Control of Household Pest Red Imported Fire Ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae) Using Herbal Extracts

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Abstract:

The laboratory experimental evaluation of the leaves of commonly occurring plants like Azadirachtaindica (Neem), Ipomoea carnea (Beshram), Vitexnegundo (Nirgudi), Tridaxprocumbens (Kambarmodi) and Pongamiaglabra (Karanj) shows highest toxicity and repellent activities against household insect pest, red fire ant, Solenopsisinvicta. The red fire ants are found everywhere mainly attacked on flour, grains and sweet food products. The fumigants mixture of 20 % methanolic plant extract of Vitexnegundo (Nirgudi) resulted in highest mortality rate and repellent activity during the experiments. The mortality rate with the increasing concentration of plant extract compared with the commercial bioformulation, 0.02 % Lindane. The evaluation of experimental data revealed that herbal extracts of Azadirachtaindica (Neem), Ipomoea carnea (Beshram), Vitexnegundo (Nirgudi), Tridaxprocumbens (Kambarmodi) and Pongamiaglabra (Karanj) are the plants species synthesized numerous volatiles known to exhibit toxic, insecticidal, repellent and diverse pest control properties against the household pests. These herbal extracts contains the alkaloids, phenolics, glycosides and tannins types of defensive chemical compounds when mixed with methanol effects on the insect feeding and unpalatable to the insects.

Keywords: *Herbal extract, toxicity, phenolic, red fire ant, Solenopsisinvicta*

Introduction:

The heavy usage of pesticides created a great concern on environment especially in case of household control of pests left higher level of insecticide residues and led the environmental problems including health hazards to humans. These chemical insecticides find maximum residues limits in the samples of milk, cattle drinking water, fodder and feed collected from cattle colony (Parveen and Masud, 1992). Awareness regarding the food safety has increased the demand for organically produced food, which necessitates evaluating the performance of herbal based pesticides as safer alternatives to conventional insecticides (Faheem Akbar *etal.,* 2010). The chemicals used as fumigants are extensively mixture of organo-phosphate (OP), Methyl bromide, added as a synergist but it is restricted due to its potential ozone depleting properties. So in the present study the mortality rate of five different herbal extracts against household insect pest, red fire ant, *Solenopsisinvicta* was tested by *Azadirachtaindica* (Neem), *Ipomoea carnea* (Beshram/sadafuli), *Vitexnegundo* (Nirgudi), *Tridaxprocumbens* (Kambarmodi) and *Pongamiaglabra(Karanj)* having diverse pest control properties (Kadu*et al.,* 2010). These plants contains the alkaloids, phenolic, glycosides and tannins types of chemical defensive compounds when mixed with alcoholic groups becomes unpalatable to the insects and effects on the insect feeding (Amritraj and William, 1999). Whereas the application of these herbal pesticides extract is limited due to the instability which needs its application at short time intervals. The chemical compounds contains in some herbal extracts act as the toxins and repellent to kill the insects pests. The herbal methanol formulations being as a safer alternative to the synthetic insecticides act as eco-friendly products. Plant extracts contain compounds that show ovicidal, repellent, antifeedant, sterilization and toxic effects in insects (Nawrot and Harmatha, 1994; Isman, 2006). The toxicity may be by contact, ingestion or through fumigant action where the specific compounds isolated from plant extracts contains essential oils having fumigant activity. Tests have also been carried out with pure compounds obtained from commercial sources (Lee *et al.*, 2003a) or synthesized in the laboratory (Peterson *et al.*, 2000; Park *et al.*, 2004). Most of the active ingredients are secondary metabolites secreted in plants as chemical defence against pest organisms. Certain anomalies in fumigant toxicity tests with plant essential oils components have been noted (Auger *et al.*, 1999). In most of the investigations, the adult

stage alone was tested. It is well known that for fumigants, the active stages (adults and non-diapausing larvae) of insects are more susceptible than the sedentary stages (eggs and pupae) due to differences in their respiratory rate (Tripathi *et al.*, 2003). There have been numerous research studies conducted at laboratory level on plant products as fumigants against household insect pests besides toxicity tests, attention has been focused to elucidate their mode of action in insects(Ware, 2000). The purpose of this study was to evaluate the toxicity of the above herbal extracts as an organic formulations to control red imported fire ants *S. Invicta*.

