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URBAN SCORPION POPULATIONS AND PUBLIC HEALTH IN BRAZIL

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Abstract Intoxications due to venomous animals are considered a neglected disease in Brazil. Out of the others poisonings, scorpionism became the most important urban plague spread through different regions. Scorpions are ancient arthropods and the bio-ecological features of some dangerous species and their abilities to colonize areas under strong antropic pressure led to a great and unexpected raise in human intoxications and deaths in Brazil and other countries from the America continent. Despite many laboratory reports showing high efficacy of different chemical tools on scorpions control, there are only few and/or poor field assays on this subject. Brazilian government strategies for prevention and control are based on education, systematic capture and environmental correction. In other hand, many insecticides are registered and used for scorpions and spiders control. Private services are also available in many cities of the country. This scenario is confuse and demands rapidly efforts to alignment of actions. The present paper discuss the technical and scientific criteria to establish minimal conditions of safety and efficacy of potentials chemicals or naturals tools for scorpion control, the mandatory needing of a field protocol for evaluation of insecticides on scorpions urban population and also the positive and negative aspects of public campaigns based on interventions on human habits and culture involved on scorpion proliferation around the world.
Key words Scorpionism, public health, environmental education.

INTRODUCTION

Some scorpion species from Buthidae family represents serious public health problem in different parts of the world (Chippaux, 2008). Asia, North Africa, Middle East, South and North America are the main regions where dangerous animals from *Leiurus*, *Androctonus*, *Mesobuthus*, *Tityus* and *Centruroides* genera are responsible for thousands envenomings and hundreds of deaths every year (Borges, 1996; Chippaux, 2012). Potent neurotoxic venom and ability to occupy human modified rural and/or urban areas are common characteristics of those species considered plague (Souza, 2012). As neglected disease, few resources on research of new treatments, medicines, pesticides and control methodologies; unsecure epidemiological data, difficult access on antivenom therapy for endangered poor human population results in a complex and underestimated global scenario of scorpionism. Since the begging texts addressing scorpions control, association of environmental interventions and appliance of chemical insecticidal substances (natural or synthetic) are the main strategy frequently proposed, with different levels of success or failure (Ramsey et all, 2002; Brites-Netto and Brasil, 2012). In Brazil The criteria for selection of chemicals are the availability of insecticide, its cost, or prior experience with the use to control another pest, excluding bio-ecological aspects of scorpions (Souza, 2012). In this study our objective is to assess the applicability and reliability of laboratory methods for evaluating the effectiveness of insecticides in the chemical control of scorpions and propose their standardization, discuss the effectiveness of control initiatives based on environmental education and collecting scorpions and the general outlines of a field trial for chemical control of scorpions.

MATERIALS AND METHODS

Experimental and control groups were composed of 10 scorpions *Tityus serrulatus*. Each experiment was repeated 3 times. We used the microencapsulated insecticide lambda-cyhalothrin 10% CS (37.5 mg i.a./m^2) [as] chemical tool model. Topical toxicity assessment was in terms of Lethal Dose 50% (LD_{50}) from lethality recorded at 72 h, 168 h and 216h after application of insecticide dosages (1-25 ug/ind) fixed in a volume of 5 ul on the back of scorpions. Pre-treated (24 h) discs of filter paper (154 cm^2) and baked bricks (551 cm^2) served as substrate to evaluate the residual effect of the active principle on scorpions by exposure to continuous contact for 24 h or 168 h at T□; 30 days, 60 days and 90 days. The dislodge effect was seen as the percentage of scorpions that drops a crevice between two bricks in a given time interval (0-15 min) after application of insecticide. The results were analyzed with Student's T test, full probit analysis test and X^2. We also show the records of scorpion stings official epidemiological information system of the Ministry of Health of Brazil between 2001 and 2013.

