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An observation on breeding habitats of *Aedes* mosquitoes in Kozhikode district, Kerala

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Abstract

Aedes mosquitoes, the major vectors of dengue, Chikungunya and Zika are known as container breeders employing both natural and artificial habitats. In the state of Kerala, both *Aedes aegypti* and *Aedes albopictus* are responsible for dengue transmission. The study was undertaken to assess the major breeding sources in different topographical areas of Kozhikode District and also to find out uncommon breeding sources due to change in socioeconomic development. The larval surveys were done in domestic and peridomestic areas randomly in the three topographical regions of Kozhikode District. In the sandy coastal belts, the major sources of breeding were abandoned boats, ice-trays, fish-trays, and tarpaulin sheets used to cover the nets. In the hilly portions of the Western Ghats where the rubber plantation is plenty, the major sources were rubber tapping coconut shells or plastic vessels, dried leaves of trees and barrels used as water containers. In the lateritic midland, the larvae were collected from numerous sources like coconut shells, unused utensils, stone grinders, unused tyres, tarpaulin sheets, dried leaves, plastic covers, plant pots etc. Prevention of creating mosquito-genic potential may be more crucial than vector control though it is an important tool for dengue control. The mind set of community need to be changed through appropriate and effective IEC/BCC activities as proactive measures rather than being reactive.

Keywords: *Aedes* mosquitoes, dengue, chikungunya, breeding sources

1. Introduction

Dengue is a fast emerging mosquito borne disease in the world and spreads throughout tropical and subtropical regions ^[1]. *Aedes* mosquitoes have the capacity of trans-ovarian transmission of diseases and they can withstand drought climatic conditions. It breeds mainly in small containers and so usage of chemicals and other methods are insufficient for vector control. The only feasible method is source reduction. So it is necessary to identify the breeding sources regularly and remove it ^[2]. Rapid expansion of *Aedes albopictus* is one of the reasons of dengue rise. Its adaptation to lesser known habitats become a major obstacle in the in the containment of the species and in turn in the control of dengue cases ^[3]. The present study aims to identify the different breeding sources of *Aedes* mosquitoes in different topographical areas of Kozhikode District. The district is situated on the South-West coast of India in the state of Kerala. Topographically, the district has three distinct regions – the sandy coastal belt, the rocky highlands formed by the hilly portions of the Western Ghats and the lateritic midland, with an average rainfall of 3266 mm and temperature ranging from 14 to 39 °C. Most parts of the district are covered with coconut plantations. The eastern hilly parts of Western Ghats region are covered with rubber, areca and cocoa plantations. The district is divided into 4 taluks covering the three regions. *Ae. aegypti* and *Ae. albopictus* are known vectors of dengue transmission in the state of Kerala including the study district. The *Ae. aegypti* is mainly abundant in urban areas whereas *Ae. albopictus* breeds more in rural areas. The breeding survey for *Aedes* mosquitoes was undertaken to study the major breeding sites different regions of Kozhikode District. The study also focused to find out uncommon breeding sources and explored its correlation with change in socioeconomic development. The larval surveys were carried out in domestic and peridomestic areas randomly which also included abandoned boats, ice-trays, fish-trays, tarpaulin sheets, rubber tapping coconut shells or plastic vessels, dried leaves of trees, barrels used as water containers, and the usual breeding sites like coconut shells, unused utensils, stone grinders, unused tyres, and plant pots etc.

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2. Materials and Methods

According to the topography, the study area was divided in to three high land, midland and coastal belt. The larval survey was conducted in these areas and the specific breeding sources which accelerate the breeding in these three different areas were recorded.

An entomological investigation including identification of domestic and peridomestic larval breeding habitats of *Aedes* mosquitoes was carried out from October 2017 to March 2018. The collection of immature stages of mosquitoes from natural and artificial breeding sources was done by using dipping and pipetting methods, to find out the *Aedes* breeding. The survey was done in and around the houses and premises in study area.

The collection of immature stages (larvae and pupae) made in the study sites were kept in the plastic containers with minute holes on top for ventilation. The containers in which the larvae and pupae were kept were filled with water from the same habitat for transportation to the laboratory of Zonal Entomology Unit attached to Disease Vector Control Unit Kozhikode. In the laboratories, mosquito larvae and pupae were transferred to the enamel trays with the same water. Larvae were identified and *Aedes* larvae were segregated in separate trays. Larval food of Yeast powder and dog biscuits (3:1) were sprinkled in the tray and the water was changed next day of collecting the larvae. Pupae were transferred inside the cloth cages for its emergence into adults. Emerged adult mosquitoes were identified morphologically at species level by using standard mosquito identification [4-6].

