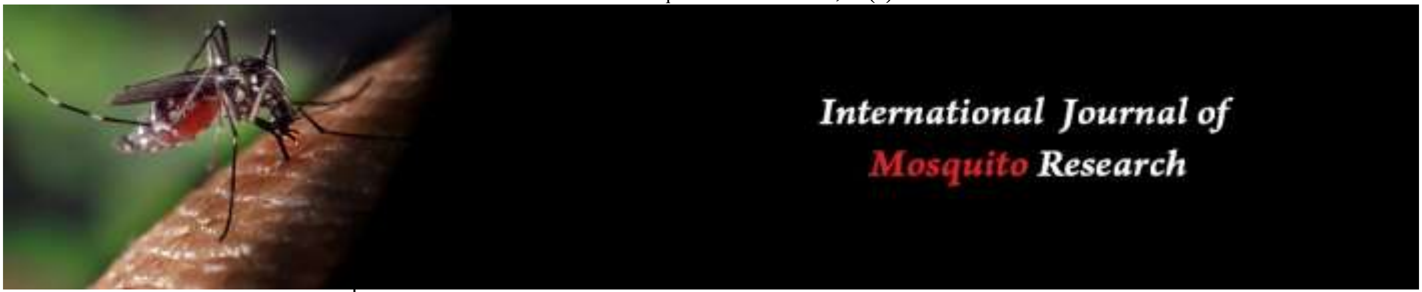

ISSN: **2348-5906**
CODEN: **IJMRK2**
IJMR 2023; 10(5): 103-108

https://www.dipterajournal.com
Received: 08-06-2023
Accepted: 13-07-2023

Bijendra Kumar
Department of Public Health, West Zone Municipal Corporation of Delhi, Dr. Sahib Singh Verma Nigam Bhawan Shivaji Place, Rajouri Garden, Delhi, India

LR Verma
Department of Public Health, Dr. Shyama Parshad Mukherjee, Civic Centre Minto Road Ajmeri Gate, Delhi, India

VN Bhagat
Department of Public Health, West Zone Municipal Corporation of Delhi, Dr. Sahib Singh Verma Nigam Bhawan Shivaji Place, Rajouri Garden, Delhi, India

Aditi Singh
Department of Public Health, West Zone Municipal Corporation of Delhi, Dr. Sahib Singh Verma Nigam Bhawan Shivaji Place, Rajouri Garden, Delhi, India

Corresponding Author:
Bijendra Kumar
Department of Public Health, West Zone Municipal Corporation of Delhi, Dr. Sahib Singh Verma Nigam Bhawan Shivaji Place, Rajouri Garden, Delhi, India

Entomological surveillance of dengue vector in different type of breeding habitats in west district of Delhi

Bijendra Kumar, LR Verma, VN Bhagat and Aditi Singh

DOI: https://doi.org/10.22271/23487941.2023.v10.i5b.701

Abstract
Entomological Surveillance of Dengue is one of the important aspects of vector control. The aim of this study was to find out the occurrence and abundance of breeding of Dengue Vector (*Aedes*) within different types of habitats at high risk areas for dengue transmission. Larval sampling was done indoor and outdoor. West Zone of MCD is divided into 29 wards; approximately 80% area of west zone falls in west district of Delhi. Various localities were covered for sampling of immature stage of *Aedes*. During this study, total 28,800 containers were examined from Jan 2020 to December 2021, out of 576 positive containers was reported. Plastic Containers (35.06%), Earthen Containers (26.56%), Iron Containers (26.04%), Cemented containers (7.46%), Rubber (4.51%) and Glass (0.34%). Maximum positive plastics containers (35.06%) was observed and minimum positive containers of Glass (0.34%) was observed. Therefore, to reduce larval habitats for *Aedes* breeding, use of water storage containers should be discouraged and another important tool as source reduction (Elimination of water stagnated containers) for the control of Dengue disease. There are two common species identified of Dengue vectors such as *Aedes aegypti* and *Aedes albopictus* which are responsible for the transmission of Dengue disease in Delhi.

