International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 08-02-2026, Accepted: 11-03-2026, Published: 26-03-2026
Volume 11, Issue 1, 2026, Page No. 565-570

Mosquitocidal activity of *Naringi crenulata* (Maha vilvam) plant extract against *Culex quinquefasciatus* mosquito vector

T Chinnamani, R Praveenkumar, M Rajasekara Pandian
Department of Zoology, Arignar Anna Government Arts College Namakkal, Tamil Nadu, India

Abstract
Mosquitocidal activity of *Naringi crenulata* (Maha vilvam) was tested against the fourth instar larvae of *C. quinquefasciatus* and plant extracts to prepare different concentrations and against larvicidal activity of *C. quinquefasciatus* mosquito vector. Perusal of the data clearly indicated that maximum larval mortality in ethyl acetate extract was recorded in *C. quinquefasciatus* mosquito at 24hrs.Values were recorded in different concentrations of 500ppm, 250ppm, 125ppm, and 62.5ppm, the values in the percentage of larval mortality 78.50±2.71, 59.14±3.79, 37.37±6.20 and 21.35±5.35% and then LC_{50} (LCL-UCL), LC_{90}(LCL-UCL) X^2 values for 2.499(2.114-2.912), 6.271(5.423-7.606)0.293 respectively. Then the values in the percentage of pupal mortality in same extract at 71.74±3.45, 53.34±2.21, 34.84±3.29 and 20.11±3.07% and then LC_{50} (LCL-UCL), LC_{90}(LCL-UCL) X^2 values for2.826 (2.396-3.327), 7.098(6.037-8.865)0.186 and the values in the percentage of ovum mortality in same extract at 73.34±7.45, 51.47±2.41, 30.51±3.65 and 21.36±4.71% and then LC_{50} (LCL-UCL), LC_{90}(LCL-UCL) X^2 values for values in 2.827(2.419-3.299), 6.849(5.877-8.421)0.374 respectively.

Keywords: *Naringi crenulata, culex quinquefasciatus*, mosquitocidal activity, larvicidal activity, pupicidal activity and ovicidal activity

Introduction

Mosquitoes are responsible for the transmission of many diseases to both humans and animals worldwide. Mosquitoes are the most pervasive insects and spread a greater number of illnesses in humans around the world. Mosquitoes are declared as "Public enemy number one" by WHO. Mosquito vectors (Aedes, Anopheles and Culex) are responsible for number of diseases like malaria, dengue fever, chikungunya, filariasis, Japanese encephalitis and yellow fever. Overall, 40% of human population are in danger of dengue. Synthetic insecticides cause physiological resistance in mosquitoes, in addition to that they affect nontarget life forms and besides it acts as pollutant (Subashini, K *et al*., 2017) [16]. In recent years, use of many of the former synthetic insecticides in mosquito control programme has been limited.

It is due to lack of novel insecticides, high cost of synthetic insecticides and concern for environmental sustainability, harmful effect on human health, and other non-target populations, their non-biodegradable nature, higher rate of biological magnification through ecosystem, increasing insecticide resistance on a global scale. Nevertheless, the extensive use of chemical pesticides have led to resistance in vectors, pollution, bioaccumulation, and several health and environmental concerns. (Bhatt. R. P *et al.,* 2010) [3]. Mosquitoes are controlled by synthetic pesticides, which have substantial environmental consequences.

Botanicals have historically been advocated as desirable alternatives to synthetic agrochemicals due to their alleged reduced environmental and human health impact in comparison to the latter Bioactive compounds, which have been utilized extensively in complementary and alternative medicine for decades, are prevalent in plants. Previous research has established the critical role of larvicides in mosquito populations at breeding sites.

(A. Anurag. *et al*., 2019) [2] Kingdom: Animalia; Phylum: Arthropoda; Class: Insect; Order: Dipteral; Family: Culicidae; Genus: *Aedes; Species: aegypti. Culex quinquefasciatus* is an important vector of *Bancroftian filariasis* in tropical and subtropical regions. According to WHO (1984), about 90 million people worldwide were once infected with *Wuchereria bancrofti.* In India alone is 25 million people microfilaria and 19 million people suffer from filarial diseases (Deepa, J.*et al*., 2015) [4].

