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EFFICACY OF SOME PLANT EXTRACTS AGAINST DENGUE MOSQUITO (DIPTERA: CULICIDAE)

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ABSTRACT

Mosquitoes are well known for being vectors of many pathogens causing diseases. The widespread use of synthetic insecticides in mosquito control has resulted in the growth of resistance to pesticides and the degradation of the ecosystem. Therefore, plants have become alternative sources of mosquito control in recent years. In the current research five plants viz. eucalyptus, neem, mint, niazbow, ginger and canola were evaluated against *Aedes aegypti* and *A. albopictus* mosquitoes. The toxicity of the crude extracts of all the plants against the third stage larvae of *Aedes* spp. gave significant results. The study showed a very substantial difference in the length of the repellents and the bite safety between the repellents and the control. Canola was less effective as compared to all other test plants. All the essential oils tested offered protection for a minimum period of > 33 minutes and may therefore be included in the standard list of repellents of *Aedes* species. Neem oil repellent had the best repellence against both Aedes mosquito species with defence times of (246±15.78) and (256±14.87) minutes respectively against *A. egypti* and *A. albopictus* as well. The defence time against A. *aegypti* was (14.34±0.00) and (19.24±0.00) minutes for the canola oil used as power against *A. aegypti* as well as *A. albopictus*. Ginger oil offered the least defence 35.76±4.99 and 33.76±4.99 minutes against *A. aegypti* and *A. albopictus* respectively. These two oils were better than other oil formulations and were statistically significant from each other. It is concluded that these plants can be used as alternatives for the management of mosquitos.

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INTRODUCTION

The widespread use of synthetic insecticides in mosquito control strategies has resulted in the growth of resistance to pesticides and the degradation of the ecosystem. Therefore, plants have become alternative sources of mosquito control agents in recent years. There are many attractive features of the use of plant products for vector control as they are easily degradable, less risky and rich stock house of chemicals of diverse biological activity and economical as well as realistic in application. Botanicals have therefore gained significant attention in recent times in integrated pest control programs (Abbott, 1925; Ameen et al., 1985; Arivoli et al., 2011; Bansal et al.,

2012; Bilal et al., 2012; Cavalcanti et al., 2004). It is possible to use plant products, particularly secondary metabolites, either as insecticides or it is possible to use plant products, in particular secondary metabolites, either as insecticides to kill larvae or adult mosquitoes, as repellents for mosquito bite defence or as oviposition deterrents, depending on the type of activity they possess (de Paula et al., 2003; El-Hag et al., 1999; Finney, 1971; Karunamoorthi et al., 2008; Kumar et al., 2011; Riaz, 2011; Tawatsin et al., 2006; WHO, 1981, 2015; Yang and Ma, 2005; Zhu and Zeng, 2006). Mosquito regulation at the larval stage is known to be an effective way of handling integrated vectors. In addition, altering the oviposition behavior of mosquitoes can also minimize the breeding of mosquitoes. The egg laying of female mosquitoes that can be used as oviposition deterrents in integrated vector control can also be inhibited by certain plant metabolites. Several scientific studies have been performed and experiments have been conducted to examine the oviposition altering activity of secondary mosquito metabolites in plants. Mosquitoes are significant arthropods that spread diseases such as malaria, filariasis, Japanese encephalitis and dengue haemorrhagic fever. They have the capacity to feed on more than one person during a single gonotropic period. There are currently over 3000 species of mosquitoes worldwide, grouped into 39 genera and 135 subgenera. *Aedes aegypti* is a very significant vector, transmitting disease among all subgenera mosquitoes. The dengue virus is primarily transmitted by *Aedes* mosquitoes, especially *A. aegypti*, and there are currently no appropriate vaccines available. Therefore, mosquito control, which is also based on the application of traditional insecticides, is the way to reduce the occurrence of this disease. About 22,000 deaths are recorded annually, mostly in children and young people (under 20 years) due to this disease (Riaz, 2011). To avoid the landing of mosquitoes on or biting human skin, generally synthetic chemicals that are not fully safe for human beings, particularly for pregnant women, infants, small children, and developing foetuses are used. These repellents may cause human skin to have respiratory diseases or inflammation, rashes, allergies and hot sensations (Das and Ansari, 2003; Das et al., 2007). For these reasons, scientists are searching for alternates. In the present study, some plants were tested for the control of *Aedes* mosquitoes.

MATERIALS AND METHODS

Plant material

The green leaves of plant species viz. Eucalyptus, Neem, Mint, Niazbow, Ginger and Canola were collected during September-December. Plant material dried under shade for 15 days.

Extraction from plants

By means of an electric blender, dried plant leaves were powdered. Powder was subjected separately to the extraction of solvents (different polarity solvents-hexane, methanol, acetone, isopropanol, di-methyl-sulphoxide) by Soxhlet instruments (Make-Borosil). Totally, at the boiling point range of 50-80°C, 200 g of powdered material was collected in 500 ml solvent for 8 hours. The extracts were filtered through Whatman filter paper No. 1 using a Buchner funnel. Using a rotary evaporator, crude extracts were dried and preserved in glass vials. In their respective solvents, with the exception of dried hexane extract, stock solutions of each plant extract were prepared as per standards with minor modifications (WHO, 2015).