Material and Method:

The fresh leaves of the five plants *Azadirachtaindica* (Neem), *Ipomoea camea*(Beshram/sadafuli),*Vitexnegundo* (Nirgudi), *Tridaxprocumbens* (Kambarmodi) and *Pongamiaglabra(Karanj)* were chopped in to small pieces with a knife and dried in shade (Fig. 1). These dried pieces were then grounded in grinder to make coarse powder. The 5 mg of each plant powder packed and processed in Soxhlet Apparatus using 100 ml methanol as stock solvent. The extracted methanolic plant extractspowderdissolved in methanol to prepare five formulations 5%, 10%, 15 %, and 20% formulations as the working formulation.The set of 30 adult life stages of the household pest, red fire ant, *Solenopsisinvicta*collected in the separate glass containers to check the % mortality at interval of of 24, 48 and 72 hours under Potter's Tower (Fig. 2). Each set was tested and compared with control set (treated with water) and a conventional synthetic insecticide Lindane powder as check in aqueous 0.02% formulation
The treated drowsing adults were also considered as dead.The observed mortality percentage was transformed to corrected mortality percentage as per Abbott's formula (1925) as mentioned below: **P =**

$$\textbf{Corrected mortality \%} = \frac{T-C}{100-C} x100$$

Where, $T = \%\ mortality\ in\ treatment$
$C = \%\ mortality\ in\ control$
$P = \%\ Corrected\ mortality$

Results and Discussion:

In the present study the methanolic leaves extractsusing five different plants viz., *Azadirachtaindica* (Neem), *Ipomoea camea(*Beshram/sadafuli),*Vitexnegundo* (Nirgudi), *Tridaxprocumbens* (Kambarmodi) and *Pongamiaglabra(Karanj)* were tested and applied viz. 5%, 10%, 15 %, and 20% formulations against red fire ant,*Solonepsis Invicta*(Fig.-1).The corrected mortality obtained after treatment of methanolic extracts compared with the Check synthetic insecticides 0.02%Lindanepowder with emphasis on their residual determination. The greenhouse trials revealed that these formulations are acts as stomach and contact toxins with higher antifeedent and repellent activity with suppressive oviposition rate. The highest methanolic herbal extracts at 20% formulation of *Vitexnegundo*(Nirgudi)shows maximum toxicity and mortality rate followed by *Azadirachtaindica* (Neem)as compared to others plants leaves extracts (Table-1).So these extracts can provide a reasonable level of control against population of household pests, red fire ant,*Solonepsis Invicta*and also will work as a short-term repellent and feeding deterrent.

Table. 1-

S.no.	Plant Extracts	% Mortality/hour			
		5%	10 %	15 %	20 %
1.	*Vitexnegundo* (Nirgudi)	30.25	53.52	85.25	98.55
2.	*Azadirachtaindica*(Neem)	27.32	74.45	82.35	95.88
3.	*Ipomoea carnea*(Beshram or sadabahar)	25.6	45.32	80.55	88.90
4.	*Tridaxprocumbens* (Kambarmodi)	24.67	48.55	60.32	75.45

5.	*Pongamiaglabra* (Karanj)	20.22	23.35	52.55	65.22
6.	Check-I / Lindane	25.44	55.42	80.22	85.44
7.	Control	00	00	00	00

(P<0.001)

Figure.1

Figure.2

As a vital part of Integrated Pest Management (IPM) high percent of all poisoning cases occur due to use of pesticides in developing countries causing harmful effects on human health (Soomro*et al.,* 2008) and the non-target organisms and ultimately pollute the environment (UNDP, 2001). While the plant based pesticides are degradable and safe for human being biorational (low risk) insecticide with residues under MRLs it could also be a remarkable tool for managing the control of different household pests (USDA, 2002).The conventional insecticides have not only distressed the agro-ecosystem but also cause the chronic pesticide poisoning like disorder of immune functions, peripheral neuropathies and allergic reactions, principally of skin, which ultimately led to cancer risk (UNEP, 1993). Scientists and environmental toxicologists have investigated different groups of insecticides including*Boric powder, BHC, Endosulfan*and*Lindane* to control the household pests so far, for their toxic end points which involved different health related problems such as cardiovascular disorders and hypertension, (Chandra *et al.*, 1992). The herbal pesticides particularly with alcoholic groups affects adversely on the insect development and reproduction due to antefeedent as well as repellent activity resulting into permanent control of the pest (Cutler, 1985; Faheem Akbar *etal.,* 2010). From the result analysis the higher % mortality rate revealed after 72 hour at 20 % in following order of *Vitexnegundo* (Nirgudi), *Azadirachtaindica*(Neem), *Ipomoea camea*(Beshram or sadabahar), *Pongamiaglabra* (Karanj), and *Tridaxprocumbens* (Kambarmodi) (Pande*et al.,* 1983; 1987 and Garrett, 2001) as the household herbal pesticides against household pest imported red fire ant,*Solonepsisinvicta.*

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