LARVICIDAL ACTIVITY OF THREE CHOSEN PLANTS’ ESSENTIAL OIL AGAINST THE MOSQUITO VECTOR, Culex quinquefasciatus (Say)

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Abstract

Mosquitoes are the most important single group of insects in terms of public health. They transmit a number of diseases, such as Malaria, Dengue fever, Filariasis, Chikungunya, Japanese encephalitis, etc. causing millions of deaths every year. The application of easily degradable plant compounds is considered to be one of the safest methods to control insect pests and vectors as an alternative source to synthetic pesticides. The present study was carried out to monitor the effects of plant oil on the fourth instar of larvae mosquito, Culex quinquefasciatus.

Key words: Abutilon indicum, Acacia nilotica and Acalypha indica, Culex quinquefasciatus and Larvicidal activity.

1. Introduction

Mosquitoes are one of the most harmful insects to mankind. Mosquitoes grow in every place where environment is not kept clean, neat and tidy. As long as the rural, urban and metropolitan areas are not fully made pollution free, and access to sanitation is still available only to 14% of the population, nothing can prevent the mosquitoes find their place as their most conducive rearing ground and continue to attack and spread diseases to human beings living there. With the speedy growth of population and the improved standard of living of the masses, Mosquito repellents have emerged as the most useful tool in households preventing epidemics like Malaria, Filaria, Dengue fever and other Mosquito borne diseases. Keeping a population of 1000 million away from mosquito bite is a stupendous task (Peterson, 2001). Over the centuries, the vector-borne diseases are imposing a serious public health threat to humankind in terms of illness and deaths worldwide. Besides their negative public health impact, these diseases are also posing a serious obstacle to socio-economic development in countries wherever they are endemic in nature (Karunamoorthi and Sabesan, 2010). Nearly all members of Culex quinquefasciatus complex, that are potent vectors of malaria in tropical Africa, have shown various degrees of resistance to commonly applied insecticides like such as DDT (dichlorodiphenyltrichloroethane) and pyrethroids. The present work has been designed to study the larvicidal activity of a few selected plant oils Abutilon indicum L., Acacia nilotica L. and Acalypha indica L. against the mosquitoes Culex quinquefasciatus.

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2. Materials and Methods

The egg of *Culex quinquefasciatus* was procured from around Jamal Mohamed College, Tiruchirappalli. The laboratory colony was maintained at 75 – 85 % R4, 27 ± 2 °C and 14:10 light and dark photoperiod cycle. The larvae were fed with powdered mixture of dog biscuits and yeast tablets in 3:1 ratio. The plant oils *Abutilon indicum* L., *Acacia nilotica* L. and *Acalypha indica* L. These plants were selected to study the larvicidal activity against *Culex quinquefasciatus*.

Larvicidal activity of the essential oils against *Culex quinquefasciatus* assessed using WHO Standard Method (WHO, 1996). For experimental treatment, stock solution (1 %) was prepared in one milliliter of essential oil dissolved to 100 ml distilled water using acetone. The other solutions were obtained from this by dilution with distilled water to the required concentration. Later 200 ml of the solution with appropriate concentrations were transferred to disposable plastic cup to carry out the tests. After 25 IV instar larvae of *Culex quinquefasciatus* on a strainer with fine mesh were transferred gently to the test medium by topping in different experimental setup. The control experiments (distilled water with one ml of acetone) were also run parallel with each replicate. The larval mortality was calculated after 24 hour of the exposure period. The mortality of mosquito larvae were recorded according to the following criteria (WHO, 2005) moribund larvae, which were incapable of rising to the surface or did not show the characteristic diving reaction when water was disturbed, had discoloration, an unnatural position or rigor. The corrected percent of mortality was calculated by applying Abbott’s formula (Abbott, 1925). The data were subjected to probit analysis in order to estimate the LC$_{50}$, and LC$_{90}$ values (Finney, 1971).