The pupa of Culex mosquito is lighter than water and, therefore, floats on the surface. The pupa is the non-feeding stage of development, but pupae are mobile, responding to light changes and moving (tumble) with a flip of their tails towards the bottom or protective areas. When the pupa is about 2 days old, the eyes, antennae, legs and wings are slowly formed that can be visible through the transparent outer covering. The respiratory trumpets of Culex mosquito are long and narrow. Adult *C. quinquefasciatus* vary in length. The type of biological form is an efficient vector of malaria in urban areas (Deepalakshmi, S *et al*., 2017) [5].

(Deepalakshmi and Jeyabalan, 2017) After facing several problems due to injudicious and over application of synthetic insecticides in nature, re-focusing phytochemicals that are easily biodegradable and have no ill-effects on non-target organisms was appreciated. Several groups of phytochemicals such as alkaloids, steroids, terpenoids, essential oils and phenolics from different plants have been reported previously for their insecticidal activity's wide selection of plants from herbs, shrubs and large trees was used for extraction of mosquito toxins. Plants produce numerous chemicals, many of which have medicinal and pesticidal properties. (Deng. Y., *et al*., 2021.) [6]

More than 2000 plant species have been known to produce chemical factors and metabolites of value in pest and mosquito control programmes. Members of the plant families- (Foster, W. 2002) [7]. Solanaceae, Asteraceae,

Cladophoraceae, Labiatae, Miliaceae, Oocystaceae and Rutaceae have various plant products available. In the present study *Naringi crenulata* plant leaf was tested against *C. quinquefasciatus.*

Materials and Method

The plant *Naringi crenulata* was identified as botanist, Department botany, Arignar anna government arts college, Namakkal District,Tamil Nadu, India. Fresh *Naringi crenulata* was collected from in and vicinity of our college, Arignar anna government arts college, Namakkal District,Tamil Nadu, India.

Collection of plant materials

Fresh *Naringi crenulate* was collected from in around our college, Arignar anna government arts college, Namakkal District, Tamil Nadu, India. The voucher specimen of (UGZOPH No.1) was prepared and deposited in PG and Research Department of Zoology, Government Arts College, Namakkal, Tamil Nadu, India.

Extraction method

The plant was shade dried under room temperature (27.0 ± 2ºC and 75 ± 5% RH). After drying the whole plant material was powdered by utilizing electric blender. 500g of plant powder was separated by Soxhlet extraction methods with hexane, chloroform and ethyl acetate derivation, consecutively with expanding extremity of solvents and filtered through Whatman's No. 1 filter paper and it was condensed. The concentrates were gatheredin clean borosil vialsand stored in the refrigerator for experiments against important mosquito vectors.

Mosquito species & Vector rearing

The mosquito species *Culex quinquefasciatus* were rearing in the laboratory. The larvae were kept in plastic trays and filled with tap water. Dog biscuits and yeast were provided once a day initially for development of all stages. The whole setup was maintained at 28 ± 2ºC and 70-80% relative humidity under the 14:10 light and dark cycles (Kamaraj *et al*., 2009).

Larvicidal activity

The extracts were prepared and tested against the freshly moulted (0-6 hrs) fourth instar larvae of selected mosquito species. For dissolving of plant extracts 2 drop tween 20 was added and then it was diluted with 100ml of dechlorinated water to obtain desired concentrations. The control was prepared using 2 drop Polysorbate 20 (Tween 20) in 100ml of dechlorinated water. 250-ml transparent cups were used for bioassay and five replications were maintained. The tenth of freshly molted fourth instar larvae of mosquitoes were introduced in respective concentrations of plant extracts. The results were observed and recorded after treatment of 24 hours. The LC_{50} value was calculated by using profit analysis (Finney, 1971). The LC_{50}, LC_{90} and other statistics chi-square values were calculated by using the software using statistical package of social science (SPSS) version 16.0 for windows, significance level was set at $p \leq 0.05$.

