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Research Article

LARVICIDAL ACTIVITY OF INDIAN MEDICINAL PLANTS ON THE DENGUE FEVER MOSQUITO, *AEDES AEGYPTI* LINNAEUS

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ABSTRACT

The Larvicidal activity of Indian medicinal plants, *Commiphora berryi, Ceiba pentandra, Pelargonium graveolens, Thevetia peruviana, Sesamum indicum, Ficus microcarpa, Melia dubia, Croton bonplandianus, Ficus religiosa* and *Coix lacryma* was tested against *Aedes aegypti* mosquito. The present research showed that the highest LC_{50} values of methanol extracts of *F. microcarpa* against *Ae. aegypti* larvae were 91.63 ppm followed by, LC_{50} values of *C. lacryma, P. graveolens, C. berryi, and M. dubia* extracts against *Ae. aegypti* larvae were 92.77, 95.65, 96.52 and 100.12 ppm, respectively.

Keywords: Larvicidal activity, Medicinal plants, Methanol extracts, *Aedes aegypti.*

INTRODUCTION

Mosquitoes constitute a most important public health problem as vectors of grave human like malaria, filariasis, dengue fever, japanese encephalitis, yellow fever and chikungunya cause considerable mortality and morbidity among people living in tropical and subtropical zones (Jang *et al.,* 2002). The container-breeding mosquito, *Ae. aegypti* L. grow well in urban and per domestic environments where it passess on the dengue virus to humans (Gubler, 1998). Dengue fever has developed an important public health problem as the number of recounting cases continue to increase, especially with more severe of the disease, dengue fever and dengue shock syndrome, or with abnormal manifestations such as central nervous system involvement (Pancharoen *et al.,* 2002). *Ae. aegypti* L. is generally known as a vector for an arbovirus responsible for dengue and chikungunya, which is endemic to South Asia, the Pacific island area, Africa, and America. This mosquito is also a vector of yellow fever in Central and South America and West Africa. The dengue fever incidence has increased fourfold since 1970 and nearly half the world's population is now at risk. In 1990, almost 30% of the world population, 1.5 billion people, lived in regions wherever the estimated risk of dengue transmission was greater than 50% (Hales *et al.,* 2002). In terms of dengue, 2.5 billion people live at risk of infection with one or more of the four serotypes of the virus, which cause an estimated 390 million infections per year (Bhatt *et al.,* 2013), and the affected area has increased rapidly in the past 30 years (Guzman *et al.,* 2010). Chikungunya is spread by the Tiger mosquito, *A. albopictus*. Chikungunya outbreaks in Europe have drawn the attention of the western world to this disease, spread by the Asian tiger mosquito, *Ae. albopictus* (Abramides *et al.,* 2013; Carrieri *et al.,* 2011; Rogers *et al.,* 2014). An outbreak of Chikungunya virus disease emerged in the southwest Indian Ocean islands in 2005, spread out to India, and resulted in an ongoing outbreak that has involved >1.5 million patients, including travelers who have visited these areas (Taubitz *et al.,* 2007).

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Currently, most important insecticides are non-selective and can be harmful to other organisms and to the environment. There is an urgent need to develop new materials for control mosquitoes in an environmentally safe way, using biodegradable and target-specific insecticides against them (Isman, 2006; Pavela, 2007; Jawale *et al.,* 2010). Bioactive organic compounds produced by plant can act as growth inhibitors, repellent activity, oviposition or toxin and food deterrents (Ezeonu *et al.,* 2001; Carlini and Grossi-de-Sa, 2002). Thus, crude plant extracts has been screened as natural and biodegradable form to control pest and vectors of infectious diseases (Omena *et al.,* 2007). Based on the foregoing, in the present study aimed to scientifically evaluate to the larvicidal activity of *C. berryi, C. pentandra, P. graveolens, T. peruviana, S. indicum, F. microcarpa, M. dubia, C. bonplandianus, F. religiosa* and *C. lacryma* leaf extracts against larvae of *Ae*. *aegypti.*

MATERIALS AND METHODS

Plants collection

The leaves of *C. berryi, C. pentandra, P. graveolens, T. peruviana, S. indicum, F. microcarpa, M. dubia, C. bonplandianus, F. religiosa* and *C. lacryma* were collected, washed methodically, blotted and shade dried.

