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SCIENTIFIC NOTES

Repellency Assays with *Schinus molle* var. *areira* (L.) (Anacardiaceae) Essential Oils against *Blattella germanica* L. (Blattodea: Blattellidae)

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Testes de Repelência com Óleos Essenciais de *Schinus molle* var. *areira* (L.) (Anacardiaceae) em *Blattella germanica* L. (Blattodea: Blattellidae)

RESUMO – Extratos de plantas têm sido utilizados como um método alternativo no controle de pragas em diversas partes do mundo. Neste trabalho foi avaliada a repelência de óleos essenciais de folhas e frutos de *Schinus molle* var. *areira* (L.) sobre machos adultos de *Blattella germanica* (L.), em teste de escolha em arena. Foram utilizados discos de papel de filtro de 9 cm de diâmetro que foram divididos em duas metades, sendo que os compostos foram impregnados em uma das metades e a outra metade foi tratada somente com o solvente. A extração de óleos essenciais foi realizada mediante a destilação de arraste com vapor de água. Cada extrato foi testado nas doses de 176, 70 e 35.38 µg/cm^2. Óleos essenciais de folhas não apresentaram atividade repelente sobre *B. germanica*. A atividade dos extratos foi comparada com o tratamento padrão à base de N, N diethyl-m-toluamide (DEET). As respostas de repelência de óleos essenciais de frutos diferiram da testemunha para todas as doses testadas. A resposta de *B. germanica* a óleos essenciais de frutos diferiu significativamente com a de DEET a 70 µg/cm^2 e 35.38 µg/cm^2. As baratas sem antenas mostraram uma redução na resposta aos compostos avaliados.

PALAVRAS-CHAVE – *Blattella germanica,* araguaraíba, repelência

ABSTRACT – Plant extracts have been used all over the world as an alternative method to control pests. In our study, essential oil extracted from leaves and fruits of *Schinus molle* var. *areira* (L.) (Anacardiaceae) was tested for repellent activity against adult males of *Blattella germanica* (L.), in a choice-test arena. Essential oil was extracted by hydrodistillation. Half of a circular white filter paper of 9 cm diameter was treated with the essential oils and the other half only with the solvents. Each extract was tested at 176, 70 and 35.38 µg/cm^2. The activity of the extracts was compared to the standard treatment with N, N diethyl-m-toluamide (DEET). The essential oil from leaves did not show repellency to *B. germanica*. The repellency response to *S. molle* var. *areira* essential oil from fruits was significantly different from the control at all doses tested. The response of the cockroaches to essential oil from fruit differed significantly from DEET at 70 µg/cm^2 and 35.38 µg/cm^2. Antennectomy of cockroaches resulted in a diminished response to the test compounds.

KEY WORDS – German cockroach, Brazilian peppertree, repellency.

In many parts of the world, plant-derived products have been used to repel or kill domestic insect pests (Omolo *et al.* 2004). Crude solvent extracts and essential oils of many plants show varying levels of insect-repellent properties (Thorsell *et al*. 1998).

Schinus molle var. *areira* (L.) (Anacardiaceae) has been considered of value for ethnobotanical uses as purgative, diuretic, parasiticide and vulnerary (Duke, 1985). The essential oil of this plant has shown significant antibacterial and antifungal activity (Gundidza 1993; Dikshit 1986, Murray *et al*. 2005).

Blattella germanica (L.) is an important medical

insect pest because of their cosmopolitan occurrence and abundance in homes and other buildings as potential carriers of faecal pathogens and major source of allergens (Chang & Anh 2001). On the other hand, they cause mechanical (chewing) and chemical (staining) damage to a variety of clothing and to stored food products. Repellents can be used in cockroach pest management as barrier treatments to protect specific areas or commodities, or as a means to make "cockroach-proof" small enclosed areas such as closets, cabinets, wall voids, and shipping crates (Appel and Mack, 1989).

The compound N, N diethyl-m-toluamide (DEET) is the common household insect repellent and has been used to repel *B. germanica* (Peterson *et al.* 2002) and other insects (Alzogaray *et al*. 2000). In the current study we describe the repellent effects of essential oil from leaves and fruits from *Schinus molle* var. *areira*. We compared the activity of essential oils with DEET. Also, we tested the effect of antennectomy on the behavioral response of adult males of *B. germanica* to doses of essential oils to intact *B. germanica*.

Leaves and ripe fruits of *S. molle* var. *areira* were collected during summer season, at Bahía Blanca, Argentina. Voucher specimen is kept in the "Herbario del Departamento de Biología, Bioquímica y Farmacia – Universidad Nacional del Sur (BBB)" under the number 10444. The essential oil was prepared by hydrodistillation using a Clevenger type apparatus for 3 h. The oils were dried over anhydrous sodium sulphate and stored at 4ºC under N_2. Essential oils used for our assays were provided by Dra. Ana Paula Murray from Instituto de Investigaciones en Química Orgánica, Universidad Nacional del Sur, Bahía Blanca, Argentina.

