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PHYSICOCHEMICAL CHARACTERISTICS AND SEASONAL VARIATIONS OF THE HABITATS, IN RELATION TO THE DENSITY OF DENGUE VECTOR *AEDES AEGYPTI* IN KUMBAKONAM, TAMIL NADU, INDIA

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ABSTRACT

Aedes aegypti (Diptera: Culicidae) is the main vector of the dengue virus globally. Dengue vector control is mainly, based on reducing the vector population through interventions, which target potential breeding sites. However, in Kumbakonam is known about this vector's habitat productivity and insecticide susceptibility status, to support evidence-based implementation of control measures. In each study, the breeding habitats such as Coconut shells, Waste bucket, Tires and Over head tank were examined, for the presence of *Aedes aegypti* mosquito larvae. The survey were carried out twice in each month, from November 2014 to October 2015. The correlation between the physicochemical characteristics and the larval density of container- breeding mosquitoes indicated that, the pH (0.09), Calcium (0.83), BOD (0.68) and COD (0.77), they showed positive correlation with the larval density, the correlation coefficients being respectively. Total dissolved solids (-0.11), Electrical conductivity (-0.68), Chloride (-0.65), Fluoride (-0.68), Salinity (-0.72) and Sulphate (-0.52) were negatively correlated with larval abundance in the containers, with correlation coefficients of respectively. Rainfall is an important environmental factor associated with *Aedes* breeding at the study sites.

KEYWORDS: *Aedes Aegypti,* the Vector Population through Interventions, the Physicochemical Characteristics

INTRODUCTION

Dengue is caused by at least four independent viruses that are all transmitted primarily, by the mosquito *Aedes aegypti.* The most typical form of the disease is commonly called dengue fever and its symptoms include fever, rash, headache, and joint and retro-orbital pain. The severe form of the disease, called severe dengue or dengue hemorrhagic fever (DHF), can result in vomiting, internal hemorrhaging, and even death (Kyle and Hariss 2008). Mosquitoes are the most important group of insect vectors of human diseases such as malaria, chikkangunya, filariasis, Dengue and Japanese encephalitis. The aquatic habitats in which they breed include pools, swamps, paddy fields and water holding containers. The container habitats have unique ecological properties and these habitats could be natural such as tree holes and leaf axis or artificial, such as tyres, plastic cup and water tank. These mosquitoes are important from the public health perspective, as they include disease vectors, as well as potential biological control agents. *Aedes aegypti* is the primary vector of dengue (Sim.Ramirez and Dimopoulos 2012). *Aedes aegypti* is a very efficient disseminator of human pathogens, as a result of evolutionary adaptations to frequent haematophagy, as well as to the colonization of countless types of habitats, associated with environmental and cultural factors, that favor the proliferation of this mosquito in urban eco system (Regis et al., 2012). A. *aegypti* mosquitoes lay eggs in clear water that is not directly affected by land and prefers containers indoor, rather than outdoor due to the indoor temperature is relatively stable. A mosquito can lay eggs 4-5 times, during her life with an average number of eggs ranges from 10-100 eggs in a single spawn. Thus the total number of eggs produced by a single female mosquito is between 300-700 eggs (Lee HL 1991). Dengue is classified as one of water-associated disease, as the water acts as a media of transmission, although occurs indirectly. Water-associated diseases account for approximately 10% of the global disease burden, representing a significant source of morbidity and mortality worldwide. These infections are spread by waterborne agents, vectors carrying viruses and these infections are spread by waterborne agents, vectors carrying viruses and parasites like dengue, and water contact diseases like schistosomiasis (Chen *et al*., 2006) Water conditions, location, presence of larval food, location, and shades are the determining factors of breeding sites of dengue vectors (Dom *et al.*, 2013). Variety of the containers that are categorizes as man-made containers and natural sites would be the preferable habitat for DVs mosquitoes. Female *Aedes aegypti* prefers to lay their eggs in domestic containers with a majority of discarded receptacles, water storage containers and tires, wells, cement tanks and sinks Variety of the containers that are categorizes as man-made containers and natural sites would be the preferable habitat for DVs mosquitoes. Female *Aedes aegypti* prefers to lay their eggs in domestic containers with a majority of discarded receptacles, water storage containers and tires, wells, cements tanks and sinks (Dieng *et al.*, 2012). The selected areas around in kumbakonam, Thanjavur District, Tamilnadu, Inida which are well known tourist place and temple city. The people visit these tourist places from all over the world. So we select theses places for mosquitoes density studies, because study areas are acting as a suitable places for vector borne diseases transmission from one place to another place. The present study deals with mosquito density and physicochemical parameters in various water sample which influences mosquitoes larval density were analyzed various habitat places in kumbakonam.