Extraction

The method of plant extraction was modified from those of Satoto (1993) and Choochote *et al.,* (1999). Five hundred grams of each plant (oven dried) were ground and filtered using a strainer silver No. 60. About 15 gm of dry sample of each plant was macerated with methanol (is the solvent easy to separate the compounds of the plants) and left to stand at room temperature for 72 hrs. Then the mixture was filtered through a Whatman No. 1 filter paper by suction. The filtrate was evaporated under vacuum for 40˚C until completely dried, and kept at a constant 4˚C until needed for tests.

Larvicidal activity

Standard WHO protocol with slight modifications was adopted for the study (WHO, 1996). The 250 ml of plastic cups containing 200 ml of water with different concentrations of extract (50, 100, 150, 200, 250, & 3000 ppm). Early third instar larvae were introduced in each concentrations. Extract from the stock solution, the different concentrations of (50, 100, 150, 200, 250 and 300 ppm) were prepared. Early 25 third instar larvae were introduced in 250 ml plastic cups containing 200 ml of water with each concentration. A control was prepared by the addition of acetone to water. Mortality was recorded after 24 hours. For each experiment, four replicates were maintained at a time. The observed percentage mortality was corrected by Abbott's Formula (Abbott, 1925).

Statistical Analysis

Mortality was recorded after 24 hours of exposure. Obtained values were subjected to logging probit regression analysis and to obtain LC_{50} and LC_{95} values with a 95 % confidence limit (Finney, 1971).

RESULTS

In the present study, family, scientific names and authors, plant part used for larvicidal test, Indian local name, English name and medicinal values of experimental of were given in (Table 1). The larvicidal activity of Indian medicinal plants used singificantly for the mosquito population control (Table 2). The LC_{50} and LC_{95} values of methanol leaf extracts of *C. berryi, C. pentandra, P. graveolens, T. peruviana, S. indicum, F. microcarpa, M. dubia, C. bonplandianus, F. religiosa* and *C. lacryma* were tested against larvae of *Ae*. *aegypti* are given in (Table 3). Among these ten methanol leaf extract, *F. microcarpa* exhibited the highest larvicidal activity with LC_{50} and LC_{95} values of 91.63 and 110.88 ppm against *Ae*. *aegypti* respectively. Followed by, LC_{50} values of methanol leaf extracts of *C. lacryma, P. graveolens, C. berryi, M. dubia, T. peruviana, S. indicum, F. religiosa, C. pentandra* and *C. bonplandianus* were 92.77, 95.65, 96.52, 100.12, 101.07, 105.70, 111.14, 118.85 and 131.72 ppm, respectively. The LC_{95} values of methanol leaf extracts of *C. lacryma, P. graveolens, C. berryi, M. dubia, T. peruviana, S.*

indicum, F. religiosa, C. pentandra and *C. bonplandianus* were 113.61, 118.18, 121.24, 127.18, 131.21, 139.27, 155.42, 171.40 and 214.96 ppm, respectively.

Table 1. Ethno medical data of the Indian medicinal plants studied.