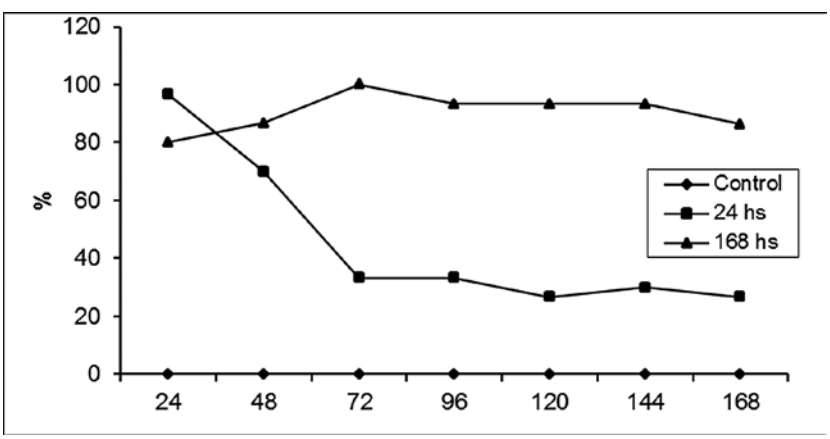

Figure 1. Filter paper impregnated with lambda-cyhalothrin 10% CS. Animals exposed for 24 h showed signs of intoxication, at 168 h lethality decays to 25% ($p < 0.05$). Scorpions exposed for 168 h continuously showed 100% lethality ($p < 0.05$).

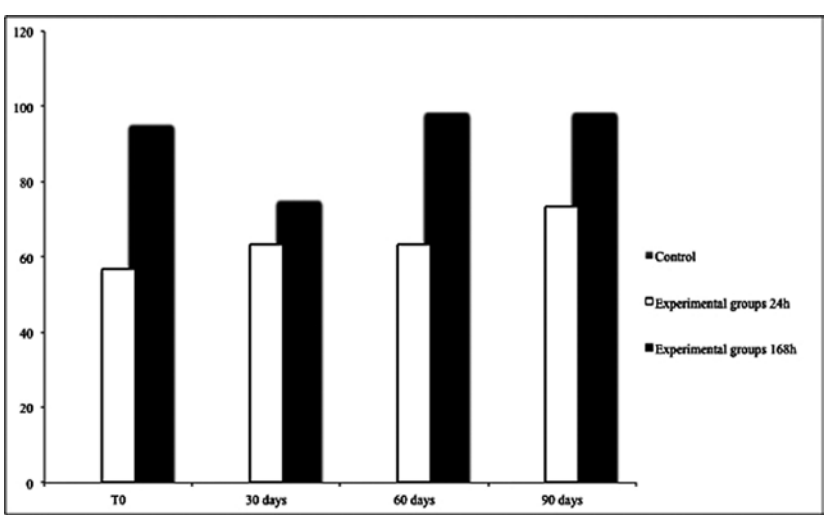

Figure 2. Bricks treated with lambda-cyhalothrin 10% CS. White bars show 168 h percentage lethality after 24 h continuous contact. Black bars show lethality for continuous exposure for 168 h to bricks.

RESULTS AND DISCUSSION

Acute Toxicity

Unlike many opinions (Brasil, 2009) *Tityus serrulatus* scorpions are highly sensitive to the insecticide tested as shown in Table 1, indicating the use of this tool for scorpions control. The animals showed

severe signs of acute intoxication and the final results in terms of mortality LD_{50} exceeded the limit of validity stated by WHO (Zaim, 2006) for control of insects with behavioral characteristics and hideaway to similar sized scorpions.

Table 1. Lethal Dose 50% of lambda-cyhalothrin 10% CS against *Tityus serrulatus* (mean weight 1.2 g, n=30). Lethal effect observed up to 216 h after treatment, indicating evidence of residual effects.

Dose	Lethality		
	72 h	168 h	216 h
1 ug/ind	4 / 30 (13.3%)	8 / 30 (26.6%)	11 / 30 (36.6%)
5 ug/ind	9 / 30 (30.0%)	15/ 30 (50.0%)	17/ 30 (56.6%)
25 ug/ind	19/30 (63.3%)	24/ 30 (80.0%)	26/ 30 (86.6%)
Lethal Dose 50% (probit analysis test)	13.00061 µg/ind (0.01083 µg/mg)	4.305473 µg/ind (0.00358 µg/mg)	2.498498 µg/ind (0.00205 µg/mg)

Treated Surfaces

Tests for different surface treatment (Figures 1, 2) showed that the habits of rest and shelter of the scorpion *Tityus serrulatus* allow contamination of its bodily surface with concentrations of insecticide capable of inducing lethality. The differences observed between the groups exposed for 24 h or 168 h to the treated surfaces (bricks) indicate that lethality is proportional to the contact time with the active ingredient, indicating the formulation and persistence of a product as essentials to effective scorpion control.

Dislodge Effect

The dislodge effect of insecticides used to control scorpion is extremely important due to urban feature of this public health problem. Our results, shown in Figure 3 indicate that the active principle tested induces important level of dislodge effect, however 24 h all scorpions that left the slit or not were dead.