Keywords: *Aedes aegypti* and *Aedes albopictus,* breeding habitats, dengue virus

Introduction

Aedes mosquito acts as vector for the transmission of Dengue, Chikungunya and Zika virus diseases. Vector-borne diseases remain a public health problem in tropical and sub-tropical countries (Cecílio *et al*, 2015, Rodrigues *et al* 2015) [2, 3]. Dengue virus is transmitted by *Aedes* mosquitoes and is called dengue fever or break bone fever (Halstead, 2008) [10]. Dengue viruses belong to the genus Flavivirus, family Flaviviridae. The genus Flavivirus comprises Yellow fever, Tick-borne encephalitis, Japanese encephalitis and West Nile (Tomlinson *et al*, 2009) [11]. There are four serotypes of dengue viruses: DENV-1, DENV-2, DENV-3 and DENV-4 with similar characteristics. However, genetic variations still exist within these serotypes (Mehboob *et al*, 2014) [12].

Dengue fever symptoms are headache, arthralgia (joint pain), exhaustion, fever, swollen lymph glands (Lymphadenopathy), severe myalgia (muscle pain), abdominal pain, mucosal bleeding, continuous vomiting, black stools and bleeding from the nose and mouth.

There are two common mosquito species of Dengue vector such as *Aedes aegypti* and *Aedes albopictus* which are responsible for the transmission of Dengue. *Aedes* belong to Arthropoda phylum, Insecta class, Diptera order and Family culicidae. The vector of Dengue breeds in both natural and artificial containers, receptacles that hold clean and fresh water. *Aedes* mosquitoes require stagnant water to complete their life cycle. *Aedes* is adaptive to urban environments, especially manmade and artificial containers such as plastics, irons, earthen, rubber tyres and cemented tanks, and other artificial containers (Brady *et al*, 2012; WHO, 2019) [4]. Therefore, any water body of stagnant, fresh and clean water represents a potential breeding habitat for mosquito larval growth. The biology of mosquito is influenced by many environmental factors, such as rainfall, temperature and humidity.

During the rainy season, many habitats collect rainwater and use containers to hold the water.

All of the households have water-holding containers on their surrounding premises. Rainwater collected in pockets of scrap articles and junk material provides potential breeding sites for dengue vectors. After rainfall, these containers act as mother foci for *Aedes* mosquitoes in non-transmission seasons, and in transmission seasons, the breeding of *Aedes* spreads from the mother foci to other containers. The survey of mother foci containers should be done during the non-transmission season for the control and prevention of Dengue vectors. Temperature and humidity are also important factors for the larval development of mosquitoes.

Aedes mosquitoes lay their eggs on the walls of water containers and after two days, the eggs hatch and develop into first instar larvae. Then, the larvae developed into first instars to fourth instar afterwards, the fourth instars developed into pupae in 5 to 7 days. Finally, the newly formed adult emerges from the pupae in 2-3 days. The complete life cycle of *Aedes* mosquito takes approximately 8-10 days at optimum climatic conditions. The high density of Dengue vectors in an area can increase the risk of Dengue outbreak. The prediction of the risk of Dengue outbreak employs vector surveillance based on entomological parameters (Chang *et al*, 2011) [6]. Vector surveillance is important in determining factors related to dengue transmission (WHO, 2019).

Vector surveillance is the most important indicator to control and prevention of Dengue, Chikungunya and Zika. The percentage of water-holding containers infested with larvae or pupae and the number of positive containers per 100 houses inspected (Chang *et al*, 2011) [6]. The aim of the study was to find out the maximum occurrence and abundance of *Aedes* vectors in different types of breeding containers.