The mosquitos

Aedes albopictus and *Aedes aegypti* mosquitoes were collected. At 27±2°C room temperature and 70±5 percept relative humidity, cyclic generations of vector mosquitoes were reared in bowls (2.5 L) and fed on yeast powder and larval stages were preserved. Adult mosquitoes were raised in wooden cages (30-30-30 inches) and cotton soaked with 10% sugar solution was given. The females were given rabbit blood once a week. Within the cage, moist filter paper was kept in the beaker for female mosquitoes to lay their eggs.

larvicidal bioassay

The larvicidal bioassay was conducted in accordance with the WHO (2015) protocol. Twenty early third instar larvae of *Aedes* spp. were placed in glass beakers (250 ml) containing 100 ml of tap water and *A. albopictus* and *A. aegypti* were added. In beakers for treatment, one ml of test solutions of various plants was added along with control that was treated with the respective solvents (acetone is used for hexane extract). Four replicates were set up for each test and larval mortality was reported after 24 hours. Data were analysed using POLO PC software by Probit analysis (Abbott, 1925; Finney, 1971) to assess the lethal concentration for of plant species.

RESULTS AND DISCUSSION

The toxicity of the crude extracts of all the plants against

the third stage larvae of *Aedes* spp. was measured. The study of ANOVA and Duncan's Multiple Range Test showed a very substantial difference in the length of the repellents and the bite safety between the repellents and the control. Canola was less effective as compared to all other test plants. All the essential oils tested offered in protection for a minimum period of > 33 min and may therefore, be included in the standard list of repellents of *Aedes* species. Neem oil repellent (E2) had the best repellence against both Aedes mosquito species with defence times of (246±15.78) and (256±14.87) minutes respectively against *A. egypti* and *A. albopictus* as well. Aedes mosquito species showed defence times of (246±15.78) and (256±14.87) minutes respectively, against *A. aegypti* and *A. albopictus*, as well. The defence time against A. *aegypti* was (14.34±0.00) and (19.24±0.00) minutes for the canola oil used as power against *A. aegypti* as well as *A. albopictus*. Ginger oil offered the least defence 35.76±4.99 and 33.76±4.99 minutes against *A. aegypti* and *A. albopictus* respectively. These two oils were better than other oil formulations and were statistically significant from each other (Table 1).

Table 1: Efficacy of herbal oil formulations from different plant sources as repellents and biting protector against *A. aegypti* and *A. albopictus* (mean ±SD).

`	Protection Time		Biting Pecentage	
	A. Aegypti	*A. Albopictus*	*A. aegypti*	*A. albopictus*
Eucalyptus	82.54±12.05c	78.64±13.15bc	0.63b	0.68b
Neem	246±15.78a	256±14.87a	0.27a	0.25a
Mint	97.87±13.76b	97.87±13.76b	0.94b	0.92b
Niazbow	64.34±10.45d	69.34±10.35c	0.97b	0.80b
Ginger	35.76±4.99e	33.76±4.99d	0.92b	0.85b
Canola	14.34±0.00f	19.24±0.00e	3.98c	4.14c

A varying degree of repellence against the two species of mosquito was shown by different plants. The longest protection time against both species was provided by neem oil, while ginger oil provided the least protection time. Our observations have shown that some essential oils (eucalyptus and ginger oils) were significantly more susceptible to *A. aegypti* than *A. albopictus*. With neem and mint oils, these findings were compatible statistically with those of Tawatsin et al. (2006), who found that both essential oils (repellency 4.5–8 h) were more susceptible to *A. albopictus* than *A. aegypti* (0.3–2.8 h repellency). Other researchers have reported that *A. aegypti* was more sensitive (Yang and Ma, 2005). *A. albopictus* was more sensitive relative to *A. aegypti* when exposed to eucalyptus extract. In the case of eucalyptus oil, in comparison to Yang and Ma (2005), who noted double protection time, around 1.5 hours of protection time was noted in this report (3 h). In this analysis, neem oil offered the maximum protection time of 4 hours and a minimum biting percentage of 27 per cent, while Ameen et al. (1985) found the maximum protection time of 8 hours and 100 per cent repellency with *Melaleuca leucadendron* against Aedes species.

In this analysis, we used canola oil to generate 10 per cent concentration of repellent oils, while Das and Ansari (2003) used 10, 20, and 30 per cent concentration of repellents in mustard and coconut oils, and with mustard oil, maximum safety was noted. The Brassicea family includes both canola and mustard crops. Karunamoorthi et al. (2008) also recorded 8 hours bite defence using petroleum ether plant extracts against different mosquito species in the field. Usually, botanical oils do not provide long protection, whereas synthetic repellents can provide more than 6 hours. These distinct responses to mosquitoes caused by the same plant extracts may be attributable to certain extrinsic and intrinsic factors. However, it is possible to use the findings of this study to establish and enhance the development of essential oil extracts for greater efficacy as insect repellents. It is concluded that these plants can be used as alternatives for the management of mosquitos.

AUTHOR'S CONTRIBUTION

AM and MT designed the study, AM and AHT performed the experiments, collected data, MT analyzed the data, AM wrote the manuscript and MT proofread the paper.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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