MATERIALS AND METHODS

Study Area

This work was done under surveillance on experimental basis. The studies on the mosquitoes larval density and larval breeding sites preference in physic-chemical parameters were carried out in and Kumbakonam, Thanjavur, Tamilnadu, India. Kumbakonam is Located 10°57’N latitude and 79°23;N longitude. Kumbakonam town is a river-edge settlement in Tamilnadu, India.

Larval Surveys

In each study, the breeding habitats such as Coconut shells, Waste bucket, Tires and Over head tank were examined for the presence of *Aedes aegypti* mosquito larvae. The survey were carried out twice in each month from November 2014 to October 2015.

Larval Density

The mosquito larvae were collected from the breeding habitats using a net (6cm. width). Incidences of *Aedes aegypti* larval collections were recorded and the larval density was calculated using the following formula:

Larval density= Number of larvae collected / Number of dips made

Physicochemical Characteristics

Samples were collected from the breeding habitats, which showed the presence of mosquito larvae. The breeding water characteristics were pH, Electrical conductivity, BOD, COD, Carbonate, Bicarbonate, Total dissolved solids, Turbidity, Calcium, Magnesium, Iron, Nitrate, Chloride, Sulphate and Phosphate was estimated by standard methods APHA (2006).

Data Analysis

Means and standard deviations (SD) were used for summarizing the physicochemical factors. The mean larval density among the readings of each month of November 2014 October 2015 was compared using one-way ANOVA. The relationships between the mean values of the habitat characteristics and the larval densities were derived by Pearson's correlation. The statistical analyses were carried out using IBM SPSS21 statistical software.

Result

The present study aimed to monitoring *Aedes aegypti* larval density and physico chemical parameter in waste bucket, Over head tank, coconut shell and tire in and around kumbakonam. *Aedes aegypti* larvae are found in water collection throughout the year. The larval collection made from the places during November 2014 to October 2015. The table 2 showed the variation in the larval density 1.03±0.15 to 15.4±0.81 from the monthly collections. From January to April and October, the larval index is considerably low. When there was complete absence of rain fall (Table 2). The maximum larval index was noticed in 2014 in the month of November and December in all four habitats.. During this time, the average rain fall was high 16.51, 16.27 and dengue cases were also prevalent in kumbakonam. Due to extreme summer *Aedes aegypti* larval improper development and mortality was noticed. The density of container breeding mosquitoes (Mean±SD) was the highest in Coconut shell (15.4±0.81) followed by waste bucket(14.25±0.66),Over head tank(12.50±0.60) and tire (11.8±0.15). Analysis of the physicochemical characteristics of water in the mosquito breeding sites indicated that the pH ranged from 7.25± 0.5 in waste bucket to 8.02 ± 0.7 in Coconut shell whereas the Electrical conductivity (mho/cm) ranged from 0.89 ± 0.7 in waste bucket to 2.56 ± 0.25 in Coconut shell. The Total dissolved solids (mg/l) was the lowest in waste bucket (571.3 ± 1.2) and the highest in Coconut shell (1662.6 ± 2.5) The salinity (ppt) was the highest in Tire (0.39± 0.09) and the lowest in waste bucket (0.18 ± 0.05). The turbidity of breeding water ranged from 15.5 ± 1.5 in waste bucket to 251.2 ± 1.2 in Coconut shell whereas the Calcium (mg/l) ranged from 263.5 ± 2.45 in coconut shell to 140.4 ± 1.15 in Tires (Table 1). The correlation between the physicochemical characteristics and the larval density of container- breeding mosquitoes indicated that the pH (0.09), Calcium (0.83), BOD (0.68) and COD (0.77) showed the positive correlation with the larval density. Sulphate (-0.52), Chloride (-0.65), Fluroide (-0.68), Salinity (-0.72), Total dissolved solids (-0.11) and Electrical conductivity (-0.68) were negatively correlated with larval abundance in the containers,