$$Corrected\ mortality\ of\ larvae = \frac{Observed\ mortality\ in\ treatment - Observed\ mortality\ in\ control}{100 - Control\ mortality} X\ 100$$

$$Percentage\ of\ laval\ mortality = \frac{Numbere\ of\ dead\ larvae}{No\ of\ larvea\ introduced} X100$$

Pupicidal bioassay

The pupicidal activity of plant crude extract was assessed by using the standard method as prescribed by WHO (2005). Similar test concentrations as stated in the previous experiments were prepared and tested against the pupae of *Culex quinquefasciatus.* Polysorbate 20 (Tween 20) is used as emulsifier and distilled water treated as control. Ten pupae of each mosquito species were introduced in respective concentrations of plant extracts. The pupal mortality was observed and recorded after 24hours of treatment. For each experiment, five replicates were maintained at a time. The percentage of mortality was calculated by using Abbott's formula (1925) [1].

$$Percentage\ mortality\ of\ Pupae = \frac{Numbere\ of\ dead\ pupae}{No\ of\ pupae\ introduced} X10$$

Ovicidal bioassay

The ovicidal activity of plant crude extract was assessed by using the standard method as prescribed by WHO (2005). Similar test concentrations as stated in the previous experiments were prepared and tested against the pupae of *Culex quinquefasciatus.* Polysorbate 20 (Tween 20) is used as emulsifier and distilled water treated as control. 100 eggs of each mosquito species were introduced in respective concentrations of plant extracts. The ovum mortality was observed and recorded after 24hours of treatment. For each experiment, five replicates were maintained at a time. The percentage of mortality was calculated by using Abbott's formula (1925) [1].

$$Percentage\ mortality\ of\ eggs = \frac{Numbere\ of\ dead\ pupae}{No\ of\ pupae\ introduced} X10$$

Statistical Analysis

Data analysis was carried out using Microsoft Excel 2007. Based on the mortality of the test organisms recorded in these bioassays, LC_{50} and LC_{90} were calculated along with their fiducial limits at 95% confidence level by profit analysis using SPSS software package 16.00 (Statistical Package of Social Sciences) software. Results with $p<0.05$ were marked as statistically significant.

Results and Discussion

Larvicidal activity of *Naringi crenulata* (Maha vilvam) against the freshly molted (0-6hrs old) fourth instar larvae of *C. quinquefasciatus.* (Table 1 and figure 1)

In the present study *Naringi crenulata* was tested against the fourth instar larvae of *C. quinquefasciatus* and the data pertaining to the experiments are shown in table 1and figar1. Perusal of the data clearly indicated that maximum larval mortality in ethyl acetate extract was recorded in *C. quinquefasciatus* mosquito at 24hrs values was recorded in different concentrations of 500ppm, 250ppm, 125ppm, and 62.5ppm the values in the percentage of larval mortality of 78.50±2.71, 59.14±3.79, 37.37±6.20 and 21.35±5.35% and then LC_{50} (LCL-UCL), LC $_{90}$(LCL-UCL) X^2 values for 2.499(2.114-2.912), 6.271(5.423-7.606)0.293 respectively. Chloroform extract, data clearly indicated that maximum larval mortality in Chloroform extract was recorded in *C*