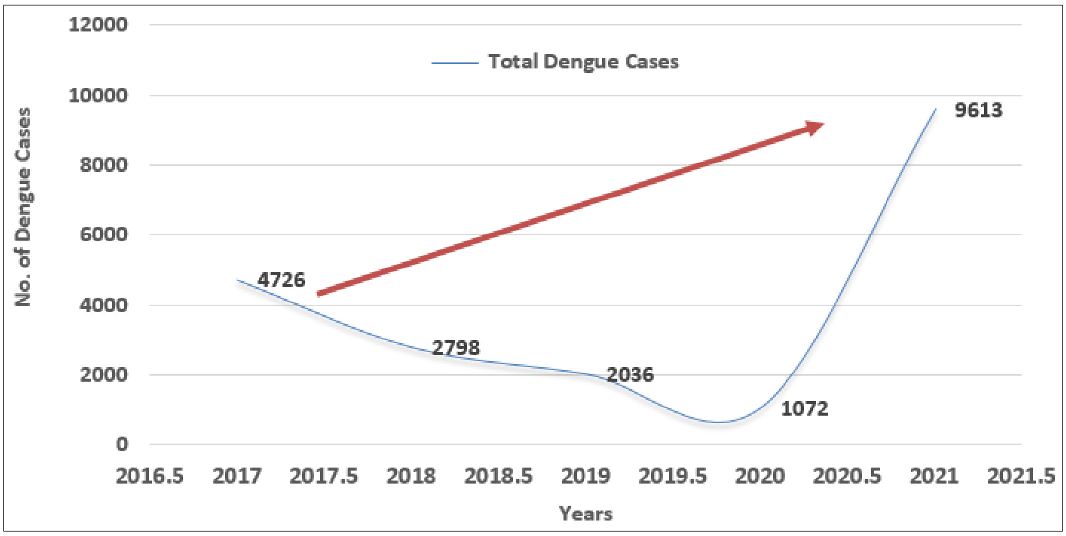

Fig 1: Epidemiological Situation: Number of dengue cases in Delhi. Source: Management Information System (MIS), MCD Delhi.

Materials and Methods

Study Area

The West Zone of the Municipal Corporation of Delhi is covered by two districts, i.e. West district and Dwarka. Approximately 80% of the West Zone is covered by West district of Delhi. Currently, it covers estimated 164 Sq. Km areas; there are averages of 38 Lakh populations. The study was selected based on high occurrence of Dengue cases as per epidemiological data of 2021 (Fig.1). Dengue is known as urban Vector Borne Disease and the number of Dengue cases reported keeps increasing annually.

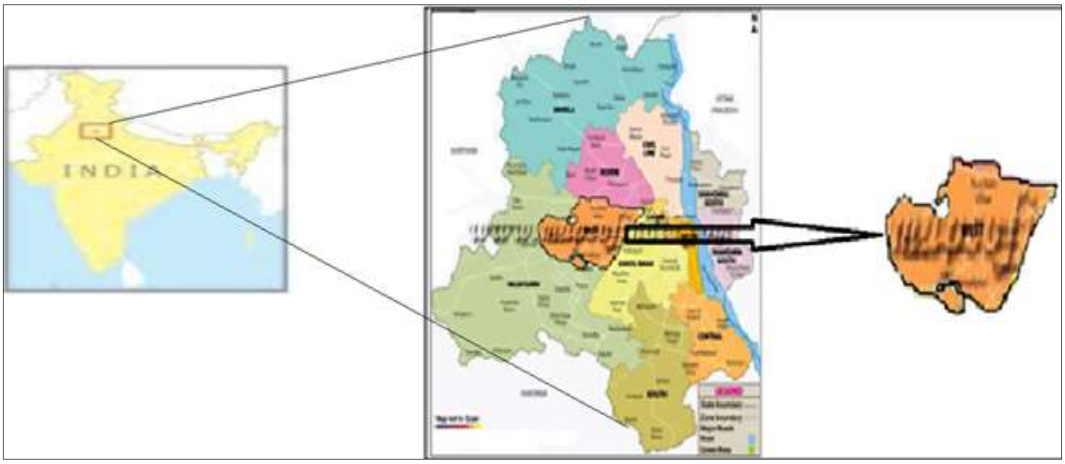

Fig 2: Showing the West Zone of MCD in west district of Delhi

Larval Sampling and identification

Dengue vector survey was carried out in domestic and peri-domestic households, as well as indoor and outdoor, at each locality of West Zone. The sampling of immature stages of

