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Repellency of volatile oils from *Moschosma polystachyum* and *Solanum xanthocarpum* against filarial vector *Culex quinquefasciatus* Say.

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Abstract: Volatile oils extracted by steam distillation from leaves of two plant species *Moschosma polystachyum* and *Solanum xanthocarpum* were evaluated in mosquito cages for their topical repellency effects against filarial vector *Culex quinquefasciatus.* The oil from *M. polystachyum* was tested at four different concentrations ranging from 1 to 4%. The 4% concentration gave 332.2 minutes protection whereas control gave only 4.4 minutes protection against mosquito bites. However, the volatile oil of *S.xanthocarpum* was tested from 2 to 8% concentration. The 8% concentration gave 311.4 minutes protection whereas control gave only 4.4 minutes protection against mosquito bites. The results suggest that the volatile oils of these two plant species were effective as repellents and gave more than 300 minutes of (>5 hour) protection against the bite of *Cx. quinquefasciatus* bite. Both volatile oils did not cause dermal irritation when applied to human skin. No adverse effects on human volunteers were observed after application. Therefore, both volatile oils can be applied as an effective personal protection measure against mosquito bites.

INTRODUCTION

Personal protective measures, including repellents, are widely used to prevent the transmission of mosquito-borne diseases by minimizing the contact between humans and vectors (Pitasawat *et al.*, 2003). The majority of commercial repellent products contain the chemical DEET (N,N-diethyl-3-methylbenzanmide), which has shown excellent repellency against mosquitoes and other biting insects (Walker *et al.*, 1996). However, side effects after the application of deet vary from mild to severe (Qiu *et al.*, 1998). To avoid these adverse effects, research on repellents that are derived from plant extracts could provide possible alternatives to DEET. (Tawatsin *et al.*, 2001)

The present study investigates the repellency of volatile oils derived from *Moschosma polystachyum* (Family: Lamiaceae) and *Solanum xanthocarpum* (Family: Solanaceae) against filarial vector *Culex quinquefasciatus* using human in a laboratory setting. *M. polystachyum* a common shrub of South India has been shown to possess larvicidal activity against *Cx.quinquefasciatus* (Rajkumar & Jebanesan, 2004). *S. xanthocarpum*, the Indian night shade, commonly known as 'baigan kateli', is found throughout the country, but more abundant in arid areas. The plant is known to have multiple medicinal properties and the extracts of fruit and root have been used as larvicides against *Anopheles culicifacies*, *Anopheles stephensi* and *Aedes aegypti* (Singh & Bansal, 2003).

MATERIALS AND METHODS

Plant procurement and volatile oils

Fresh samples of both leaves without the stalk were collected in the month of August 2004 from the medicinal plant garden at Sivapuri village, Tamil Nadu, India. Voucher specimens have been deposited in the botanical survey of India, Coimbatore, India. At least 15 kg each of both leaves were extracted for volatile oils by steam distillation. Fresh leaves were cut into small pieces and placed in a distillation flask with approximately five times as much water. The distillation chamber was heated at about 120°C and allowed to boil until the distillation was completed. The distillate was collected in a separating funnel in which the aqueous portion was separated from the volatile oil. This procedure was repeated until at least 20 ml of oil had been recovered. The volatile oil was collected and kept in a stoppered cylinder at 4°C until it was tested for mosquito repellency. The volatile oil of *M. polystachyum* and *S. xanthocarpum* are pale yellow in colour, no odour and with medium viscocity.The oil yield of the *M. polystachyum* and *S. xanthocarpum* ranged from 2.0 to 2.5 ml/kg and 1 to 1.5 ml/kg, respectively. Each volatile oil was dissolved in ethanol and 4 different concentrations of *M. polystachyum* (1, 2, 3 and 4%); *S. xanthocarpum* (2, 4, 6 and 8%) were prepared.

Repellency tests

The repellency of the volatile oils were evaluated using the technique of Fradin & Day (2002) with modification. For each test, 10 disease free, laboratory - reared, unfed female mosquitoes that were between 7 and 12 days old were placed into separate laboratory cages (45 x 38 x 38 cm). Before each test, the volunteer skin was washed with unscented soap and the volatile oil being tested from the elbow to the finger tips. After the application, the subjects were not allowed to rub, touch, or wet the arm. In each cage one arm was inserted for one test concentration and the other arm treated with ethanol served as control. Each test concentration was repeated five times and in each replicate subject different volunteers were used to nullify any effect of colour of the skin on repellent.

Volunteers were asked to follow the testing protocol. Volunteers conducted their test of each concentration by inserting the treated and control arms into a same cage for one full minute for every five minutes. If they were not bitten within 20 minutes, then the arms were reinserted for 1 full minute for every 15 minutes, until the first bite occurred.