quinquefasciatus mosquito at 24 hrs values was recorded in different concentrations of 500ppm, 250ppm, 125ppm, and 62.5ppm the values in the percentage of larval mortality 58.48±3.79, 37.31±2.86, 21.47±4.63 and 16.36±4.75and then LC_{50} (LCL-UCL), LC_{90} (LCL-UCL) X^2 values for 4.066 (3.502-4.910), 8.806(7.334-11.419)0.651respectively.
Petroleum extract was recorded in *C. quinquefasciatus* mosquito at 24 hrs values was recorded in different concentrations of 500ppm, 250ppm, 125ppm, and 62.5ppm the values in the percentage of larval mortality in 51.33±6.35, 31.74±7.32, 20.43±4.57 and 12.36±2.47% and then LC_{50} (LCL-UCL), LC $_{90}$(LCL-UCL) X^2 values for 4.715 (4.021-5.866), 9.782(8.011-13.103)0.544 respectively. The use of biologically active plant-based products with insecticidal properties have attracted considerable interest from scientists all over the world. (Anurag. A 2019.) [2] The biodegradable of the plant properties and safer on human beings and non-target organisms. Extensive survey of the flora was undertaken to search for potential plant extracts or compounds which could be used in the management of important human vector mosquitoes Foster, W. 2002 [7]. Similar type of activity was already reported by various authors.?
Mosquito species such *C. qunquepaceatus* tested for its larvicidal and pupicidal activity. The latex of *Naringi crenulata* was extracted using water and tested for mosquitocidal properties against selected mosquito species. Among the latex crude extracts tested *C. tritaeniorhynchus* larvae and pupae. The extract showed significant larvicidal and pupicidal activity. (Hira Amir, 2017) [8]. The highest cumulative mortality was observed at the highest concentration of plant leaf and stem extract (500ppm). The investigation of the larvicidal efficacy of the crude leaf ethyl acetate extract of *T. procumbens* was tested against *C. tritaeniorhynchus* showed promising larvicidal activity (Kamaraj *et. al.*, 2011) [11].

Pupicidal activity of *Naringi crenulata* (Maha vilvam) against pupae of *Cx. Quinquefasciatus.* (Table 2 and figure 2)

The pupae of *C. quinquefasciatus* and the data pertaining to the experiments and Perusal of the data clearly indicated that maximum pupal mortality in ethyl acetate extract was recorded in *C. quinquefasciatus* 24hrs values was recorded in different concentrations of 500ppm, 250ppm, 125ppm, and 62.5ppm the values in the percentage of pupal mortality in 71.74±3.45, 53.34±2.21, 34.84±3.29 and 20.11±3.07% and then LC_{50} (LCL-UCL), LC $_{90}$(LCL-UCL) X^2 values for2.826 (2.396-3.327), 7.098(6.037-8.865)0.186 and Pupae mortality in Chloroform extract was tested at 24 hrs. values was recorded in pupae mortality of 50.37±1.91, 31.41±3.90, 20.45±4.65 and 11.41±3.71% and then LC_{50} (LCL-UCL), LC $_{90}$(LCL-UCL) X^2 values in 4.789 (4.082-5.972), 9.864(8.070-13.238)0.424respectively. Petroleum ether extract was recorded in *C. quinquefasciatus* at 24 hrs. Values was recorded in percentage of pupae mortality in 37.41±4.43, 24.89±6.23, 18.77±4.31, and 10.10±1.77% and then LC_{50} (LCL-UCL), LC $_{90}$(LCL-UCL) X^2 values for 6.505(5.180-9.587), 13.327(10.050-21.453) 0.395 respectively.
The result suggested that the ethyl acetate of *M. azedarach* leaf extract was an excellent larvicidal potential in controlling mosquito vectors. (Kamaraj, C., *et al*., 2010) [10] . (A. Jeyasankar *et al.,*2016) [9] have reported that the ethyl acetate extract of *Phyllanthus Emblica* Linn. Exhibited more than 90% larval mortality at 250ppm on *C. quinquefaciatus.* Plants belonging to the family Lamiaceae have been screened and studied for their larvicidal activity against mosquitoes. Maia. M F *et al*., 2011 [12]. Plants that showed promising larvicidal activity were ethanolic aerial extracts of *Teucrium divaricatum* (LC_{50} 18.6ppm), *Mentha longifolia* (LC_{50} 26.8ppm), *Melissa officinalis* (LC_{50} 39.1ppm), *Salvia sclarea* (LC_{50} 62.7ppm) and *Mentha pulegium* (LC_{50} 81.0ppm) Rathy *et al.* (2015) have reported that the aqueous extracts of *Ocimum gratissimum, Phyllanthus emblica*, *Terminalia chebula*, *Aegle marmelos* and *Lantana camara* exhibited more than 90% larval mortality at 1.08 to 9.12 mg/ml on *A. aegypti*. Kamaraj *et al*. (2010) [10].