Family, Scientific name and Authors	Plants part use	Indian Local name	English name	Medicinal values
Burseraceae *Commiphora berryi* (Arn.) Engl.	Leaves	Mullu kiluvai	Indian balm of Gilead	It's used to resin; the resin is used for astringent, antiseptic, carminative, diuretic, appetite stimulator, uterine stimulant and emmenagogue.
Malvaceae *Ceiba pentandra*-(L) Gaertn. var. pentandra	Leaves	Illavam	Kapok	Leaves used to alternative laxative and infusion; flowers are used to guinea for gonorrhea treatments
Geraniaceae *Pelargonium graveolens* L' Herit	Leaves	Geranium	Rose-geranium	It's used as a fragrant component in perfumery, food and beverages industry, also as antidepressant and antiseptic remedy.
Apocynaceae *Thevetia peruviana* (Pers.) Merr.	Leaves	Ponnarali, Thiruvanch-ipoo	Mexican oleander	It's treatment of mild cardiac insufficiency and week heart.
Pedaliaceae *Sesamum indicum* L.	Leaves	Ellu	Semsem, Gingelly	It is used for preparation of pharmaceutical products and ointments especially in inflammatory conditions.
Moraceae *Ficus microcarpa*-L.f.	Leaves	Kalinji, Kalatthi	Chinnese banyan, Indian laurel	It is used to various conditions like diabetes, ulcers, burning sensations, haemorrhages, leprosy, itching, liver disease and Tooth ache.
Meliaceae *Meliadubia* Cav.	Leaves	Malaivembu	Persian lilac	Plant is all parts used to traditional herbal medicines, such as anthelmintics, leprosy, eczema, asthma, malaria, fevers and veneral diseases, cholelithiasis, acariasis and pain.
Euphorbiaceae *Croton bonplandianum*-Baill	Leaves	Rail bhundu	Three-leaved caper	It is used to highly medicinal & controlling Blood pressure and treatment of skin diseases and cut & wounds and antiseptic and antidote.
Moraceae *Ficus religiosa*-Vahl	Leaves	Kaaddarasu	Peepul tree	It's management of various types of disease like respiratory disorders, sexual disorders, central nervous system disorders, cardiovascular, gastric problems, skin infections and diabetes etc.
Poaceae *Coix lacryma*-jobi L	Leaves	Kaaddu kundumani	Job's tears	It's used to reducing liver fat accumulation, protecting from tumor stimulating compounds, and protecting against viral infection, reducing allergic reaction, reducing coronary artery disease and arthrosclerosis and reducing osteoporosis.

Table 2. Larvicidal activity of methanol extracts against third instar larvae of *Ae. aegypti*.

Name of the Plants	Mortality±SD					
	50 ppm	100 ppm	150 ppm	200 ppm	250 ppm	300 ppm
C. berryi	18.5±1.76	29.3±1.03	40.3±1.63	55.5±1.76	70.6±1.96	84.6±2.06
C. pentandra	5.5±1.76	10.3±1.63	19.5±1.37	30.1±1.94	39.8±1.16	49.6±1.86
P. graveolens	20.3±1.63	30.6±2.50	44.8±1.72	59.8±1.94	75.3±2.06	89.6±1.63
T. peruviana	14.1±1.32	24.5±1.37	34.1±1.32	45.3±1.63	60.3±1.86	75.3±2.06
S. indicum	10.6±1.50	20.5±1.37	30.1±1.32	40.3±1.03	55.1±1.94	72.3±3.50
F. microcarpa	24.5±1.76	41.3±1.75	55.1±1.32	71.1±2.22	85.6±1.50	99.3±0.81
M. dubia	15.3±1.86	25.5±1.76	34.8±1.32	50.1±1.60	65.1±1.94	80.5±1.97
C. bonplandianus	4.1±1.32	9.3±1.21	15.5±1.37	21.1±1.94	30.6±1.75	40.5±1.64
F. religiosa	8.3±1.03	15.8±1.47	25.3±1.63	35.1±1.94	44.6±2.73	62.5±3.20
C. lacryma	23.8±1.94	34.5±1.37	50.6±1.50	64.5±1.76	80.5±2.07	94.8±1.72

Table 3. LC_{50} and LC_{90} values of different plant methanol extracts against third instar larvae of *Ae. aegypti*.

Plants name	LC_{50} (ppm)	LCL-UCL	LC_{95} (ppm)	Slope	Regression
C. berryi	96.52	91.73-101.56	121.24	2.337602	Y=2.2652x+0.084
C. pentandra	118.85	111.18-127.06	171.40	2.066285	Y=2.1364x-0.4046
P. graveolens	95.65	91.20-100.32	118.18	2.531303	Y=2.5637x-0.4569
T. peruviana	101.07	95.60-106.85	131.21	2.131687	Y=2.0663x+0.2898
S. indicum	105.70	99.92-111.81	139.27	2.208583	Y=2.2017x-0.1643
F. microcarpa	91.63	87.61-95.83	110.88	3.419437	Y= -2.0456x+8.7428
M. dubia	100.12	95.09-105.40	127.18	2.291383	Y=2.29474x-0.1421
C. bonplandianus	131.72	121.35-142.98	214.96	1.865297	Y=1.709x+0.3522
F. religiosa	111.14	104.14-118.61	155.42	2.058794	Y=1.9109x+0.3018
C. lacryma	92.77	88.51-97.24	113.61	2.749268	Y= 2.7078x+0.5881