RESULTS

The results of skin repellency against the *Cx.quinquefasciatus* under laboratory condition are shown in Table 1. There were no bites by the mosquitoes for at least two hours (140 minutes) after the application of minimum concentration (1%) of *M. polystachyum* volatile oil. However, the volatile oil of *S. xanthocarpum* at minimum concentration of 2% provided less than 2 hours (102 minutes) of protection against mosquito bites. The ethanol applied arm which served as control provided maximum of 6.4 minutes protection against *Cx. quinquefasciatus*. Among the two oils, *M. polystachyum* provided repellency against *Cx. quinquefasciatus* for 332.2 minutes at 4% concentration while *S. xanthocarpum* gave 311.4 minutes protection against mosquito bites at 8% concentration. No skin irritation, hot sensations or rashes were observed on the arms of the test volunteers treated with volatile oils during the study period.

DISCUSSION

Earlier studies involving the extract obtained from various plants viz., *Ferronia elephantum*, *Curcuma longa*, *Citrus hystrix*, *Cymbopogan winterianus*, *Ocimum americanum* and *Myrica gale* at

Table 1. Protection times of volatile oil of *Moschosma polystachyum* and *Solanum xanthocarpum* against *Culex quinquefasciatus*

Plant species	Concentration (%)	Complete protection time (min)	
		Treated	Control
Moschosma polystachyum	1	140.2 ± 3.1 [a]	6.4 ± 1.0[a]
	2	208.2 ± 4.0 [b]	5.4 ± .7 [a]
	3	276.2 ± 4.6 [c]	5.4 ± .7 [a]
	4	332.2 ± 4.9 [d]	4.4 ± .7 [a]
Solanum xanthocarpum	2	102.2 ± 2.8 [a]	6.4 ± 1.0 [a]
	4	191.4 ± 3.8 [b]	6.4 ± .7 [a]
	6	258.2 ± 4.4 [c]	5.4 ± .7 [a]
	8	311.4 ± 4.7 [d]	4.4 ± .7 [a]

Each value ($\bar{X}$ ± S.E) represents the mean of five values with different superscripts are significantly different at P<0.05 level (Tukey's test of multiple comparison).

different concentration (10 to 20%) provided less than 4 hrs protection against vector mosquitoes. (Venkatachalam & Jebanesan, 2001; Tawatsin *et al*., 2001; Blackwell *et al*., 2003). However, the present study revealed that the volatile oil obtained from *M. polystachyum* and *S.xanthocarpum* exhibited repellency against mosquito *Cx. quinquefasciatus* at a very lower concentration than those of the plants studied earlier, but the repellent effect was only for 2 hrs.

The findings of the present investigation revealed that the volatile oil of *M. polystachyum* and *S. xanthocarpum* possess effective skin repellent activity against *Cx. quinquefasciatus*. The biological activity of the volatile oil might be due to the various compound, including phenolics, terpenoids, and alkaloids, that exist in plants and these compounds may jointly or independently contribute to produce skin repellent activity. Further investigations are needed to elucidate both volatile oils against a wide range of mosquito species and also the active volatile compound(s) responsible for repellent activity should be identified and utilized if possible, in preparing a commercial product/formulation to be used as mosquito repellent.

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REFERENCES

Blackwell, A., Stuart, A.E. & Estambale, B.A. (2003). The repellent and antifeedant activity of *Myrica gale* oil against *Aedes aegypti* mosquitoes and its enhancement by the addition of salicyluric acid. *Journal Royal College of Physicians Edinburgh* **33:** 209-214.

Fradin, M. & Day, J.F. (2002). Comparative efficacy of insect repellents against mosquito bites. *New England Journal of Medicine* **347(1):** 13-18.

Pitasawat, B., Choochote, W., Tuetun, B., Tippawangkosal, P., Kanjanapothi, D., Jitpakdi, A. & Riyong, D. (2003). Repellency of aromatic turmeric *Curcuma aromatica* under laboratory and field conditions. *Journal of Vector Ecology* **28(2):** 234-240.

Qui, H., Jun, H.W. & McCall, J.W. (1998). Pharmacokinetics, formulation, and safety of insect repellent N,N-diethyl-3-methylbenzamide (DEET): A review. *Journal of American Mosquito Control Association* **14:** 12-27.

Rajkumar, S. & Jebanesan, A. (2004). Mosquitocidal activities of octacosane from *Moschosma polystachyum* Linn. (Lamiaceae). *Journal of Ethnopharmacology* **90:** 87-89.

Singh, K.V. & Bansal, S.K. (2003). Larvicidal properties of perennial herb *Solanum xanthocarpum* against vectors of malaria and dengue / DHF. *Current Science* **84(6):** 749-751.

Tawatsin, A., Wratten, S.D., Scott, R.R., Thavara, U. & Techadamrongsin, Y. (2001). Repellency of volatile oils from plants against three mosquito vectors. *Journal of Vector Ecology* **26(1):** 76-82.

Venkatachalam, M.R. & Jebanesan, A. (2001). Repellent activity of *Ferronia elephantum* Corr. (Rutaceae) leaf extract against *Aedes aegypti* (L.). *Bioresource Technology* **76:** 287-288.

Walker, T.W., Robert, L.L., Copeland, R.A., Githeko, A.K., Wirtz, R.A., Githure, J.I. & Klein, T.A. (1996). Field evaluation of arthropod repellents, DEET and a piperidine compound, A13-37220, against *Anopheles funestus* and *Anopheles arabiensis* in Western Kenya. *Journal of American Mosquito Control Association* **12:** 172-176.