Ovicidal activity of *Naringi crenulata* plant leaf extract against *Cx. quinquefasciatus*(Table 3 and figure 3)

Naringi crenulata plant leaf was tested against the eggs of *C. quinquefasciatus* and the data pertaining to the experiments. Perusal of the data clearly indicated that maximum eggs mortality in ethyl acetate extract was recorded in *C. quinquefasciatus* mosquito at 24 hrs values was recorded in different concentrations of 500ppm, 250ppm, 125ppm, and 62.5ppm the values in the percentage of eggs mortality values in 73.34±7.45, 51.47±2.41, 30.51±3.65 and 21.36±4.71% and then LC_{50} (LCL-UCL), LC $_{90}$(LCL-UCL) X^2 values for values in 2.827(2.419-3.299), 6.849(5.877-8.421)0.374respectively.
The chloroform extract in same plant of ovum mortality values in 59.40±1.71, 33.76±3.45, 21.43±5.21 and 11.37±6.51% and then LC_{50} (LCL-UCL), LC $_{90}$(LCL-UCL) X^2 values for 4.099 (3.585-4.834), 8.298 (7.051-10.380)0.484 respectively. Petroleum ether extract in 45.31±3.21, 28.47±2.72, 19.51±7.32, 10.12±2.42 and then LC_{50} (LCL-UCL), LC $_{90}$(LCL-UCL) X^2 values for 5.857 (6.461-6.886), 10.806(8.669-15.111) 0.360 respectively. Ovicidal activity of ethyl acetate, butanol, and petroleum ether extracts of five species of Euphorbiaceae plants, *Jatropha curcas*, *Pedilanthus tithymaloides*, *Phyllanthus amarus*, *Euphorbia hirta*, and *Euphorbia tirucalli*, were tested against the early fourth instar larvae of *Aedes aegypti*. The ethyl acetate leaf extract of the experimental plant has also showed ovicidal activity of mosquito species. (Manish. K D *et al*., 2022) [13].
The ovicidal activity by ethyl acetate, aqueous solution, ethanol leaf extract of *Nerium oleander* against *A. stephensi* at 100, 150, 200, 250, and 300ppm were considered. With each extract at a concentration of100ppm, the take of hatchability was very high, and nil hatchability was recorded as the concentration of extract was better to 300ppm in the case of aqueous and ethanol extract Singh. (K V *et al*., 2003) [14]. The LC_{50} values of *A. stephensi*, *Cx. Quinquefasciatus* and *A. aegypti* and Chi-square values were significant at $P<0.05$ four solvents for ethyl acetate, benzene, petroleum ether and methanol extract were tested Sinka. (M.E., *et al*., 2011) [15].
(Subashini, K *et al*., 2017) [16] ovicidal activity of *L. camara latex* extract in 14% larval mortality was recorded in 98% absorbing, adults emerged from the surviving pupal as they have raised in the plant extract. (Sukumaran., 2020) [18]. ovicidal activity of *Melaleuca leucadendra* leaves extract with ethanol against C. *quinquefasciatus* the mortality is observed after 24 hours the highest mortality (47.5%) reached by concentration 4%. The LOGIT test showed that the number of LC_{50} was 3.7(37600 mg/l) with 95% significance the extract less effect to kill so it causes lethal effect of *A. aegypti* (Manis kumar*., et al,* 2022).