Aedes was done monthly basis (Table 1 & 2). Natural and artificial water-holding containers were visually inspected for the presence of mosquito larvae and pupae (Chang *et al*, 2015) [7]. Larvae were identified at the genus level established as *Aedes*, Anopheles and Culex based on morphological characteristics and resting stages in breeding habitats (Pratt, 1993) [21]. *Aedes* and Culex are vertically hanging from the water surface while Anopheles is found parallel to water's surface. The Siphon (Breathing) tube of *Aedes* occurs short in comparison to Culex while Anopheles has rudimentary siphon tube. Larvae were identified basis on the absence siphon tube at the 8th abdominal segment and presence of ventral palmate hair. Therefore, Culex well developed siphon tube with more than one pair of hair tuft and in *Aedes* larvae, presence of one pair of hair tufts.

Entomological data was recorded on entomological report of each positive container. Average of 10 containers was observed for each material. Total number of places inspected, total number of houses and containers inspected, and also noted type of containers like Plastic, Iron, Earthen, Cement and Rubber etc. Immature stages of *Aedes* mosquito were identified in each container as follows: positive (+) container, indicating the presence of larval and/or pupal stages in a container and negative (-) containers, indicating that no larval and/or pupal stages were found (Fig. 2). Larvae and pupae were collected and put into a plastic bottle/container using a dropper (Getachew *et al*, 2015 and Madzlan *et al*, 2016) [8, 9]. After that, the larvae and pupae are carefully reared at optimum conditions. The immature stage developed into adult mosquitoes which were identified as proper species under the light microscope using the identification Key.

Fig 3: Inspection on different type of containers for *Aedes* breeding. A. Wooden Container, B. Broken Ceramic Flower Pot, C. Plastic Containers, D. Rubber Tyre

Results and Discussion

In the present study, it has been observed that the prevalence of *Aedes* larvae in different types of containers like Plastic, Iron, Cement, Earthen, Glass and wood. Total of 28,800 containers were examined from Jan 2020 to December 2021. Maximum positive (30) plastic containers were observed and minimum positive containers were recorded of (01) of Glass and Wood 2021. Out of 576 positive containers was reported. Plastic Containers (35.06%), Earthen Containers (26.56%), Iron Containers (26.04%), Cemented containers (7.46%), Rubber (4.51%) and Glass (0.34%). It was found that maximum positive plastic containers (35.06%) were observed and minimum positive containers of Glass (0.34%) were observed. plastic containers are used for water storage due to tap water scarcity. Earthen containers are more suitable for the larval development of *Aedes* mosquitoes. Mostly earthen containers are used as water feeding for birds. A similar study found that water-filled earthen pots kept for birds are the most preferred breeding habitats for *Aedes* mosquitoes (Singh *et al*, 2014) [14]. Similar observations were reported that the use of earthen pots may serve as very potent containers for the breeding of *Aedes aegypti* due to faster development of larvae in Delhi (Kumari *et al*, 2011; Das and Hazra, 2013) [15, 16]. Another study reported earthen container has least variation in water temperature due to it being thermally insulating. Plastic container was found positive throughout the year except for the month of May 2020 while minimum positivity was recorded for (01) wood type of containers in September 2020. In the west zone, the maximum number of plastic containers was used for the storage of water due to scarcity of water supply in unauthorized localities, huts and slum areas.

In this study, we have observed that the maximum containers were found positive in the transmission season rather than in the non-transmission season. Vector surveillance is an important aspect of dengue control before dengue transmission in the community with the previous studies carried out in many parts of Thailand (Mogi *et al*, 1988; Thavara *et al*, 2001) [22, 23].

Similar observation found that containers develop effective control strategies (Arunachalam *et al*, 2010; Olano *et al*, 2015) [18, 19]. This survey confirmed that *Aedes* larvae and pupae were not concentrated, but showed among many containers (Alexander *et al* 2006) [20]. Earthen containers are one of the major sources of *Aedes* breeding in the transmission season it has an insulating role against water temperature. *Aedes aegypti* breeding was found in almost all freshwater holding containers (Radhakrishnan A., 2019) [1]. Continually, iron containers were found positive from June to October 2020. Only in September 2020, the breeding of *Aedes* was recorded in Glass and Wood Containers such types of containers that were not used in water storage. This type of container was found in open-site solid waste around residential premises and public places provided as potential (Valerie *et al*, 2016) [24] breeding sites for *Aedes* mosquitoes. Solid waste management is an important tool for the control of vector breeding.