DISCUSSIONS

The present study was carried out in the monthly variations in the relative abundance of *Aedes aegypti*. water retention and resource content unused wells, and coconut shells containers as favorable breeding habitats of dengue vectors, it was observed by Soumyajit *et al* (2015), the number of habitats recorded positive for the species *Aedes aegypti* was found to vary with the type of habitats. The physicochemical factors such as turbidity, sulphate, phosphate and nitrate from the mosquito larvae oviposition site did not show relationship with larval density after statistical analysis, their roles could not be disregarded, it can be support with the study by (Seyed Hassan Nikookar *et al.*, 2017). As is evident in positive correlation between P^H, BOD, COD, calcium, where as fluoride, Sulphate, Chloride, salinity, Total dissolved solid and EC were negatively correlated with the abundance of *Aedes aegypti*.

In the present study reveals that the *Aedes aegypti* have also has a Fast adaptation to the environment and surroundings condition, it can be support with the study by Reji *et al.*, (2013), the survival of *Aedes aegypti* larvae was found to be in the maximum P^H range from 7.5 to 8.02 P^H can be used as weapons to control the DF by spraying of biopesticides, such neem oil.

Calcium also plays important role in determining larval density, there is analyzed by Faiz Madzlan *et al*., (2015), reported that the calcium and potassium can give an ideal breeding ground for *Aedes aegypti*. The characteristics of aqueous larvae habitat also being analyze and relate to the species of larvae present. From the result calcium and potassium can provide a good breeding ground for *Aedes* species.

In the present study reported that the collection of mosquito larvae from the following four breeding habitats such as waste bucket, over head tank, coconut shells, tires. The density of container breeding mosquitoes (mean SE mean) was more in coconut shell (15.4± 0.81), followed by waste bucket (14.25± 0.66), over head tank (12.50± 0.60) and tire (11.8 ±0.15) it can be analyzed by Thangamathi *et al*.,(2014), suggest the density of container breeding mosquitoes was the highest in coconut shell, waste bucket.

The community store water in different containers for long period of time for the domestic use. In addition to domestic containers, different discarded containers and tires hold rain water for long period time. This enables *Aedes aegypti* to breed in these containers. As our study showed, most of the containers were infested with the mosquito species which may serve as vector of dengue disease. From this investigation, it is clear that there are many chances of mild dengue viral infection spreading in the sampling location. However, to determine whether this mosquito is transmitting disease or not by looking for the mosquitoes needs further investigation.