Table 1: Larvicidal activity of *Naringi crenulata* (Maha vilvam) (L) plant leaf extracted against mosquitoes

Crude extract	Concentration (%)	Percentage of larval mortality (%)	LC_{50} and LC_{90}		X^2
			LC_{50} (LCL-UCL)	LC_{90} (LCL-UCL)	
Ethyl acetate	5%	78.50±2.71	2.499 (2.114-2.912)	6.271 (5.423-7.606)	0.293
	2.5%	59.14±3.79			
	1.25%	37.37±6.20			
	0.625%	21.35±5.35			
chloroform	5%	58.48±3.79	4.066 (3.502-4.910)	8.806 (7.334-11.419)	0.651
	2.5%	37.31±2.86			
	1.25%	21.47±4.63			
	0.625%	16.36±4.75			
Petroleum ether	5%	51.33±6.35	4.715 (4.021-5.866)	9.782 (8.011-13.103)	0.544
	2.5%	31.74±7.32			
	1.25%	20.43±4.57			
	0.625%	12.36±2.47			

The value represents mean ± SD of five replications. LC_{50} = Lethal Concentration brings out 50% Mortality and LC90 = Lethal Concentration brings out 90% Mortality. LCL-UCL (Lower Confidence Limit- Upper Confidence Limit

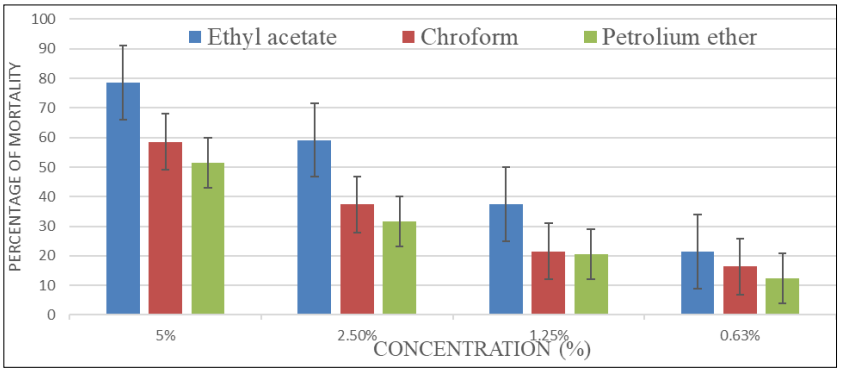

Fig 1: Larvicidal activity of *Naringi crenulata* (Maha vilvam) (L) Corr plant laef extract against mosquitoes

Table 2: Pupicidal activity of *Naringi crenulata* (Maha vilvam) (L) plant leaf extract against mosquitoes

Crude extract	Concentration (%)	Percentage of larval mortality (%)	LC_{50} and LC_{90}		X^2
			LC_{50} (LCL-UCL)	LC_{90} (LCL-UCL)	
Ethyl acetate	5%	71.74±3.45	2.826 (2.396-3.327)	7.098 (6.037-8.865)	0.186
	2.5%	53.34±2.21			
	1.25%	34.84±3.29			
	0.625%	20.11±3.07			
chloroform	5%	50.37±1.91	4.789 (4.082-5.972)	9.864 (8.070-13.238)	0.424
	2.5%	31.41±3.90			
	1.25%	20.45±4.65			
	0.625%	11.41±3.71			
Petroleum ether	5%	37.41±4.43	6.505 (5.180-9.587)	13.327 (10.050-21.453)	0.395
	2.5%	24.89±6.23			
	1.25%	18.77±4.31			
	0.625%	10.10±1.77			

The value represents mean ± SD of five replications. LC_{50} = Lethal Concentration brings out 50% Mortality and LC90 = Lethal Concentration brings out 90% Mortality. LCL-UCL (Lower Confidence Limit- Upper Confidence Limit