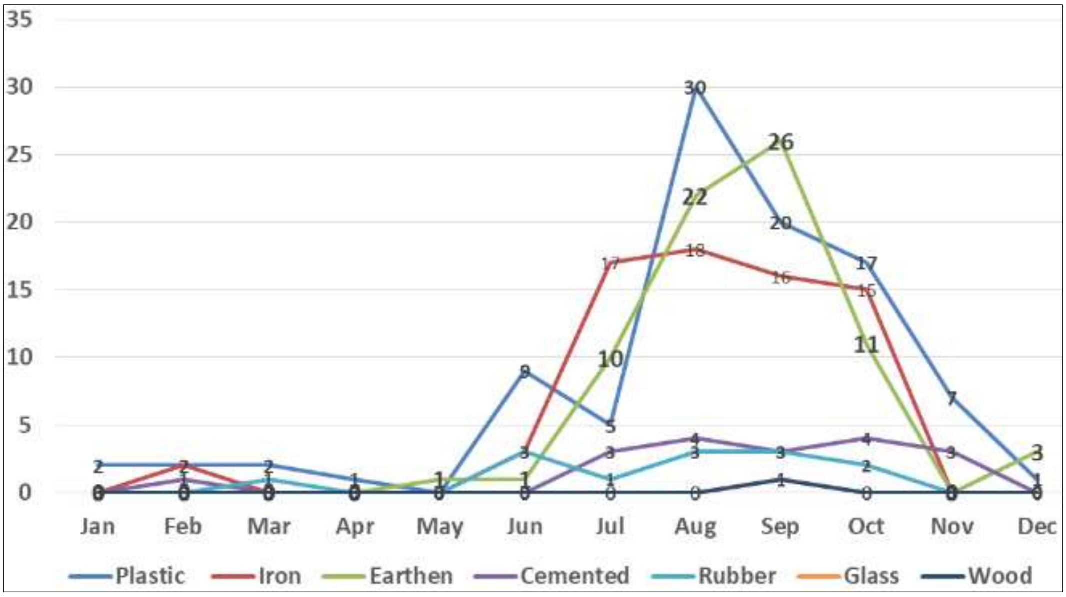

Fig 4: Monthly number of positive container of *Aedes* breeding from Jan. to Dec. 2020

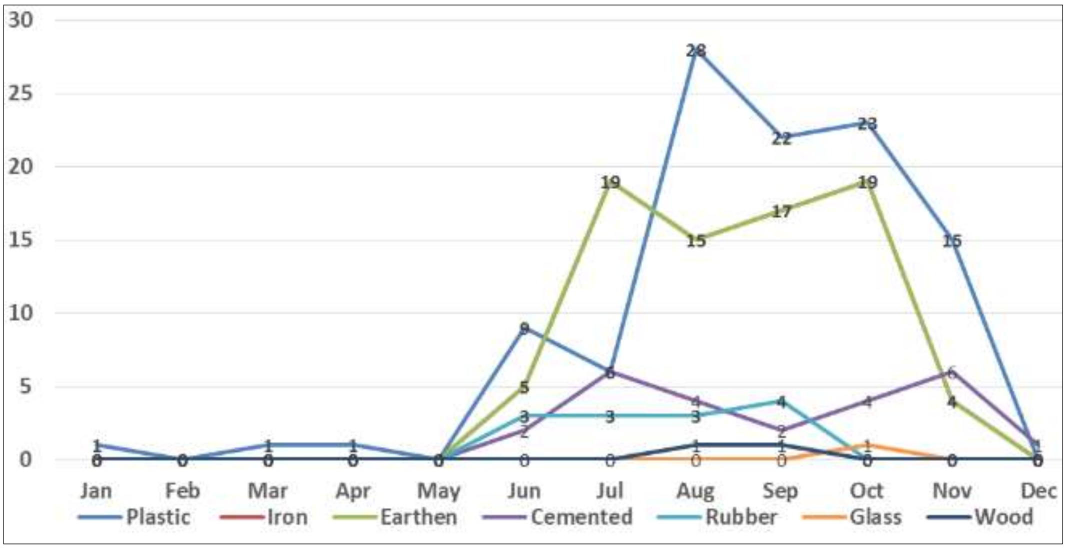

Fig 5: Monthly number of positive container of *Aedes* breeding from Jan. to Dec. 2021

