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Studies on mosquito larvicidal efficacy of indigenous plant extracts

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Abstract: *The larvicidal activity of methanol extracts of 18 indigenous plant extracts were studied against 3 species of mosquito larvae. Among these, rhizome extract of Acorus calamus was found to have the most promising larvicidal activity against Aedes albopictus and Anopheles culicifacies with LC_{50} (0.03), LC_{90} (0.12) and LC_{50}(0.02), LC_{90} (0.89) respectively whereas Cimicifuga foetida Bugbane extract is more effective Culex. quinquefasciatus LC_{50} (0.12) and LC_{90}(1.78). This extract is also equally effective against larvae of Aedes albopictus and Anopheles culicifacies. Artemisia annua extract is very effective against all the three of mosquito larvae. The extract of Gynandropsis gynandra is equally effective against the larvae of Aedes albopictus LC_{50} (0.22), LC_{90}(0.36) and Anopheles culicifacies LC_{50}(0.82), LC_{90}(1.01). The Ocimum basilicum leaves extract found to be least effective against larvae of Aedes albopictus LC_{50} (255.13), LC_{90} (413.55), Anopheles culicifacies with LC_{50} (302.66), LC_{90} (527.13) and Culex. quinquefasciatus LC_{50} (324.22) and LC_{90}(490.23). However plant extracts were found more effective against Aedes albopictus, Anopheles culicifacies and Culex. quinquefasciatus.*

Key Words : Plant extract, Mosiquito larvae,

Introduction

Mosquito spreads deadly diseases such as malaria, filariasis, dengue, yellow fever and Japanese encephalitis. These are major health problems for infants to adult human beings (Vatandoost and Vaziri, 2004; Das and Ansari 2003. Once the adult mosquito is developed and flies in the air, it very difficult to go after it and destroy it. The best way of mosquito control is to destroy it in the larval stage. The advantage of biological larval control agents in comparison with chemical controls can include their effectiveness at relatively low doses. The parasite and vector have developed physiological resistance against available drugs and insecticide. The plant products are less deleterious to human beings and non target wild life, in manufacturing, handling and application. Low cost of production especially in developing countries have been developed were no safe alternative methods are available, there is lower risk of resistance development. More than 2000 species of plants are known to possess insecticidal properties. Before the discovery of synthetic organic insecticides the natural plant origin insecticides were in use for the control of mosquito such as nicotine obtained from tobacco leaves, *Nicotiana tabacum*, (Campbell *et. al.*, 1993). The alkaloids extracted from Russian weed, *Anabanis aphylla*, *rotenone from Derris elitica* and pyrethrums from *Chrysanthemum cinereriaefolium* flower (Jacobson and Crosby, 1971). India is very rich in flora to have promising medicinal properties. Many other plant based products are widely used for their larvicidal/repellent properties for control of mosquito larvae in water/ protection from mosquito bites. A number of plant extracts were treated as mosquito repellent and as insecticidal activity such as *Azadirachta indica, Ocimum basilicum, Citrus rossa, Allium sativum, Annona squamosa, Polyalthia longifolia, Tagets errecta, Mentha piperita,*

Cymbopogam spp, Dalbergia sisoo Roxb, Solanum nigram Lin, Lantanacamara, Ageratum conyzoides etc (Hartzell and Wilcoxon, 1941). Only a very few plant products have shown good results for mosquitoes control in the laboratory as well as under field conditions. One of the most commonly studied plant is (neem plant) *Azadirachta indica* for the mosquito control.

Materials and Methods

Plant material collected from Kanpur, Uttar Pradesh and different parts of India were segregated as leaf, twig, flower, tuber, root, etc. Plant and plants parts were identified at NBRI Lucknow UP. Plant materials were air dried in a shady place to retain their active compound intact. Dried materials were powdered in grinder for extraction and each of the powdered plant material (500 gm) was soaked in methanol in an airtight wide mouthed bottle and kept for ten days. Extracts were filtered and kept in petri dishes for drying at room temperature. The average yield of crude extract (500 gm) of powder was 2 gm. Dried powered extracts material were used for larvicidal bioassay. Stock solutions were prepared by dissolving plant extract (1 gm) in water (1L) to make its strength 1000 ppm and Triton (1 ppm) was also added as emulsifying agent. Different concentrations were prepared by adding required doses of stock solution in beakers (250 ml).

