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Efficacy of *Melia azedarach* L. extract on the malarial vector *Anopheles stephensi* Liston (Diptera: Culicidae)

Sengottayan Senthil Nathan [a,b,*], G. Savitha [b], Dency K. George [b], Alagirisamy Narmadha [b], Laxmanan Suganya [b], Paul Gene Chung [a]

[a] *Department of Environmental Engineering, Chonbuk National University, Jeonju City, Chonbuk 561 756, South Korea*
[b] *Post Graduate and Research Department of Biotechnology, Vivekanandha College (W), Trichengode, Namakkal 637 205, Tamil Nadu, India*

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Abstract

Methanolic extracts of leaves and seeds from the chinaberry tree, *Melia azedarach* L. (Meliaceae) was tested against mature and immature mosquito vector *Anopheles stephensi* Liston (Diptera) under laboratory condition. The extract showed strong larvicidal, pupicidal, adulticidal, antiovipositional activity, repellency and biting deterrency. The *M. azedarach* seed and leaf extracts were used to determine their effect on *A. stephensi* adults and their corresponding oviposition and consequent adult emergence in comparison with the control. The seed extracts showed high bioactivity at all doses, while the leaf extracts proved to be active, only in the higher dose. Results obtained from the laboratory experiment showed that the seed extracts suppressed the pupal and adult activity of *A. stephensi* even at low dose. In general, first and second instar larvae were more susceptible to both leaves and seed extracts. Clear dose–response relationships were established with the highest dose of 2% plant extract evoking 96% mortality. Entire development of *A. stephensi* was inhibited by *M. azedarach* treatment. Less expensive (less than US$0.50 per 1 kg seed), naturally accruing biopesticide could be an alternative for chemical pesticides.

Abbreviations: LE, leaf extract; SE, seed extract; EC_{50}, effective concentration; ±SE, standard error

Keywords: Malarial vector; Chinaberry; Larvicidal; Biology; Mortality; Repellency

1. Introduction

The Meliaceae plant family is known to contain a variety of compounds, which show insecticidal, antifeedant, growth regulating and development modifying properties (Nugroho et al., 1999; Greger et al., 2001; D'Ambrosio and Guerriero, 2002; Nakatani et al., 2004). *Melia azedarach* L. (Sapindales: Meliaceae) known as Chinaberry or Persian lilac tree is a deciduous tree that is native to northwestern India and has long been recognized for its insecticidal properties but yet to be well analyzed. This tree typically grows in the tropical and subtropical parts of Asia, but nowadays it is also cultivated in other warm regions of the world because of its considerable climatic tolerance. Fruit extracts of *M. azedarach* elicit a variety of effects in insects, such as antifeedant, growth retardation, reduced fecundity, moulting disorders, morphogenetic defects, and changes of behavior (Schmidt et al., 1998; Hammad et al., 2001; Gajmer et al., 2002; Banchio et al., 2003; Wandscheer et al., 2004). The effects of compounds,

* Corresponding author. Address: Department of Environmental Engineering, Chonbuk National University, Jeonju City, Chonbuk 561 756, South Korea. Tel.: +82 63 270 2444; fax: +82 63 270 2449.
E-mail addresses: senthil@moak.chonbuk.ac.kr, senthilkalaidr@hotmail.com (S.S. Nathan).

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products and extracts obtainable from *M. azedarach* on insects have been reviewed by Ascher et al. (1995). Effects of *M. azedarach* extracts on many insects have been already reported (Saxena et al., 1984; Schmidt et al., 1998; Juan et al., 2000; Carpinella et al., 2003; Senthil Nathan and Saehoon, 2005).

Control of mosquito is required, because many species of mosquitoes are vectors of malaria filariasis, many arboviral diseases, and also simply because they constitute an intolerable biting nuisance (Youdeowei and Service, 1983; Curtis, 1994; Collins and Paskewitz, 1995). In a worldwide consideration, malaria has been said to be the most epidemic disease. Thus, the effect of vector borne diseases is a major threat to human survival on earth. *Anopheles stephensi* Liston (Diptera: Culicidae) predominantly breeds in wells, overhead or ground level water tanks, cisterns, coolers, roof gulters, and artificial containers (Collins and Paskewitz, 1995). Furthermore, it has a wide distribution and is a major vector in India as well as in some of the West Asian countries and has been shown to be directly responsible for about 40–50% of the annual malarial incidence (Curtis, 1994; Collins and Paskewitz, 1995). It transmits malaria in the plains of rural and urban areas of India. Biotechnologists and Entomologists agree that, mosquito control efficiency should be with selectivity for a specific target organism. New control methodologies aim at reducing mosquito breeding sites and biting activity by using a combination of chemical–biological control methods soothing several advocated biocontrol methods to reduce the population of mosquito and to reduce the man–vector contact (Service, 1983).

