J Vect Borne Dis 43, June 2006, pp. 88–91

Mosquito larvicidal properties of *Momordica charantia* Linn (Family: Cucurbitaceae)

R.K. Singh, R.C. Dhiman & P.K. Mittal

National Institute of Malaria Research (ICMR), 2 Nanak Enclave, Delhi, India

Key words *Aedes aegypti* – *Anopheles stephensi* – *Culex quinquefasciatus* – larvicidal action – *Momordica charantia*

Malaria and other vector-borne diseases contribute to the major disease burden in India. One of the methods to control these diseases is to control the vectors for the interruption of disease transmission. In the past, synthetic organic chemical insecticides-based intervention measures for the control of insect pests and disease vectors have resulted in development of insecticide resistance in some medically important vectors of malaria, filariasis and dengue fever[1,2]. During the last decade, various studies on natural plant products against mosquito vectors indicate them as possible alternatives to synthetic chemical insecticides[3-12].

However, more concerted efforts have to go into these studies to make these environment-friendly compounds viable for field use and for large-scale vector control operations. Sukumar *et al*[13] reported 99 families, 276 genera and 346 species to have insecticidal properties. An earlier study with a common medicinal and vegetable plant of *Momordica charantia* Linn (Family: Cucurbitaceae), has shown the insecticidal activity of this plant against mustered saw fly[14] but there is no report about its insecticidal activity against mosquitoes. The present communication reveals the mosquito larvicidal property of *M. charantia* against three mosquito species—*Anopheles stephensi*, *Culex quinquefasciatus* and *Aedes aegypti* (Diptera: Culicidae). This plant is widely distributed and cultivated in many parts of India. The local name in some important vernacular languages is: Hindi–karela; Tamil–pakal, pavakka; Marathi–karke; Bengali–karela; Malayalam–kaippa, kaippa-valli[15]. This species is reported to have anti-plasmodial properties[16,17] and is used in vegetable, unani, ayurvedic medicines in the treatment of many diseases particularly the fruits and leaves are useful in piles, leprosy, jaundice, vermifuge, sugar problem in snake-bite, and other diseases and it is found to have anti-oxidant properties[18].

Fresh fruits of *M. charantia* were obtained directly from the plants in field located in Burari village in north Delhi. Crude and hexane extracts of fresh fruits of *M. charantia* were used in the experiments. One kg thoroughly washed and cleaned fresh fruits of *M. charantia* were cut into small pieces and immediately ground using a pestle and mortar. This ground material was filtered through a muslin cloth and the filtrate of the crude extract was used in the first experiment as such after further dilutions in distilled water. Hexane extract was obtained by extraction of 500 g of ground fruits in cold hexane (500 ml) three times for 24 h. The hexane part obtained from each of the extract was pooled and evaporated to dryness. The residue, which weighed 1.1 g was dissolved in acetone to make a 10% stock solution. Standard methods for testing the susceptibility of mosquito larvae to insecticides, as suggested by WHO were followed in all the experiments [19]. Early IV instar larvae of *An. stephensi, Cx. quinquefasciatus* and *Ae. aegypti*, colonised in the insectary being maintained at National Institute of Malaria Research, 2 Nanak Enclave, Delhi, were used in all bioassays.

The crude extract was tested to determine the larvicidal activity by making serial dilutions like 10, 2.5, 1, 0.5, 0.25 and 0.1%, and hexane extract was used at 20, 40, 80, 120, 160 and 200 ppm dilutions in bioassays against larvae of the three mosquito species. The bioassays were performed at a room temperature of 27±1°C by exposing 25 larvae in each concentration of the extract in a final volume of 250 ml water taken in 500 ml glass beaker. Four replicates for each concentration and the control (without plant extract), were tested for larval bio-efficacy. The larval mortality in each concentration and control was recorded after 24 h of continuous exposure. The corrected mortality was determined using Abbott's formula whenever required [20]. The dose mortality data was analysed by log-probit method of Finney [21] and lethal concentrations for 50 and 90% mortality were calculated.

Bioassays with crude extract of *M. charantia* against larvae of *An. stephensi, Cx. quinquefasciatus* and *Ae. aegypti* revealed the LC_{50} values of 0.50, 1.29 and 1.45%, respectively (Table 1). Further, in bioassays hexane extract showed more potent larvicidal activity than the crude extract, indicating the non-polar characteristics of larvicidal components. The LC_{50} values of hexane extract against IV instar larvae of *An. stephensi, Cx. quinquefasciatus* and *Ae. aegypti* were 66.05, 96.11 and 122.45 ppm, respectively

Table 1. Laboratory evaluation of crude fruit extract of *M. charantia* against IV instar mosquito larvae

Species	% Conc. LC_{50} (95% confidence limits)	LC_{90}	?^{2} (df=4)
An. stephensi	0.50 (0.44–0.57)	1.54	7.7924
Cx. quinquefasciatus	1.29 (1.12–1.50)	4.11	12.2807
Ae. aegypti	1.45 (1.27–1.69)	4.46	11.4545

(Table 2). The results revealed that the larvae of *An. stephensi* were more susceptible in comparison to the larvae of *Cx. quinquefasciatus* and *Ae. aegypti*. The results indicate that the hexane extract of *M. charantia* possesses better larvicidal activity than the crude extract, however, further studies to identify the larvicidal components are needed. High chi-square values in the bioassays indicated probably the heterogeneity of the test population.