As per the results of the study, *Aedes* breeding increases from June to October months and decreases in the rest of months. In these months, the number of potential breeding sites increases due to monsoon. Increasing *Aedes* breeding is the indicator of disease transmission months. Climatic factors like temperature, relative humidity and rainfall affect the breeding of mosquitoes and dengue transmission (Chakravarti and Kumaria, 2005) [17]. If the water supply is used through pipes, the development and survival of *Aedes* breeding will be downward resulting in a lower density of *Aedes* mosquitoes.

Conclusion

This study helped to detect the prevalence of *Aedes* and their breeding sites. This study also demonstrates the importance of container types as the breeding grounds for the development and survival of *Aedes* mosquitoes. It is the most important tool to control strategies for Dengue diseases in the future. In this study, the high density of Dengue vector was observed in plastic and earthen containers. Annually, plastic containers are used for storage of water due to scarcity of tap water while earthen containers are mostly used for water feeding of birds. Maximum positive container was observed mostly plastics. Therefore, to reduce larval habitats for *Aedes* breeding, the use of water storage containers should be discouraged and another important tool as source reduction (Elimination of water stagnated containers) for the control of Dengue disease and water of earthen and plastic containers should be changed weekly basis. Keeping in view, the vector surveillance indicated that a critical value of the Container Index and Breteau Index (Container positive in houses) were responsible for the risk of dengue transmission. Our study showed that in west zone was an area at risk of dengue transmission and should provide insights into vector-borne diseases for vector control and prevention programs to be implemented to reduce the dengue vector population. There are two common species identified of Dengue vectors such as *Aedes aegypti* and *Aedes albopictus* which are responsible for the transmission of Dengue disease in Delhi.

Acknowledgements

A grateful thanks to the Public Health Department, MCD Delhi for providing the necessary support to carry out the study. We would like to extend our gratitude to all staff of the Entomological Cross-checked Rapid Response Team (RRT), West Zone who have been involved directly or indirectly in this study. Furthermore, I would like to express our deepest gratitude and special respect to all participants in this study.