DISCUSSION

Vector control is in front of a serious risk due to the development of resistance in vector mosquitoes to conventional synthetic insecticides or growth of newer insecticides. However, the unbroken increase in resistance of mosquitoes to familiar synthetic insecticides. In the present study to assess the larvicidal properties of medicinal plant leaf extracts against the dengue fever mosquito, *Ae. aegypti*. The secondary metabolite of plant origins makes up an enormous repository compound with an extensive variety of biological activities. There have been many reports of superior plant extracts keeping relatively good potential to inhibit viruses (Van Den Berghe, 1978).

Dhanasekaran *et al.*, (2013) have investigated that the LC_{50} of ethanol crude extracts of nominated indigenous medicinal plants are *G. ula* extract in the experimental larvae of *An. stephensi* (LC_{50}= 82.86ppm), followed by *S. hispida* (LC_{50}= 89.45ppm). Even as Sukumar *et al.*, (1991) listed and described over 344 plant species that showed mosquitocidal activity. Shaalan *et al.*, (2005) revised the in progress state of knowledge on larvicidal plant species and listed the growth and reproduction inhibiting, phytochemicals, synergistic, botanical ovicides, additive and antagonistic joint action special effects of botanical mixtures, residual capacity and effects on non-target organisms, and appearance of resistance. Gokulakrishnan *et al.* (2012) tested that the larvicidal and ovicidal efficacy of different solvent leaf extract of *A. indica* against *An. stephensi*. The hatch rates were assessed 48

h after treatment. The LC_{50} and LC_{90} values of acetone, benzene, chloroform, hexane and methanol extracts of *A. indica* against *An. stephensi* larvae in 24 h were 76.29, 58.82, 53.59, 65.84, 51.78 and 205.85, 193.23, 185.16, 196.72 and 181.00 ppm, respectively. Rahuman and Venkatesan (2008) have reported that the LC_{50} value of petroleum ether extracts of *Jatropha curcas*, *Pedilanthus tithymaloides*, *Phyllanthus amarus*, *Euphorbia hirta*, and *Eu. tirucalli* were 8.79, 55.26, 90.92, 272.36, and 4.25 ppm, respectively, against *Ae. aegypti* and 11.34, 76.61, 113.40, 424.94, and 5.52 ppm, respectively, against *Cx. quinquefasciatus*, and the larvicidal effect of ten plants corresponding to different botanical families on *An. stephensi* and *Cx. quinquefasciatus*. The larvicidal activity of the essential oil aqueous solutions of the stalks and leaves of *C. argyrophylloides*, *C. nepetaefolius*, *C. sonderianus*, and *C. zehntneri* showed 100% mortality at 50 ml concentration against *Ae. aegypti* (Lima *et al.,* 2006).

In recent times, bio-pesticides with plant origins are given for use against several insect species, especially disease transmitting vectors, derived from the fact that compounds of plant origin are safer to use, without phototoxic properties and leaves no scum in the environment reported by Schmutterer, (1990). Elumalai *et al.*, (2012) investigate that the *E. roseum* acetone and methanol extracts of LC_{50} values of 121.65 and 139.86 ppm, it was that 100% mortality was distinguished from the acetone and methanol extracts of 100 ppm. *Solanum elaeagnifolium* and *Luffa cylindrical* exhibited more toxic special effects when the first instar of *Ae. aegypti* was treated for 24 h and the LC_{50} values were 0.0586 and 0.812 mg/ml, respectively (Renugadevi and Thangaraj, 2006). The toxicity of *Eu. milii molluscide* latex and niclos amide revealed toxic effect of *Ae. albitarsis*, *Ae. aegypti*, and *Ae. fluviatilis* larvae (Filho and Paumgartten, 2000). Krishnappa *et al.,* (2013) tested that the LC_{50} and LC_{90} values of *C. quadrangularis* and *C. ovalifolium* methanol extracts against *An. stephensi* were 37.48 and 74.53 mg/L, respectively.

CONCLUSION

The conclusion of the existing study would be useful in promoting research targeting at the statistics development of new agents for mosquito control based on plant sources.

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