3. Results

The major breeding source in the high lands or hilly regions mainly includes rubber plantations. The cups or coconut shells used to collect rubber after tapping, is not kept inverted after usage, so it acts as a good breeding source for *Aedes*

mosquitoes. Water scarcity was another problem noted in the hilly areas where people used to store water in pots, vessels, buckets, synthetic tanks etc. The improper covering and cleaning of these containers accelerates the mosquito breeding potential. Shed leaf sheaths of Areca Nut palms also supported breeding of *Aedes*. Hectares of land without proper care and management, lead to the accumulation of dried leaves of large plants like Teak acts as water reservoirs during rains and provide space for mosquito breeding. In midland areas, the larvae were collected from numerous sources like coconut shells, unused utensils, stone grinders, unused tyres, tarpaulin sheets, dried leaves, plastic covers, plant pots, disposable bottles etc. both domestic containers and natural sources serves as habitats for mosquito breeding. In coastal belts, the breeding sources were abandoned fishing boats, Ice trays, fish boxes and tarpaulin sheets used to cover the fishing nets and boxes. The major problem with the fish boxes were, it acts as a reservoir both in the upward and inverted form. If it inverted the sides of boxes were having space in its four corners for water accumulation and mosquito breeding. The tyres tied on the sides of boats also hold water and helps mosquito's development.

According to the habitat, the breeding sources were classified as indoor or outdoor. Indoor sources were the trays of refrigerator, A/C outlet trays, moneyplant, lucky plant and other decorative plant pots inside house, the bottles used to keep curry leaves and coriander leaves to keep it fresh and unused aquariums with water. Outdoor sources included bottles, tyres, flower pots, the small pots kept in the bird cages and hen hatchery, coconut shells, unused utensils, plastic wastes etc. Careless dumping of tyres and tubes in and around workshops, retreading centres and peri-domestic areas mainly in urban settings were also included in outdoor breeding sources.

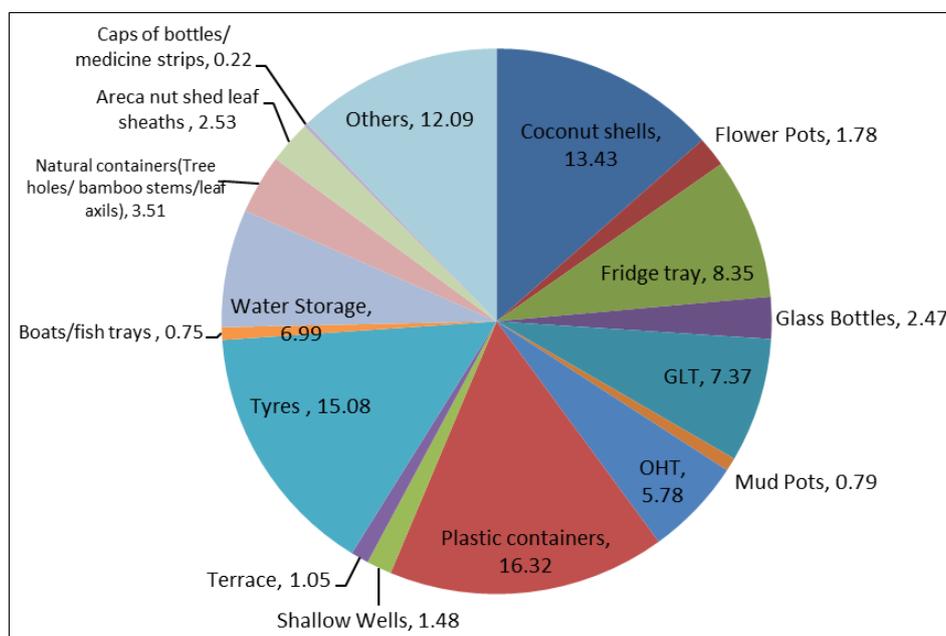


Fig 1: Percent contribution of different breeding sources

According to the nature of containers, the survey was conducted to find breeding and the breeding sources were classified as natural and artificial containers. Tree holes, leaf axils of pineapple and other decorative plants, leaf sheaths of

areca nut palms, cut ends of bamboo stems, areca nut plants, coconut trees and other trees, dried leaves of teak and other trees, coconut shells, used tender coconuts, banana leaves, areca nut palm leaves, nut mug shells, peel of passion fruit,

eggs and mussel shells were the major natural breeding sources of *Aedes* mosquitoes. Artificial or man-made containers included tyres, plastic sheets, plastic trays, barrels, unused vessels, boats, fish trays, plastic containers, tarpaulin sheets, plant pots and its trays, moneyplant pots and bottles inside the houses, curry leaves keeping bottles, medicine strips, bottle caps, tray behind the refrigerators, coolers and air conditioners.

The study revealed maximum breeding in plastic containers, tyres and coconut shells contributing about 40 per cent. Except Coconut shells, other two breeding sources are man-made. Coconut shells though natural, the breeding has been facilitated by human by throwing in open space and water is collected during monsoon which facilitate profuse breeding. Water storage and Overhead tanks collectively contributed about 13 percent breeding whereas other sources accounted about 12 per cent breeding in the present study. Natural breeding sources contributed only about 2%. In addition to major breeding sources, immature stages were also present in water fountains and decorative structures in houses, parks, and offices. The breeding was also noticed in water trays kept underneath the planters holding the drained water coming from the pot.