M. charantia has shown good larvicidal activity against three container breeding mosquitoes—*An. stephensi, Cx. quinquefasciatus* and *Ae. aegypti* in laboratory experiments. Toxicological studies have shown that *M. charantia* is safe for human health and there is no toxic effect [18,22,23]. *M. charantia* is used as a vegetable for human consumption. Hence the larvicidal action of the fruits extract of *M.*

Table 2. Laboratory evaluation of hexane extract of *M. charantia* against IV instar mosquito larvae

Species	Conc. in ppm LC_{50} (95% confidence limits)	LC_{90}	?^{2} (df=4)
An. stephensi	66.05 (62.74–73.54)	125.96	21.0597
Cx. quinquefasciatus	96.11 (90.24–106.18)	185.95	47.6710
Ae. aegypti	122.45 (112.06–128.48)	191.86	21.3368

charantia could be exploited for use in potable waters against mosquito larvae. Field trials are needed to assess the efficacy and cost-effectiveness.

Acknowledgement

The authors are thankful to Prof. A.P. Dash, Director, National Institute of Malaria Research, Delhi for guidance and encouragement and for providing necessary facilities. We acknowledge the technical help rendered by Mr. V.P. Singh and Mr. Pan Singh.

References

1. Vector resistance to pesticides. *Fifteenth report of the WHO expert committee on vector biology and control*. *WHO Tech Rep Ser* 1992; *818:* 62.
2. Kumari R, Thapar BR, Dasgupta RK, Kaul SM, Shiv Lal. Susceptibility status of malaria vectors to insecticides in India. *J Com Dis* 1998; *30*(3): 179–85.
3. Davidson G. Alternative measures to insecticides for mosquito control. *Pesticide Sci* 1972; *3*: 503–14.
4. Deshmukh PB, Chavan SR, Renapurkar DM. A study of insecticidal activity of twenty indigenous plants. *Pesticides* 1982; (Dec); p. 7–10.
5. Mittal PK, Subbarao SK. Prospects of using herbal products in the control of mosquito vectors. *ICMR Bull* 2003; *33*(1): 1–10.
6. Dharmagadda VSS, Naik SN, Mittal PK, Vasudevan P. Larvicidal activity of *Tagetus patula*. *Bioresource Technol* 2005; *96*: 1235–40.
7. Singh RK, Mittal PK, Dhiman RC. Laboratory study on larvicidal properties of leaf extract of *Calotropis procera* (Family: Asclepiadaceae) against mosquito larvae. *J Com Dis* 2005; *37*: 109–13.
8. Thomas TG, Raghavendra K, Shiv Lal, Saxena VK. Larvicidal properties of latex from unripe fruits of *Carica papaya* Linn (Caricaceae). *J Com Dis* 2004; *36*(4): 290–2.
9. Singh SP, Raghavendra K, Singh RK, Subbarao SK. Studies on the larvicidal properties of leaf extract of *Solanum nigrum* Linn (Family: Solanaceae). *Curr Sci* 2001; *81*(12): 1529–30.
10. Mehra BK, Haridhar PK. The effect of crude acetone extract of *Annona squamosa* Linn (Family: Annonaceae) on possible control potential against larvae of *Culex quinquefasciatus* Say. *J Entomol Res* 2001; *24*(4): 141–6.
11. Thomas TG, Sharma SK, Jalees S, Rehman SJ. Larvicidal properties of an indigenous plant *Yucca aloifolia* Linn against mosquito larvae. *J Basic Appl Bio Med* 1994; *2*: 53–5.
12. Pathak N, Mittal PK, Singh OP, Sagar V, Vasudevan P. Larvicidal action of essential oil from plants against the vector mosquitoes, *Anopheles stephensi* (Liston), *Culex quinquefasciatus* (Say) and *Aedes aegypti* (L). *Intl Pest Contr* 2000; *46*: 53–5.
13. Sukumar Kumuda, Perich MJ, Boobar LR. Botanical derivatives in mosquito control: a review. *J Am Mosq Contr Assoc* 1991; *7*: 210–37.
14. Kumar Arun, Tewari GD, Panday ND. Studies on antifeeding and insecticidal properties of bitter gourd (*Momordica charantia* Linn) against mustered saw fly *Athalia proxima* Klug. *Pesticides* 1979; *13*(12): 9.
15. Satyawati GV, Gupta AK, Tandan Neeraj. *Medicinal plants of India*, v 2. New Delhi: Indian Council of Medical Research 1987; p. 266.
16. Sharma Poonam, Sharma JD. Plants showing antiplasmodial activity from crude extracts to isolated compounds. *Indian J Malariol* 1998; *35*(2): 57–110.
17. Gbeassor M, Kedjagni AY, Koumaglo K, DeSouza C, Aklikokou K, Amegbo KA. *In vitro* antimalarial activity of six medicinal plants. *Phytotherapy Res* 1990; *4*: 115–7.
18. Chopra RN, Nayar SL, Chopra IC. *Glossary of Indian medicinal* plants. New Delhi: Publication and Information Directorate, Council of Scientific and Industrial Research 1956; p. 229.
19. *Instructions for determining the susceptibility or resistance of mosquito larvae to insecticides. WHO/VBC 81*: 807.
20. Abbott WS. A method for computing the effectiveness of

the insecticide. *J Econ Entomol* 1925; *18*: 265–7.

21. Finney DJ. *Probit analysis*, III edn. London: Cambridge University Press 1971; p. 1–333.
22. Chopra RN. *Indigenous drugs of India*. Calcutta: The Art Press 1933; p. 310.
23. *The useful plants of India*. New Delhi: Publication and Information Directorate, Council of Scientific and Industrial Research 1992; p. 581.

Corresponding author: Dr. R.C. Dhiman, Dy. Director, National Institute of Malaria Research (ICMR), 2, Nanak Enclave, Delhi–110 009, India.
e-mail: dhiman@mrcindia.org

Received: 03 February 2006 *Accepted in revised form:* 26 April 2006