International Journal of Pure and Applied Zoology
Volume 2, Issue 2, pp: 182-186, 2014

ISSN (Print) : 2320-9577
ISSN (Online): 2320-9585
http://www.ijpaz.com

Research Article

MOSQUITO OVICIDAL PROPERTIES OF *AGERATINA ADENOPHORA* (FAMILY: ASTERACEAE) AGAINST FILARIASIS VECTOR, *CULEX QUINQUEFASCIATUS* (DIPTERA: CULICIDAE)

M. Rajeswary[1], M. Govindarajan*[1], K. Murugan[2], Jiang-Shiou Hwang[3], Donald R. Barnard[4], A. Amsath[5], K.Veerakumar[1] and U. Muthukumaran[1]

[1]Unit of Vector Biology and phytochemistry, Department of Zoology, Annamalai University, Annamalainagar-608 002, Tamilnadu, India

[2]Department of Zoology, School of Life Sciences, Bharathiar University, Coimbatore- 641 046, Tamilnadu, India

[3]Institute of Marine Biology, National Taiwan Ocean University, Keelung, Taiwan, 202

[4]USDA-ARS-CMAVE, 1600 SW 23rd Drive, Gainesville, FL 32608, USA

[5]Department of Zoology, Khadir Mohideen College, Adirampattinam-614 701, Tamilnadu, India

Article History: Received 5th June 2014; Accepted 16th June 2014; Published 19th June 2014

ABSTRACT

Mosquito-borne diseases with an economic impact create loss in commercial and labor outputs, particularly in countries with tropical and subtropical climates. Mosquito control is facing a threat because of the emergence of resistance to synthetic insecticides. Extracts from plants may be alternative sources of mosquito control agents because they constitute a rich source of bioactive compounds that are biodegradable into nontoxic products and potentially suitable for use to control mosquitoes. Insecticides of botanical origin may serve as suitable alternative biocontrol techniques in the future. In view of the recently increased interest in developing plant origin insecticides as an alternative to chemical insecticide, this study was undertaken to assess the ovicidal potential of the crude hexane, benzene, chloroform, ethyl acetate, and methanol solvent extracts from the medicinal plant *Ageratina adenophora* (*A. adenophora*) against the filariasis vector, *Culex quinquefasciatus* (*Cx. quinquefasciatus*) (Diptera: Culicidae). Ovicidal activity was determined against *Cx. quinquefasciatus* mosquito to various concentrations ranging from 75-450 mg/L under the laboratory conditions. All the five solvents extracts showed moderate ovicidal activity; however, the methanol extract showed the highest ovicidal activity. One hundred percent mortality was observed at 375 mg/L. These results suggest that the plant extracts have the potential to be used as an ideal eco-friendly approach for the control of mosquitoes. This study provides first report on the mosquito ovicidal activity of *A. adenophora* plant extracts against filariasis vector, *Cx. quinquefasciatus.*

Keywords: *Ageratina adenophora*, Leaf, *Culex quinquefasciatus*, Ovicidal activity.

INTRODUCTION

Vector and vector-borne diseases have become a challenging problem to public health in these days as it has social and economical impact especially in subtropical and tropical countries. Mosquitoes are the most important arthropod disease vectors, transmitting nine dreadful human diseases in over 100 countries, causing mortality of nearly two million people every year (Govindarajan *et al*., 2012). The mosquito control, therefore, continues to be an important strategy in preventing the mosquito-borne diseases (Midega *et al*., 2010). Control of this mosquito during their development in aquatic

*Corresponding Author email: drgovind1979@gmail.com, Tel: +91 9080220148

medium by employing a very effective method is highly warranted for the sake of public health. *Culex quinquefasciatus*, a vector of lymphatic filariasis, is widely distributed in tropical zones with around 120 million people infected worldwide and 44 million people having common chronic manifestation (Bernhard, 2003). Human filariasis is a major public health hazard and remains a challenging socioeconomic problem in many of the tropical countries. Lymphatic filariasis caused by *Wuchereria bancrofti* and transmitted by mosquito *Cx.quinquefasciatus* is found to be more endemic in the Indian subcontinent. The extensive and indiscriminate applications of synthetic chemical insecticides lead to environmental and health concerns, widespread development of resistance by mosquitoes and unwarranted toxic or lethal effects on non-target organisms. These well known drawbacks with synthetic insecticides shifted the mosquito control programme to use of eco-friendly, biodegradable and environment friendly method (Govindarajan, 2011a).