The present study also revealed high density of *Aedes* mosquitoes in summer season which may be attributed to improper water storage practices due to scarcity of water.

4. Discussions

Aedes mosquitoes are known to breed in fresh water stored in different types of water containers. *Ae. aegypti* is predominant in urban areas whereas *Ae. albopictus* is found in rural areas. The presence of breeding in different structures, containers and natural breeding sites etc., has also been noticed by Roop *et al.*, 2016^[7] in their study on *Ae. aegypti* and *Ae. albopictus* in Delhi. They have noticed breeding preference of *Ae. albopictus* in plastic water storage, tank and planted pots. However, in the present study, the *Aedes* breeding contribution of 40% by major breeding sites in and around houses is suggestive of focused vector control measures and adequate health education to community for preventing creation of such breeding. The breeding in different sites may be attributed to the improper covering and cleaning of water containers which lead to hike in the vector breeding. Another problem was associated with habit of people who used to keep or hang water pots outside the houses, in open terrace and in common places like gardens and trees as a drinking water source for birds and other animals. Such water pots are regularly filled without regular and proper cleaning which allows presence of water always facilitating breeding. Associated with infrastructure development like highways, gardens and parks, the barrels or tanks are kept for water storage at a particular place. The water is filled regularly for different purposes and usually no cleaning is done. The barrel without proper cover was found positive for mosquito larvae. The ignorance about proper covering of such tanks may result the area as receptive for dengue transmission.

Further, Change in culture and lifestyle had also led to the creation of new breeding sources. It is known that urbanization leads to an increase in the amount of artificial containers, including water-storage tanks and urban trash like discharged tyres and bottles. Despite their utility, these are stored in open areas for selling to factories for recycling and till such garbage is disposed, it creates huge breeding grounds

due to rain water collection. The population living in slums and resettlement colonies near such stores are always at risk of dengue and chikungunya. Rural areas are also at similar risk due to urbanization and construction.

Tarpaulin sheets which are used to cover logs, roof of hatcheries, open terrace with truss work and leaking water outlet pipes or holes allow water accumulation and facilitate mosquito breeding. In addition, other domestic breeding noticed were in terrace/portico top where water gets blocked especially during rainy season or due to overflow from overhead water tanks. The stone grinders used as mixer grinders, and the disposed stone grinder's acts as breeding areas.

Improper disposal of single-used plastic covers like milk packets, packed foods, paper plates, paper cups, and plastic cups etc., increase the breeding potential of *Aedes* as has been indicated in 'others' category in figure-1. Bhaskar Rao in 2010^[8-12] has studied in Calicut and indicated that *Ae. albopictus* which is known as a container breeder world over, breeds in both natural and man-made habitats. It is primarily a forest-fringe mosquito breeding in natural sites including rock pools, leaf axils, tree holes, cut bamboo stumps, etc. He has further reported that widespread deforestation and increase in plantations especially of rubber, cocoa and areca nut contributed to the rapid spread of tiger mosquito in Kerala. During his study, extensive breeding was found in containers used for collecting rubber sap in rubber plantations during the rainy season. In Western Ghat regions of Malabar, profuse breeding was observed in shed leaf sheaths of areca nut palms and cocoa pods hanging from the trees as well as grounded ones. It was also reported that due to highly invasive nature and ecological plasticity, it spread to rural and suburban niches breeding in artificial containers like plastics and tyres. Hiriyan *et al.*,^[13] had already reported in 2004, breeding of this mosquito in plastic cups around tea vendor shops in Ernakulam City, Kerala. They have also showed coconut shells and plastics dumped around the households as the major source of breeding of *Ae. albopictus* in rural settings of Calicut, Kerala. Other breeding sites recorded were flower pots, glass products and tyres.

5. Conclusion

Aedes mosquitoes are highly adapted to the domestic environment and, therefore, the abundance is positively correlated with increasing urbanization. The breeding sites identified reflect the change in ecology, cultural and social behaviour of population and life style changes^[14-16]. *Aedes* breeds in a wide range of habitats from artificial containers to natural habitats^[17]. Besides various kinds of domestic containers and tyres, *Aedes* has been observed breeding in various types of habitats related to agricultural crops in Kerala like coconut, rubber, areca nut, cocoa and pine apple^[18]

In conclusion, Kozhikode District has vast range of breeding sources varying from the small sized drug strips to large sized synthetic tanks. The major breeding containers were found to be tyres, coconut shells, plastic containers, fridge trays, water storage tanks etc. This study is expected to provide insights for vector control programme to be implemented in Kozhikode to reduce *Aedes* population. Control measures needs to be adopted with much vigour throughout the year without seasonal prevalence.

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