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\% \text{ Mortality} = \frac{\text{Mortality at treatment} - \text{Mortality at control}}{100 - \text{Mortality at control}} \times 100
\]

3. Results and Discussion

The essential oil of five selected medicinal plants was used for preparing the stock solution in acetone, for testing the larvicidal activity against the vector mosquito *Culex quinquefasciatus* larvae. The result of the larvicidal activity of selected three medicinal plant essential oil viz., *Abutilon indicum*, *Acacia nilotica* and *Acalypha indica*. On IV instar larvae of the mosquito *Culex quinquefasciatus* are presented in Table - 1.

The LC$_{50}$ (LC$_{90}$) values of the essential oil of *Abutilon indicum* was 140.10 ppm (248.81 ppm) for the IV instar larvae of *Cx. quinquefasciatus* (Table - 1). The LC$_{50}$ and LC$_{90}$, regression equation and 95 % confidence limit of LCL and UCL were $Y = 1.605 \pm 2.270 \times 130.02$ ppm and 210.45 ppm (LCL) and 150.42 ppm and 265.32 (UCL) respectively. The chi-square value 1.691 was not significant at $p<0.05$ level. The LC$_{50}$ (LC$_{90}$) values of the essential oil of *Acacia nilotica* was 164.46 ppm (275.01 ppm) for the IV instar larvae of *Cx. quinquefasciatus*. The LC$_{50}$ and LC$_{90}$, regression equation and 95 % confidence limit of LCL and UCL were $Y = 1.534 \pm 2.222 \times 154.07$ ppm and 218.65 ppm (LCL) and 175.59 ppm and 312.56 (UCL) respectively. The chi-square value 6.818 was significant at $p<0.05$ level.

The LC$_{50}$ (LC$_{90}$) values of the essential oil of *Acalypha indica* was 173.17 ppm (274.15 ppm) for the fourth instar larvae of *Cx. quinquefasciatus*. The LC$_{50}$ and LC$_{90}$, regression equation and 95 % confidence limit of LCL and UCL were $Y = 5.017 \pm 4.422 \times 163.29$ ppm and 216.32 ppm (LCL) and 183.78 ppm and 302.45 (UCL) respectively. The chi-square value 2.798 was significant at $p<0.05$ level.

The LC$_{50}$ (LC$_{90}$) values of IV instar larvae of *Abutilon indicum* was 140.10 ppm (248.81 ppm) > *Acacia nilotica* 164.46 ppm (275.01 ppm) and *Acalypha indica* 173.17 ppm (274.17 ppm) respectively.

The selected three plants essential oil viz., *Abutilon indicum* L., *Acacia nilotica* L. and *Acalypha indica* L. were tested for the mosquito larvicidal activity IV instar larvae at different concentration for 24 hour exposure period against *Cx. Quinquefasciatus* larvae.
Table 1: Larvicidal activity of three plant oils against IV instars larvae of *Culex quinquefasciatus*

<table>
<thead>
<tr>
<th>Plants</th>
<th>Concentration (ppm)</th>
<th>LC(_{50})</th>
<th>LC(_{90})</th>
<th>Regression equation</th>
<th>95% Confidential limit</th>
<th>Chi-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LC(_{50})</td>
<td>LC(_{90})</td>
<td></td>
<td>LCL</td>
<td>UCL</td>
</tr>
<tr>
<td><em>Abutilon indicum</em></td>
<td>50.0 100.0 150.0 200.0 250.0</td>
<td>140.10</td>
<td>248.81</td>
<td>Y=1.534±2.270X</td>
<td>130.02</td>
<td>150.42</td>
</tr>
<tr>
<td><em>Acacia nilotica</em></td>
<td>50.0 100.0 150.0 200.0 250.0</td>
<td>164.46</td>
<td>275.01</td>
<td>Y=1.534±2.222X</td>
<td>154.07</td>
<td>175.59</td>
</tr>
<tr>
<td><em>Acalypha indica</em></td>
<td>50.0 100.0 150.0 200.0 250.0</td>
<td>173.17</td>
<td>274.15</td>
<td>Y=5.017±4.422X</td>
<td>163.29</td>
<td>183.78</td>
</tr>
</tbody>
</table>