Recently, there has been a major concern for the promotion of botanicals as environmentally friendly pesticides, microbial sprays, and insect growth regulators amidst other control measures such as beneficial insects and all, necessitate an integration of supervised control (Ascher et al., 1995; Senthil Nathan et al., 2004, 2005b,c,d). The development of insects growth regulators (IGR) has received considerable attention for selective control of insect of medical and veterinary importance and has produced mortality due to their high neurotoxic effects (Wandscheer et al., 2004; Senthil Nathan et al., 2005a).

Although, biological control has an important role to play in modern vector control programs, it lacks in the provision of a complete solution by itself. Irrespective of the less harmful and ecofriendly methods suggested and used in the control programmes, there is still need to depend upon the chemical control methods in situations of epidemic out break and sudden increase of adult mosquitoes. Hence, insecticides are known for their speedy action and effective control during epidemics. Nonetheless, they are preferred as effective control agent to reduce the mosquito population irrespective of their side effects.

Recent studies stimulated the investigation of insecticidal properties of plant derived from materials or botanicals and concluded that they are environmentally safe, degradable, and target specific (Senthil Nathan and Kalaivani, 2005). Muthukrishnan and Puspalatha (2001) evaluated the larvicidal activity of extracts from *Calophyllum inophyllum* (Clusiaceae), *Rhinacanthus nasutus* (Acanthaceae), *Solanum suratense* (Solanaceae) and *Samadera indica* (Simaroubaceae), *Myriophyllum spicatum* (Haloragaceae) against *A. stephensi*. Several indigenous plants viz, *Ocimum basilicum*, *Ocimum santum*, *Azadirachta indica*, *Lantana camera*, *Vitex negundo* and *Cleome viscosa* were studied for their larvicidal action on the field which collected fourth instar larva of *Culex quinquefasciatus* (Kalyanasundaram and Dos, 1985). Murugan and Jeyabalan (1999) reported that *Leucas aspera*, *O. santum*, *A. indica*, *Allium sativum* and *Curcuma longa* had a strong larvicidal, antiemergence, adult repellency and antireproductive activity against *A. stephensi*. In addition *Pelargonium citrosa* (Jeyabalan et al., 2003), *Dalbergia sissoo* (Ansari et al., 2000a) and *Mentha piperita* (Ansari et al., 2000b) were shown to contain larvicidal and growth inhibitory activity against *A. stephensi*.

The Meliaceae plant family has been known as a potential source for insecticide properties. Extracts from the neem and other plants seeds and leaves have shown excellent insecticidal properties against mosquito vector and were at the same time very eco-friendly (Schmutterer, 1990; Senthil Nathan et al., 2005a). Recently, the efficacy of these neem products on mosquitoes were established (Chavan, 1984; Zebitz, 1984, 1986; Schmutterer, 1990; Murugan et al., 1996; Su and Mulla, 1999). The present investigation was undertaken to study the effect of *M. azedarach* against the larvae of *A. stephensi* (Liston) mosquito.

2. Methods

2.1. Mosquito culture

A. stephensi eggs were collected from in around the Vivekananda College Campus, Namakkal District, Tamil Nadu and larvae were reared in plastic and enamel trays in tap water. They were maintained at 27 ± 2 °C, 75–85% relative humidity under 14:10 light and dark photo period cycle. Larvae were fed with diet Brewers Yeast, dog biscuits and algae collected from ponds in the ratio of 3:1. Pupae were transferred from the trays to a cup containing tap water and placed in screened cages ($23 \times 23 \times 32$ cm) where the adult emerged. The adults of *A. stephensi* were reared in the glass cages of $30 \times 30 \times 30$ cm dimension. Adults were continuously provided with 10% sucrose solution in a jar with cotton wick. On day 5 postemergence the adult females were