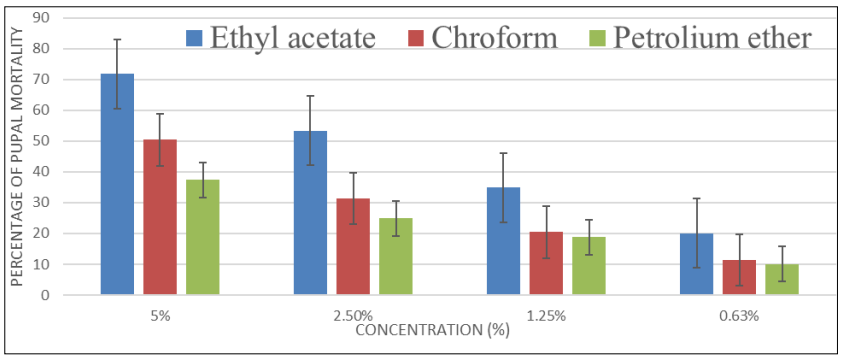

Fig 2: Pupicidal activity of *Naringi crenulata* (Maha vilvam) (L) Corr plant life extract against mosquitoes

Table 3: Ovicidal activity of *Naringi crenulata* (Maha vilvam) (L) plant leaf extract against mosquitoes

Crude extract	Concentration (%)	Percentage of larval mortality (%)	LC_{50} and LC_{90}		X^2
			LC_{50} (LCL-UCL)	LC_{90} (LCL-UCL)	
Ethyl acetate	5%	73.34±7.45	2.827 (2.419-3.299)	6.849 (5.877-8.421)	0.374
	2.5%	51.47±2.41			
	1.25%	30.51±3.65			
	0.625%	21.36±4.71			
chloroform	5%	59.40±1.71	4.099 (3.585-4.834)	8.298 (7.051-10.380)	0.484
	2.5%	33.76±3.45			
	1.25%	21.43±5.21			
	0.625%	11.37±6.51			
Petroleum ether	5%	45.31±3.21	5.857 (6.461-6.886)	10.806 (8.669-15.111)	0.360
	2.5%	28.47±2.72			
	1.25%	19.51±7.32			
	0.625%	10.12±2.42			

The value represents mean ± SD of five replications. LC_{50} = Lethal Concentration brings out 50% Mortality and LC90 = Lethal Concentration brings out 90% Mortality. LCL-UCL (Lower Confidence Limit- Upper Confidence Limit

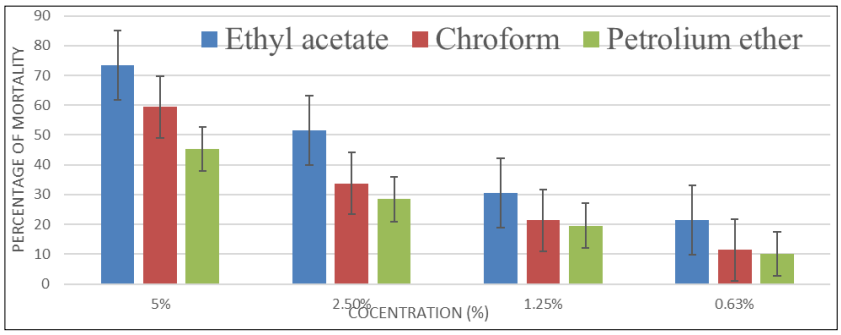

Fig 3: Ovicidal activity of *Naringi crenulata* (Maha vilvam) (L) plant leaf extract against mosquitoes