Larvae of *Aedes albopictus, Anopheles culicifacies and Culex. quinquefasciatus* were collected from Kanpur city and their larvae were reared in the department of Zoology DAV. Post Graduate College Kanpur. They were used for larvicidal bioassay under laboratory conditions (27 ± 2 °C and 80 ± 5 % RH).The larvae were fed on a powdered mixture of dog biscuits and yeast tablets in the ratio of 1:3. The emerged adults were fed with goat blood with 10% glucose solution. Twenty five mosquito larvae of fourth instar were released in each beaker for 24 h with a concurrent control for every set of experiment. Three replicates were kept for each concentration. No food was added in the beaker and mortality was recorded after 24 h of treatment and mortality was corrected by Abbot's formula. Data were analysed by probit analysis.

Results and Discussion

From the Table 1 it is clear that eighteen plants were taken under the test against three species of mosquitoes. These plants belong to fourteen families. On the basis of LC_{50} these may be divided in to three groups viz', (i) Active group i.e., having LC_{50} less than 10 ppm, (ii) moderate group i.e., having LC_{50} between 10 and 50 ppm, (iii) Inactive group i.e., having LC_{50} more than 50 ppm.

(i) Active group : This group contained Acorus calamus, Cimicifuga foetida bugbane, Vitex negundo, Gyanan drophis gynandra, Artemisia annua, melia azedarach and Abrus precatorius having their efficacy in descending order against the larvae of *Aedes albopictus*. Their LC_{50} varied from 0.03 to 6.22 ppm.

The extracts of these plants was also found very effective against the larvae of other two species of mosquitoes *Anopheles culicifacies* and *Culex quinqulfasciatus,* but the order of their efficacy was slightly changed. Acorus calamus was found most effective against the larvae of *Aedes albopictus* and *Anopheles culicifacies*, while Cimicifuga foetides bugbane showed most effective response followed by Artemisia annua against the larvae of *Culex quinquefasciatus*.

(ii) Moderate Group : In this group the sausuria lappa (LC_{50}=12.62ppm) was found very effective against the larvae of *Aedes albopictus* and it was followed by *Nyethanthes arbour tristislium, Centrathrum anthelminticum* and *Acatcia catechu* showing LC_{50} value as 12.75, 15.12 and 15.14, respectively.

Table.1 Efficacy of Plant Extracts on Mosquito Larvae

S. No	Name of Plant	Name of Part	Aedes albopictus			Anopheles culicifacies			Culex. quinquefasciatus		
			LC_{50} ppm	LC_{90} ppm	Regression equation	LC_{50} ppm	LC_{90} ppm	Regression equation	LC_{50} ppm	LC_{90} ppm	Regression equation
1	*Abrus precatorius*	Leave and Stem	6.22	16.37	Y=0.692x +3.452	5.31	14.72	Y=1.742x +2.452	4.86	14.32	Y=0.652x +3.459
2	*Acacia catechu*	Leave and Stem	15.14	14.47	Y=1.503x +2.516	6.21	18.37	Y=2.541x +3.476	8.32	19.48	Y=2.937+ 6.283
3	*Acorus calamus*	Rhizome	0.03	0.12	Y=0.685x+ +2.792	0.02	0.89	Y=0.753x +1.582	1.48	3.65	Y=0.625x +2.737
4	*Artemisia annua*	Leave and Stem	1.05	2.76	Y=0.993x +7.553	0.99	3.11	Y=0.893x +3.571	1.40	2.93	Y=0.723x +5.432
5	*Centratherum anthelminticum*	Leave and Stem	15.12	37.24	Y=1.86x +8.983	13.28	40.26	Y=1.924x +6.582	19.37	54.56	Y=1.258x +3.455
6	*Cimicifuga foetida bugbane*	Leave and stem	0.05	0.12	Y=0.458x +2.249	0.03	0.98	Y=0.123x +8.462	0.12	1.78	Y=0.253x +2.459
7	*Cyprus rotundus*	Leaves	152.3	274.61	Y=3.246x +3.767	115.76	274.11	Y=4.653x +7.455	164.44	290.43	Y=5.136x +1.951
8	*Dolichos biflorus*	Leaves	171.12	310.20	Y=2.954x +6.524	218.39	531.92	Y=6.523x +9.239.	238.36	428.66	Y=6.995x +2.568
9	*Embelia ribes Burm*	Leave and stem	15.63	27.44	Y=1.521x +2.541	40.43	72.56	Y=1.305x +6.524	28.27	54.13	Y=1.926x +1.240
10	*Fern*	rizome	190.71	300.17	Y=4.291x +7.209	360.38	615.27	Y=5.049x +5.490	340.32	728.22	Y=4.952x +7.511
11	*Gynandropsis gynandra*	Leaves Stem Root	0.22	0.36	Y=0.203x +5.650	0.82	1.01	Y=0.312x +6.412	2.13	5.99	Y=0.394x +4.527
12	*Marsdemia tenaeissima*	Leave and Stem	82.76	150.22	Y=1.757x +2.512	121.34	190.58	Y=1.995x +5.321	170.75	290.35	Y=2.013x +2.351
13	*Melia azedarech*	Leaves	2.93	5.11	Y=0.829x +3.512	1.92	3.77	Y=6.623x +6.235	390.02	14.51	Y=0.952x +3.576
14	*Momordica charantia*	Leave and Stem	181.7	315.73	Y=4.588x +2.332	205.63	397.54	Y=4.952x +3.761	190.29	321.78	Y=3.992 +9.541
15	*Nyethanthes arbour-tristislium*	Leave and Stem	12.75	20.08	Y=0.979x -1.952	11.23	30.82	Y=1.237x -2.672	10.73	29.18	Y=1.531x -7,542
16	*Ocimum basilicum*	Leave and Stem	755.13	413.55	Y=3.352x -2.442	302.66	527.13	Y=7.925x -3.542	324.22	490.23	Y=7.840x -6.455