*Significant at P<0.05. LCL, Lower Confidence Limit. UCL, Upper Confidence Limit.*
All three plant essential oils shown to possess larvicidal activity in different concentration. Stock solution was prepared using acetone, because basic toxicological investigation and screening the flora for insecticidal activity, acetone is commonly used as a solvent. It has good solvency for synthetic insecticides (Singh and Jain, 1987) and easy to evaporate (Chauhan et al., 1987). Concentration of 50.0 ppm to 250.0 ppm was prepared for Abutilon indicum and Acacia nilotica because these two oils exerted low LC50 values. 100.0 to 250.0 ppm was prepared for Acalypha indica these plant exerted the larvicidal activity above 100.0 ppm. Among the three plants tested. Abutilon indicum exerted the low LC50 value 140.0 ppm for IV instar larva. The LC50 values of three plant essential oils for IV instar of Culex quinquefasciatus larvae were Abutilon indicum 140.10 ppm, Acacia nilotica 164.46 ppm and Acalypha indica 173.17 ppm respectively.

Michaelakis et al. (2007) noted the larvicidal activities of essential oils of Satureja spinosa, S. parnassica, S. thymbra and S. montana against Cx. pipiens biotype molestus. The LC50 values ranged between 37.7-64.4ppm respectively. Senthilnathan (2007) studied the larvicidal activity of essential oil of Eucalyptus tereticornis against the malarial vector An. stephensi and observed the LC50 and LC90 values of 18.3 and 51.6 ppm for first instar, 23.8 and 63.9 ppm for second instar. Tiwary et al. (2007) assessed the larvicidal potential of the essential oil from the seeds of Zanthoxylum armatum against three medically important species of mosquito vectors, Ae. aegypti, An. stephensi and Cx. quinquefasciatus. Among the three mosquito species tested, Cx. quinquefasciatus was the most sensitive (LC50 = 49 ppm) followed by Ae. aegypti (LC50 = 54 ppm) and An. stephensi (LC50 = 58 ppm).

Das et al. (2007) evaluated the larvicidal activity of Aristolochia saccata (root), Annona squamosa (leaf), Gymnopetelum cochinensis (fruit), Caesalipinea species (bark), Piper spp (stem) extract against Ae. albopictus and Cx. quinquefasciatus larvae and observed the LC50 values of 14.52, 20.26, 50.67, 53.66 and 76.35 ppm for Ae. albopictus 19.83, 6.96, 57.4, 42.27 and 57.4ppm for Cx. Quinquefasciatus larvae. Knio et al. (2007) studied the larvicidal activity of essential oils of Petroseum crunch and Thymus vulgaris against sea side mosquito Ochlerotatus caspiscus. The LC50 values were 15.00 and 34.3 µg/ml respectively. Champakaew et al. (2007) reported the larvicidal activity of essential oils of Curcuma zedoaria against Ae. aegypti and it pronounced potential against the fourth instar of Ae. aegypti with an LC50 of 3.45 ppm.

Autran et al. (2009) studied the larvicidal activity of the essential oils of leaves, stems and inflorescences of Piper marginatum against Aedes aegypti. The essential oil of the inflorescences exhibited potent activity against the IV instar with LC10 and LC50 values of 13.8 and 20.0ppm respectively. Sa et al. (2009) studied the larvicidal activity of lectins isolated from Myrrocrodrone urundeuva bark and heartwood with the LC16, LC50 and LC84 values of 0.077, 0.125, 0.173 and 0.03, 0.04 and 0.05 mg/ml respectively.

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4. References