The larvicidal and ovicidal potential of the crude hexane, benzene, chloroform, ethyl acetate and methanol solvent extracts from the medicinal plant *Pithecellobium dulce* against the mosquito vectors, *Anopheles stephensi* and *Aedes aegypti* (Govindarajan *et al.,* 2013). Al-Doghairi *et al*. (2004) have reported that the methanolic extracts of *Solenostemma argel* were tested oviposition, egg hatchability, and larval viability against *Cx. pipiens.* The active components dymalol, nymania-3, and triterpenes isolated from the extract of *Dysoxylum malabaricum* act as an oviposition repellent and deterrent to *An. stephensi* (Hisham *et al*., 2001). Govindarajan *et al*. (2011a) evaluated the ovicidal and repellent activities of methanol leaf extract of *Ervatamia coronaria* and *Caesalpinia pulcherrima* against *Cx. quinquefasciatus, Ae. aegypti* and *An. stephensi*. The leaf extract of *Acalypha indica* with different solvents viz., benzene, chloroform, ethyl acetate, and methanol was tested for larvicidal, ovicidal activity, and oviposition attractancy against *A. stephensi* (Govindarajan *et al.,* 2008).The leaf extract of *C. fistula* with different solvents viz., methanol, benzene, and acetone was studied for the larvicidal, ovicidal, and repellent activity against *Ae. aegypti* (Govindarajan, 2009). Therefore, the aim of this study was to investigate the mosquito ovicidal activity of the different solvent extracts of *A. adenophora*. This is the first report on the mosquito ovicidal activity of the solvent extracts of selected plant.

MATERIALS AND METHODS

Collection of plants

Fully developed leaves of *A. adenophora* were collected from hilly regions of the Nilgiris District, Tamil Nadu, India. It was authenticated by a plant taxonomist from the Department of Botany, Annamalai University. A voucher specimen is deposited at the herbarium of Plant Phytochemistry Division, Department of Zoology, Annamalai University, India.

Extraction

The leaves were washed with tap water, shade-dried, and finely ground. The finely ground plant leaf powder (1.0 kg/ solvent) was loaded in Soxhlet apparatus and was extracted with five different solvents, namely hexane, benzene, chloroform, ethyl acetate, and methanol, individually (Vogel, 1978). The solvents from the extracts were removed using a rotary vacuum evaporator to collect the crude extract. Standard stock solutions were prepared at 1% by dissolving the residues in ethanol. From this stock solution, different concentrations were prepared, and these solutions were used for ovicidal bioassay.

Test organisms

Cx. quinquefasciatus were reared in the vector control laboratory, Department of Zoology, Annamalai University. The larvae were fed on dog biscuits and yeast powder in the 3:1 ratio. Adults were provided with 10% sucrose solution and 1-week-old chick for blood meal. Mosquitoes were held at 28±2°C, 70–85% relative humidity (RH), with a photoperiod of 12 h light, 12 h dark.

Ovicidal activity

The ovicidal activity, slightly modified method of Su and Mulla (1998) was performed. The eggs of *Cx. quinquefasciatus* were collected from vector control laboratory, Annamalai University.

The leaf extracts were diluted in the ethanol to achieve various concentrations ranging from 75 to 450 mg/L. Eggs of these mosquito species (100) were exposed to each concentration of leaf extracts. After treatment, the eggs from each concentration were individually transferred to distilled water cups for hatching assessment after counting the eggs under microscope. Each experiment was replicated six times along with appropriate control. The hatch rates were assessed 48 h post-treatment by the following formula.

$$\% \text{ of egg hatchability} = \frac{\text{No. of hatched larvae}}{\text{Total no. of eggs}} \times 100$$

RESULTS

The result of the ovicidal activity of crude hexane, benzene, chloroform, ethyl acetate, and methanol solvent extracts of leaf of *A. adenophora* against the vector mosquito *Cx. quinquefasciatus* are presented in Table 1. Among the extracts tested for ovicidal activity against *Cx. quinquefasciatus* the leaf methanol extract of *A. adenophora* exerted 100% mortality (zero hatchability) at 375 mg/L. Control eggs showed the 100% hatchability.