Reference

1. Abbott WS, A method of computing the effectiveness of an insecticide. Journal of Economic Entomology.,1925:18:265-267.
2. Anurag A, Agrawal, Amy P, Hastings Plant Defense by Latex: Ecological Genetics of inducibility in the Milkweeds and a General Review of Mechanisms, Evolution, and Implications for Agriculture. J Chem Ecole,2019:45(11-12):1004-1018.
3. Bhatt RP, Khanal SN, Environmental impact assessment system and process: A study on policy and legal instruments in Nepal. African Journal of Environmental Science and Technology,,2010:4(9):586-594.
4. Deepa J, Gokulakrishnan J, Baranitharan M, Dhanasekaran S, Larvicidal activity of Indian medicinal plants on the dengue vector mosquito, *A.aegypti* Linn. International Journal of Pure and Applied Zoology, 2015, 130-136.
5. Deepalakshmi S, Jeyabalan D, Studies on mosquitocidal and biological activity of endemic plants of Nilgiris Hills against filarial vector, *culex quinquefasciatus* (Say) (Insecta: Diptera: Culicidae). International Journal of Advance Research in Biological Science.,2017:4(3):137-151.
6. Deng YY, Qu B, Zhan ZL, Wang AQ, Zhou W, Jia MY, *et al*., Bioactive tagline diterpenoids from the latex of *Euphorbia fisherman*. Nat Prod Res.,2021:35(2):179-187.
7. Foster WA, Walker ED, Mosquitoes (Culicidae). In Mullen g, Durden L (Eds.) Medical and veterinary entomology. Academic Press, San Diego, CA,2002:597:203-262.
8. Amir H, Butt BZ, Vehra SE, Evaluation of larvicidal activity of *Parthenium hysterophorus* against *Aedes aegypti*, International Journal of Mosquito Research,2017:4(2):01-04.
9. Jeyasankar A, Ramar G, Phytochemical screening, larvicidal and pupicidal activity of *Murraya paniculata* (L.) Jack (Rutaceae) Leaf extracts against three important vector mosquitoes (Diptera: Culicidae). International Journal of Current Research in Biosciences,2016:3(10):150-156.
10. Kamaraj C, Abdul Rahuman A, Bagavan A, Abduz Zahir A, Elango G, Kandan P, *et al*., Larvicidal efficacy of medicinal plant extracts against *Anopheles stephensi* and *Culex quinquefasciatus* (Diptera: Culicidae). Tropical Biomedicine,2010:27(2):211–219.
11. Kamaraj C, Bagavan A, Elango G, Abduz Zahir A, Rajakumar G, Marimuthu S, *et al*., Larvicidal activity of medicinal plant extracts against *Anopheles subpictus* & *Culex tritaeniorhynchus*. Indian Journal of Medical Research,2011:134:101-106.
12. Maia MF, Moore SJ, Plant-based insect repellents: a review of their efficacy, development and testing. Malaria Journal,2011:10(1):S11.
13. Manish KD, Suvashish KP, Prashant KS, Larvicidal activity of green synthesized zinc oxide nanoparticles from *Carica papaya* leaf extract, Inorganic and Nano-Metal Chemistry., 2022.
14. Singh KV, Bansal SK, Larvicidal properties of a perennial herb *Solanum xanthocarpum* against vectors

of malaria and dengue/DHF. Current Science.,2003:84:749-751.
15. Sinka ME, Bangs MJ, Manguin S, The dominant *Anopheles* vectors of human malaria in the Asia-Pacific region: occurrence data, distribution maps and bionomic précis. Parasites Vectors,2011:4:89:3305-4-89.
16. Subashini K, Sivakami R, Jeyasankar A, Larvicidal activity of *Scutellaria violacea* (Lamiaceae) leaf extracts against three important human vector mosquitoes: *Aedes aegypti*, *Anopheles stephensiand Culex quinquefasciatus* (Diptera: Culicidae), International Journal of Mosquito Research;,2017:4(2):108-110.
17. Sugauara EYY, Sugauara E, Sugauara RR, Bortolucci WDC, Fernandez CMM, Goncalves JE, *et al*., Larvicidal activity of *Brunfelsia uniflora* extracts on *Aedes aegypti* larvae. Natural Product Research,,2022:36(4):1031-1037.
18. Sukumaran, Soorya, Maheswaran R, Larvicidal Activity of *Elytraria acaulis* against *Culex quinquefasciatus* and *Aedes aegypti* (Diptera: Culicidae). Journal of Arthropod-Borne Diseases., 2020, 14.
19. World Health Organization, Fact sheet: World Malaria Report, 2015.