While conducting the experiments, animals exposed to low doses of the insecticide tested showed signs of detoxification and full recovery after up to 216 h, indicating the quality of correct dosage of the application as critical to the effectiveness of an insecticide to control scorpions. In tests with other insecticides, scorpions showed “high heels” behavior indicating the capacity of the sensory system to perceive the treatment and prevent intoxication of the animal. The irritant effect is really a major concern in planning strategies for chemical control of scorpions, as it may aggravate the problem in very dense urban areas. All results in the laboratory indicate the use of insecticides for control of scorpions, after due execution of large field trial.

The initiatives of scorpion control based on environmental intervention, environmental education and collecting consolidated and implemented since 2009 in Brazil, have not yet shown the ability to influence the crescent curve of scorpionism in the country (Figure 4). Perhaps this maybe explained by the high and fast rate of parthenogenetic reproduction of the main problem species, *Tityus serrulatus* and *Tityus stigmurus* and the high operating costs of maintenance teams for systematic collection of these animals, as proposed in the National Program for Scorpion Control. Another important point is the high colonizing ability of these species in areas with high standard of urbanization and income

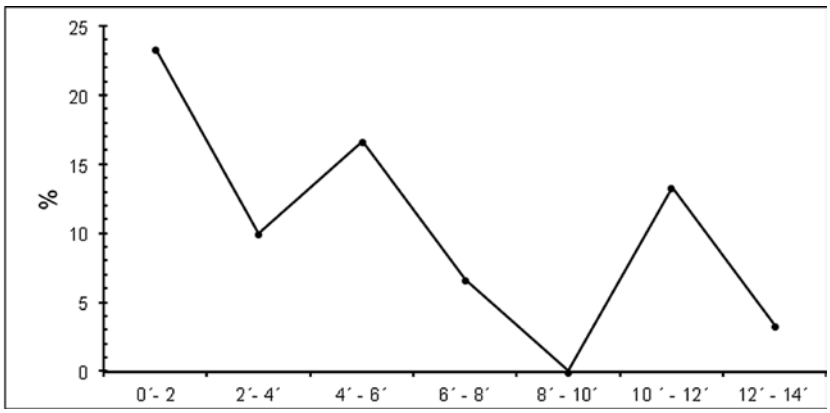

Figure 3. Dislodge effect of lambda-cyhalothrin 10% CS on T. serrulatus scorpions. In 15 min, about 70% of the animals left the crevice after application of insecticide. 100 % lethality after 24 h.

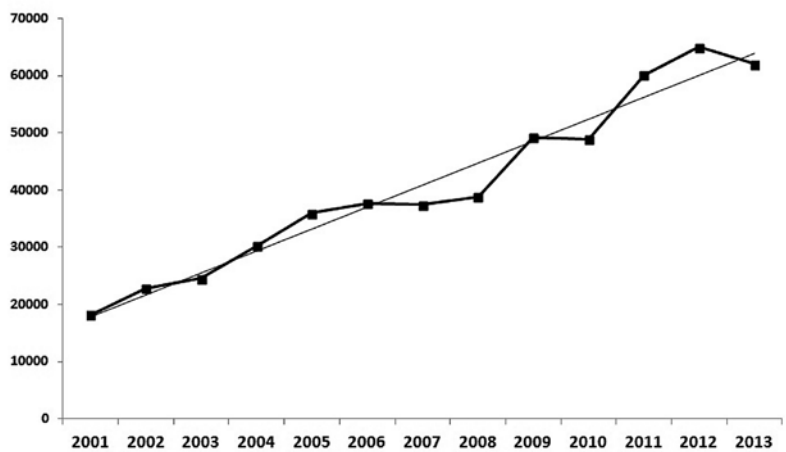

Figure 4. Evolution of the epidemiology of scorpions stings recorded by Ministry of Health from Brazil 2001-2013.

(Brites Neto and Galassi, 2012; Fernandes, 2012), indicating that only measures of environmental correction are not able to make the environment inhospitable to such animal. The justified fear of broad indication of insecticides to control scorpions in Brazil, should be the need for careful evaluation methodologies in the field of application, suitable formulations, schedules, statistical models and effects of candidate insecticides on behavior of urban populations of scorpions, environment and human population health exposed as the Mexican experience (Ramsey, 2002; Conyer, 2003), since the actual indications of the manufacturers for insecticide use in scorpions control, is based only on the known behavior of theirs products to control pests with very different biological characteristics of scorpions.

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