Table 1. Ovicidal activity of *Agerantina adenophora* plant leaf extracts against *Culex quinquefasciatus.*

Name of the solvent	Percentage of egg hatch ability						
	Concentration (mg/L)						
	Control	75	150	225	300	375	450
Hexane	100±0.0	78.1±1.3	69.6±1.2	55.2±1.3	43.5±1.8	29.5±1.6	20.6±1.5
Benzene	100±0.0	74.5±1.5	65.2±1.6	52.6±1.5	39.2±1.4	26.4±1.3	NH
Chloroform	100±0.0	68.2±1.6	59.1±1.5	41.9±1.8	31.9±1.0	19.8±1.4	NH
Ethyl acetate	100±0.0	61.7±1.7	53.9±1.4	42.5±1.2	25.4±1.1	NH	NH
Methanol	100±0.0	56.9±1.9	48.5±1.3	34.3±1.0	21.6±1.5	NH	NH

DISCUSSION

Vector control is facing a serious threat due to the emergence of resistance in vector mosquitoes to conventional synthetic insecticides or development of newer insecticides. However, the continuous increase in resistance of mosquitoes to familiar synthetic insecticides. In the present study to assess the ovicidal properties of *A. adenophora* leaf extracts against the filariasis vector mosquito, *Cx. quinquefasciatus*.

The result of the present study are also comparable to the earlier reports of Autran *et al*. (2009) have reported that the essential oil from leaves and stems of *Piper marginatum* exhibited an oviposition deterrent effect against *Aedes aegypti* at 50 and 100 ppm in that significantly lower numbers of eggs (<50%) were laid in glass vessels containing the test solutions compared with the control solution. Govindarajan, (2010) evaluated larvicidal activity of crude extract of *Sida acuta* against three important mosquitoes with LC_{50} values ranging between 38 to 48 mg l−1. The larvicidal, ovicidal, and repellent activities of crude benzene and ethyl acetate extracts of leaf of *Ervatamia coronaria* and *Caesalpinia pulcherrima* were assayed for their toxicity against three important vector mosquitoes (Govindarajan *et al*., 2011b). The leaf methanol, benzene, and acetone extract of *C. fistula* were studied for the larvicidal, ovicidal, and repellent activity against *Ae. aegypti*, and the mortality was observed in 24 h LC_{50} concentration of the extracts at 10.69, 18.27, and 23.95 mg/l, respectively (Govindarajan, 2009).

The highest larvicidal activity was observed in the EO from *Z. officinale* against *Cx. tritaeniorhynchus* and *An. subpictus* with the LC_{50} and LC_{90} values as 98.83, 57.98 ppm and 186.55, 104.23 ppm, respectively (Govindarajan, 2011b). The LC_{50} and LC_{90} values methanol extract of *F. benghalensis* against early third instar of *Cx. tritaeniorhynchus* and *An. subpictus* were 100.88, 159.76 ppm and 56.66, 85.84 ppm, respectively (Govindarajan *et al*., 2011c). Govindarajan and Sivakumar (2014)

studied that the methanol extract of *Asparagus racemosus* against *Cx. quinquefasciatus*, *Ae. aegypti* and *An. stephensi* exerted 100 % mortality (zero hatchability) at 375, 300 and 225 mg/L , respectively.

CONCLUSION

The results of the present study would be useful in promoting research aiming at the development of new agent for mosquito control based on plant source.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest associated with this article.

ACKNOWLEDGMENTS

The authors are grateful thankful to the Professor and Head, Department of Zoology, Annamalai University for the laboratory facilities provided. We acknowledge the staff members of the VCRC (ICMR), Pondicherry for their cooperation.

REFERENCES

Al-Doghairi, M., El-Nadi, A., Elhag, E., Al-Ayedh H., 2004. Effect of *Solenostemma argel* on oviposition, egg hatchability and viability of *Culex pipiens* L. larvae. *Phytother. Res*., 18: 335-338.

Autran, E.S, Neves, I.A., Da Silva, C.S., Santos, G.K., Da Camara, C.A., Navarro D.M., 2009. Chemical composition, oviposition deterrent and larvicidal activities against *Aedes aegypti* of essential oils from *Piper marginatum* Jacq. (Piperaceae). *Bioresour. Technol*., 100(7): 2284-2288.

Bernhard, L., Bernhard, P., Magnussen, P., 2003. Management of patients with lymphoedema caused by filariasis in North-eastern Tanzania: alternative approaches. *Physiotherapy.*, 89: 743-749.