Reference

1. Radhakrishnan A. Study on mosquito (Diptera: Culicidae) diversity in Ernakulam district of the Kerala state, South India. International Journal of Mosquito Research. 2019;6(1):01-5.
2. Cecílio SG, Júnior WF, Tótola AH, de Brito Magalhães CL, Ferreira JM, de Magalhães JC. Dengue virus detection in *Aedes aegypti* larvae from southeastern Brazil. Journal of Vector Ecology. 2015;40(1):71-4.
3. Rodrigues MM, Marques GRAM, Serpa LLN, Arduino MB, Voltolini JC, Barbosa GL, *et al*. Density of *Aedes aegypti* and *Aedes albopictus* and its association with number of residents and meteorological variables in the home environment of dengue endemic area, São Paulo, Brazil. Parasit Vectors. 2015;8:115-124.
4. Brady OJ, Gething PW, Bhatt S, Messina JP, Brownstein JS, Hoen AG, *et al*. Refining the global spatial limits of dengue virus transmission by evidence-based consensus. PLoS Ne Trop Dis. 2012;6(8):e1760.
5. World Health Organization. Dengue and severe dengue. Available from: http://www.who.int/news-room/factsheets/detail/dengue-and-severe-dengue. Accessed on: April 20, 2019.
6. Chang MS, Christophel EV, Gopinath D, Abdur RM. Challenges and future perspective for dengue vector control in the Western Pacific Region. WPSAR. 2011;2(2):1-8.
7. Chang FS, Tseng YT, Hsu PS, Chen CD, Lian IB, Chao DY. Re-assess vector indices thre-shold as an early warning tool for predicting dengue epidemic in a dengue non-endemic country. PLoS Negl Trop Dis. 2015;9(9):e0004043.
8. Getachew D, Tekie H, Gebre-Michael T, Balkew M, Mesfin A. Breeding Sites of *Aedes aegypti*: Potential Dengue Vectors in Dire Dawa, East Ethiopia. Interdiscip Perspec Infect Dis. 2015, 1-8.
9. Madzlan F, Doma NC, Tiong CS, Zakaria N. Breeding Characteristics of *Aedes* Mosquitoes in Dengue Risk Area. Procedia - Soci Behav Sci. 2016;234:164-172.
10. Halstead SB. Dengue fever. J of Entomol. 2008;53:273-291.
11. Tomlinson SM, Malmstrom RD, Russo A. Infectious Disorder Drug Targets. J Antiviral Res. 2009;82(3):110-114.
12. Mehboob M, Noreen S, Nouroz F, Amir R, Mobin T. Dengue: A review on disease symptoms, detection and its management. Journal of Rashid Latif Medical College 2 2014, 01-06.
13. Thermal conductivity of some common materials and gases. Available from: http://www.engineeringtoolbox.com/thermalconductivity-d_429.html (Accessed on February 16, 2016).
14. Singh RK, Mittal PK, Kumar G, Dhiman RC. Prevalence of *Aedes* mosquitoes in various localities of Delhi during dengue transmission season. Entomol Appl Sci Lett. 2014;1(4):16-21.
15. Kumari R, Kumar K, Chauhan LS. First dengue virus detection in *Aedes albopictus* from Delhi, India: Its breeding ecology and role in dengue transmission. Trop Med Int Health. 2011;16(8):949-54.
16. Das B, Hazra RK. Entomological investigations with special attention to pupal indicators of *Aedes* vectors during outbreaks of dengue in coastal Odisha, India. J Vector Borne Dis. 2013;50(2):147-50.
17. Chakravarti A, Kumaria R. Eco-epidemiological analysis of dengue infection during an outbreak of dengue fever, India. Virology Journal. 2005;2(1):1-7.
18. Arunachalam N, Tana S, Espino F, Kittayapong P, Abeyewickreme W, Wai KT, *et al*. Eco-bio-social determinants of dengue vector breeding: a multicountry study in urban and periurban Asia. Bull World Health Organz. 2010;88(3):173-84.
19. Olano VA, Matiz MI, Lenhart A, Cabezas L, Vargas SL, Jaramillo JF, *et al*. Schools as potential risk sites for vector-borne disease transmission: Mosquito vectors in rural schools in two municipalities in Colombia. J Am Mosq Control Assoc. 2015;31(3):212-22.
20. Alexander N, Lenhart AE, Romero-Vivas CME, Barbazan P, Morrison AC, Barrera R, *et al*. Sample sizes for identifying the key types of container occupied by dengue-vector pupae: the use of entropy in analyses of compositional data. Ann Trop Med Parasitol. 2006;100(1):S5-16.
21. Pratt DD. Andragogy after twenty-five years. New directions for adult and continuing education. 1993 Mar;57(57):15-23.
22. Mogi T, Stern LJ, Marti T, Chao BH, Khorana HG. Aspartic acid substitutions affect proton translocation by bacteriorhodopsin. Proceedings of the National Academy

of Sciences. 1988 Jun;85(12):4148-52.
23. Thavara U, Tawatsin A, Chansang C, Kong-ngamsuk W, Paosriwong S, Boon-Long J, *et al*. Larval occurrence, oviposition behavior and biting activity of potential mosquito vectors of dengue on Samui Island, Thailand. Journal of Vector Ecology. 2001 Dec 1;26:172-80.
24. Valerie A, Vassiliki K, Irini M, Nikolaos P, Karampela E, Apostolos P. Adipose-derived mesenchymal stem cells in the regeneration of vocal folds: a study on a chronic vocal fold scar. Stem cells international. 2016 Jan 6;2016.