Table 1: Physicochemical Parameters of Different Breeding Habitat

Physico-Chemical Parameters	Waste Bucket	Over Head Tank	Coconut Shell	Tires
Turbidity NTU	15.5±1.5	20.7±0.89	251.2±1.2	150.3±0.95
Total dissolved solids mg/1	1100.4±2.1	1662.6±2.5	780.5±1.3	573.3± 1.2
p^H	7.25±0.5	7.26±0.6	8.02±0.7	8.00±1.5
Electrical conductivity mho/cm	2.56±0.25	1.22±0.4	0.89±0.7	1.80±0.35
BOD mg/1	69.4±0.95	74.6±0.88	274.5±0.96	104.5±0.89
COD mg/1	44.6±0.45	42.3±0.54	148.3±1.23	46.5±0.45
Carbonate mg/1	00	00	0.8±0.45	0.45±0.25
Bicarbonate mg/1	155.4±1.65	128.5±1.1	214.4±1.25	288.4±0.96
Chloride mg/1	135±1.25	123.4±1.45	125.5±1.45	135.5±0.25
Sulphate mg/1	58.5±0.65	59.3±0.94	78.4±1.04	70.4±0.45
Phosphate mg/1	0.05±0.01	0.04±0.01	0.07±0.02	0.03±0.02
Silicate mg/1	5.36±0.34	5.21±0.40	6.25±0.87	5.45±0.35
Nitrate mg/1	0.05±0.01	0.08±0.02	1.25±0.45	0.35±0.25
Fluoride mg/1	3.25±0.25	3.65±0.15	4.25±0.65	3.25±0.16
Aluminium mg/1	00	00	0.2±0.01	0.4±0.2
Calcium mg/1	152.5±1.26	142.4±1.11	263.5 ±2.45	140.4±1.15
Magnesium mg/1	89.5±0.88	85.6±1.24	184±1.49	195±1.35

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Sodium mg/1	23.5±1.1	26.4±0.92	128±0.99	30±0.9
Potassium mg/1	0.13±0.13	0.12±0.02	0.22±0.05	0.14±0.04
Zinc mg/1	0.03±0.01	0.02±0.01	0.22±0.10	0.07±0.02
Iron mg/1	0.04±0.01	0.03±0.01	0.68±0.03	0.74±0.15
Salinity (ppt)	0.18±0.04	0.34±0.15	0.28±0.05	0.39±0.09
Temperature C^0	25±0.45	24±0.56	26±0.56	23±0.60

Table 2: The Survey of Aedes Aegypti Larvae from November 2014 to October 2015

Mean Samples of Mosquitoes Larvae					Average Rainfall (cm)
10 Dipping/Larval Density (±)					
Monthly Catches	**Waste Bucket**	**Over Head Tank**	**Coconut Shell**	**Tire**	
November	14.25±0.66	12.50±0.60	15.4±0.81	11.8±0.15	16.51
December	13.6±1.5	10.10±0.95	14.30±0.04	8.26±1.10	16.27
January	3.56±0.40	3.70±0.62	1.13±0.40	1.5±0.60	0
February	4.0±0.45	5.50±0.50	1.03±0.15	1.16±1.04	0
March	3.45±0.35	4.56±0.60	1.20±0.30	1.33±0.76	0
April	5.26±0.25	3.63±0.70	1.16±0.35	1.40±0.85	0
May	12.25±0.51	9.27±0.60	11.70±1.05	8.16±1.02	12.14
June	10.45±1.9	7.10±0.34	11.43±0.67	7.3±1.6	13.2
July	11.67±1.2	9.8±0.24	12.96±0.56	8.14±1.3	11.7
August	12.74±1.5	8.6±0.32	13.13±0.45	7.96±1.4	12.6
September	12.30±1.4	9.90±0.65	13.00±0.87	9.14±1.7	13.6
October	4.25±0.87	4.23±0.6	1.10±0.78	1.83±0.56	0

Table 3: Correlation Coefficient between *Aedes Aegypti* Larval Density and Physicochemical Parameter of Breeding Habitats

Parameters	Correlation Coefficient	*p*- Value
p^H	0.09	0.90
Total dissolved solids mg/1	-0.11	0.88
Electrical conductivity mho/cm	-0.68	0.31
Calcium	0.83	0.17
Chloride	-0.65	0.34
Sulphate	-0.52	0.48
Salinity	-0.72	0.27
BOD	0.68	0.31
COD	0.77	0.22
Fluoride	-0.68	0.31

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