Adult males of *B. germanica* were obtained from a colony reared in our laboratory for several years. Male German cockroaches have been found to be more sensitive than females to olfactory stimuli (Scheffer & Dombrowsky 1992). The essential oil of fruit and leaves were dissolved in petroleum ether, and DEET (N, N diethyl-m-toluamide; 98% purity; Aldrich, Milwaukee, USA) was dissolved in acetone. A 9 cm round filter paper was cut in half. One side was treated with 0.5 ml of the test compound solution, and the other side was treated with either acetone or petroleum ether, depending upon which solvent was used to dissolve the test material. The papers were allowed to dry for 5 minutes before being placed in a 10 cm petri dish arena. Ten insects were released in the center of each Petri dish, and their distribution was recorded 24 h later. Repellency values were calculated by dividing the number of insects on the untreated zone by the total number of insects. The doses tested were 176, 70 and 35.38 µg/cm^2 for each compound solution. Each experiment was replicated 4 times. For the test that used antennectomized cockroaches, a Noyes dissected scissor was used to remove the antennae at the scape. The cockroaches were allowed to recover from the procedure for 24 h before been exposed to the test compounds by the method and concentrations outlined in the previous paragraph. Significance due to concentration was determined by using ANOVA, and means for each dose were compared by least-squared mean analysis to determine dose-response relationship. Comparison between compounds or treatments was performed by using a paired *t*-test. Significance level of all tests was $\alpha = 0.05$.

The essential oil from leaves did not show repellency. Significance due to concentration was observed by ANOVA for DEET ($F = 9.76$; df =3, 12; $P = 0.001$) and essential oils from fruits ($F = 42.21$; df =3, 12; $P < 0.001$). Repellency values were calculated and means were compared by using least-squared mean analysis. The highest concentration tested of DEET was significantly different from the control by least-squared means analysis ($\alpha = 0.05$). The response to *S. molle* var. *areira* essential oil was significantly different from the control at all doses tested (Table 1).

Table 1. Percentage repellency (± SEM) of male of *B. germanica* of DEET and *S. molle* var. *areira* essential oil from fruits in a choice-test assay.

Treatment	Dose (µg/cm^2)	% repellency ± SEM
DEET	176	100 ± 0 c
	70	75 ± 6.45 bc
	35.38	37.5 ± 16.52 a
	0	50 ± 0 ab
S. molle	176	100 ± 0 c
	70	95 ± 2.88 c
	35.38	82.5 ± 6.29 b
	0	50 ± 0 a

Mean values followed by the same letter are not significantly different by LSD mean analysis ($\alpha = 0.05$).

Paired *t*-test comparisons (df = 6) between the different compounds at equivalent doses were made. The response of the cockroaches to essential oil from fruit differed significantly from DEET at 70 and 35.38 µg/cm^2 but did not differ from it at higher doses.

Antennectomy of adult male cockroaches resulted in a diminished response to the test compounds (Table 2). In the two comparisons the response of the antennectomized cockroaches differed significantly from nonantennectomized. This indicates that the chemoreceptors involved in this behavioral response are probably located on the antennae. Similar results were obtained by Peterson *et al.* (2002) when evaluated the behavioral activity of catnip, *Nepeta cataria* L. (Lamiaceae), essential oil components to the German cockroach.

Table 2. Repellency of antennectomized and nonantennectomized males of *B. germanica* to DEET and *S. molle* essential oil from fruits.

Treatment	Dose (μg/cm^2)	% Repellency ± SEM		*t*- value
		Antennectomized	Nonantennectomized	
DEET	176	60 ± 4.08	100 ± 0	2.78*
S. molle	35.38	45 ± 11.90	82.5 ± 6.29	9.79*

* Significant by two-tailed paired *t* test at α = 0.05, df = 6.

Chirino *et al.* (2001) reported repellent effects of crude extracts from fruits of *S. molle* in neonate larvae of *Cydia pomonella* (L.) (Lepidoptera:Tortricidae). Furthermore, Ferrero *et al.* (2006) recorded that leaf and fruit extracts from this plant were highly repellent for first nymphs of *Triatoma infestans* (Klug, 1834) (Hemiptera: Reduviidae).

The results presented herein indicate that essential oil from fruits of *S. molle* var. *areira* had volatile compounds that generated an olfactory response on *B. germanica.* This oil is a promising repellent and may play an important role in reducing populations of cockroaches.

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