Govindarajan, M., Sivakumar, R., 2014. Ovicidal, larvicidal and adulticidal properties of *Asparagus racemosus* (Willd.) (Family:Asparagaceae) root extracts against filariasis (*Culex quinquefasciatus*), dengue (*Aedes aegypti*) and malaria (*Anopheles stephensi*) vector mosquitoes (Diptera: Culicidae). *Parasitol. Res.,* 113(4): 1435-1449.

Govindarajan, M., 2011a. Mosquito larvicidal and Ovicidal activity of *Cardiospermum halicacabum* Linn. (Family: Sapindaceae) leaf extract against *Culex quinquefasciatus* (say.) and *Aedes aegypti* (Linn.) (Diptera: Culicidae). *Eu. Rev. Med. Pharmacol. Sci.*, 15(7): 787-794.

Govindarajan, M., 2009. Bioefficacy of *Cassia fistula* Linn. (Leguminosae) leaf extract against chikungunya vector, *Aedes aegypti* (Diptera: Culicidae). *Eur. Rev. Med. Pharmacol. Sci.*, 13(2):99-103.

Govindarajan, M., 2010. Larvicidal and repellent activities of *Sida acuta* Burm. F. (Family: Malvaceae) against three important vector mosquitoes. *Asian Pac. J. Trop. Med*., 3: 691-695.

Govindarajan, M., Jebanesan, A., Pushpanathan, T. and Samidurai, K., 2008. Studies on effect of *Acalypha indica* L. (Euphorbiaceae) leaf extracts on the malarial vector, *Anopheles stephensi* Liston (Diptera:Culicidae). *Parasitol. Res.*, 103(3): 691-695.

Govindarajan, M., Sivakumar, R., Amsath, A. Niraimathi, S., 2011c. Mosquito larvicidal properties of *Ficus benghalensis* L. (Family: Moraceae) against *Culex tritaeniorhynchus* Giles and *Anopheles subpictus* Grassi (Diptera: Culicidae). *Asian Pac. J. Trop. Med.*, 4: 505-509.

Govindarajan, M., Rajeswary, M. and Sivakumar, R., 2013. Larvicidal & ovicidal efficacy of *Pithecellobium dulce* (Roxb.) Benth. (Fabaceae) against *Anopheles stephensi* Liston and *Aedes aegypti* Linn. (Diptera: Culicidae). *Indian.J.Med.Res.*, 138: 129-134.

Govindarajan, M., Rajeswary, M., Sivakumar, R., 2012. Mosquito larvicidal and ovicidal activity of *Delonix elata* (L.) Gamble against *Culex quinquefasciatus* Say (Diptera: Culicidae). *Asian. Pacific. J. Trop. Dis.*, S571-S573.

Govindarajan, M., Mathivanan, T., Elumalai, K., Krishnappa, K., Anandan A., 2011a. Ovicidal and repellent activities of botanical extracts against *Culex quinquefasciatus*, *Aedes aegypti* and *Anopheles stephensi* (Diptera: Culicidae). *Asian. Pacific. J. Trop. Biomed.*, 1: 43-48.

Govindarajan, M., 2011b. Larvicidal and repellent properties of some essential oils against *Culex tritaeniorhynchus* Giles and *Anopheles subpictus* Grassi (Diptera: Culicidae). *Asian Pac. J. Trop. Med.*, 4: 106-111.

Govindarajan, M., Mathivanan, T., Elumalai, K., Krishnappa, K., Anandan A., 2011b. Mosquito larvicidal, ovicidal and repellent properties of botanical extracts against *Anopheles stephensi*, *Aedes aegypti* and *Culex quinquefasciatus* (Diptera: Culicidae). *Parasitol. Res.* 109:353-367.

Hisham, A., Ajitha Bai, M.D., Jayakumar, G., Nair, M.S., Fujimoto, Y., 2001. Triterpenoids from Dysoxylum malabaricum. *Phytochemistry.*, 56: 331-334.

Midega, J.T., Muturi, E.J., Baliraine, F.N., Mbogo, C.M., Githure, J., Beier, J.C., Yan, G., 2010. Population structure of *Anopheles gambiae* along the Kenyan coast. *Acta. Trop.*, 114: 103-108.

Su, T., Mulla, M.S., 1998. Ovicidal activity of neem products (azadirachtin) against *Culex tarsalis* and *Culex quinquefasciatus* (Diptera: Culicidae). *J. Am. Mosq. Control. Assoc.*, 14:204-209.

Vogel, A.I., 1978. Text book of practical organic chemistry. *The English Language Book Society and Longman, London*, p. 1368.