The order of efficacy of plant extract in descending order against the larvae of *Anopheles cuticifacies* : *Nuethanthes arbour – Tristislium, Cetratherum anthelminticum, Sausurea lappa* and *Embilia ribes* having the LC_{50} values as 11.23, 13.28, 27.34 and 40.43 ppm, respectively.

Against the larvae of *Culex quanquefasciatus* the order of efficacy of plant extracts in descending order was as : *Nyenthanthes arbour – tristislium, Sausurea lappa, Centratherum anthelminticum* and Embilia ribes showing the LC_{50} values as 10.73, 19.25, 19.37 and 28.27 ppm, respectively.

(iii) Inactive group : The remaining plants viz, *Cyperus rotundus, Fern, Marsdemia, Momordica, Ocimum basilicum and Dolichos, biflorus* showed that the LC_{50} varied from 82.76 in case of *Marsdemia tenaeissima* against the larvae of *Aedes albofictus* to 755.13 *Ocimum basilicum.*

In the present study, the leaf extract of *Melia agedarach* was found to be very effective against the larvae of *Aedes albopictus* and *Anopheles culicifacies* but less effective in lower concentration against the larvae of *Culex quinque fasciatus.*

In our findings the rhizome extract of Vitex negundo was proved to be very potential for killing the larvae of all the three species of mosquitoes under the test. Similarly have noted that the leaf extract of *Vitex negundo* at very low concetnration had larvicidal activity against *Culex quinqulfasciatus* and *Anopheles stephene.* The various plant extracts also have been reported to be toxic against the larvae of mosquitoes by various scientists Sujatha *et al.* (1998) Sharma and Srivastava (1998) and Latha *et al.* (1999). Singh *et al.* (2002) have found the larvicidal properties of leaf extracts of solanum nigrum have studied the effect of methanol extracts of nineteen indigenous plants as mosquito larvicides. Among these, pericarp of *Zanthoxylum limonella* was found to have most effective larvicidal properties against *Aedes (s) albopitus* and *Culex quinquefasciantus* with LC_{90} values at 0.47 ppm and 0.73 ppm, respectively. Kim *et al.* (2002) studied the larvicidal efficacy of Australian and Mexican plant extract against *Aedes aegypti* and *Culex pipiens pallens* and Rahuman *et al.* (2008) also studied the efficacy of five cucurbitacious plant leaf extracts against mosquito species and found good larvicidal effect.

Biopesticides of plant origin being indigenous resources to minimize loss in ecosystem as they are non toxic to mammalians and the create no adverse effect on growth viability, less expensive and easy to handle.

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