Evaluation of Larvicidal actvity of perennial herb *Solanum xanthocarpum* against vectors of malaria and dengue in Dehradun, Uttarakhand.

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Abstract

Larvicidal efficacy of the aqueous and methanol extracts from fruits and roots of the plant Solaum xanthocarpum was evaluated against Anopheles culicifaces, An. stephensi and Aedes aegypti, the important mosquito vectors prevalent in the Uttarakhand state. Studies were carried out on late 3rd or early 4th instar larvae of these species using standard WHO technique. Based on concentration mortality data LC_{50} and LC_{90} values along with their fiducial limits, regression equation , chi-square heterogeneity of the response have been determined by log probit regression analysis.The24 hr LC_{50} values as observed for fruits were 0.112, 0.058 and 0.052 for Anopheles culicifacies, An. stephensi, and Aedes aegypti respectively.

***Key words**: Larvicidal, Solanum xanthocarpum, vector mosquitoes, Anopheles*

Introducton;

Mosquitoes are of very great importance to man as vectors of dreaded huma disease such as malara, filaria, dengue and dengue hemorrhagic fever etc. *Anopheles culicifaces, An. stephensi* and *Aedes aegypti* are common vector species of mosquitoes in this region. Hence, their control is essential. The use of different parts of locally available plants and their various products in the control of mosquitoes has been well established (Evans and Kaleysa,1988). The use of chrysanthemum flower heads and tobacco leaf smoke was known to people since ancient times. A number of unsaturated N-(2-methyl propyl) amides with larvicidal activities have been reported from the plants of families Compositae, Piperaceae and Rutaceae(Jacobson, 1971). Studies on azadi-rachtin-rich fractions from neem (Raghunath et al., 1988) and water extracts of de-oiled neem kernel (Singh, 1984) reveal the larvicidal properties of different fractions of these plants. The larvicidal properties of indigenous plants have also been documented in many parts of our country (Deshmukh et.al., 1982), along with the repellant and anti-juvenile hormone activities (Saxena et al., 1992). *Solanum xanthocarpum*, the Indian night-shade, commonly known as 'baigan kateli', is found throughout the country, but more abundantly in arid areas. The plant is known to have multiple medicinal properties(Govindn et al.,(1999) and the extracts of various parts have been used against agricultural pests as repellant (Hussain, 1995) and contact poison (Pandey et al., 1980) and as molluscicide in public health. However, studies against the pests of public-health importance are totally lacking. In the present study, the extracts of different parts of the plant have been evaluated against the larvae of important vectors of malaria and dengue, and the findings are summarized here.

Materials and Methods

For evaluating the larvicidal activity of *S. xanthocarpum*, the crude extracts of fruits and roots from the fresh plants were collected from the fields. For obtaining the fruit extract, the unripe ber- ries of the plant were used. For extracting the fruit extract the pulp of the berries was weighed, blended and finally centrifuged. The supernatant so obtained was used as stock solution, from which the serial dilutions according to requirements, were prepared in distilled water for experimentation. The root extract was also prepared following a similar method. Concentrations between 0.001 and 10.0% were tried initially, but after subsequent experiments the final concentrations of the extracts of different parts were determined to obtain graded-mortalities of tested mosquito species. The concentrations of fruit extract between 0.01 and 0.6% against the larvae of *Anopheles culicifacies*, between 0.005 and 1.0% and *Anopheles stephensi*, against between 0.005 and 1.0% against *Aedes aegypti* were finally considered for evaluating the efficacy. In case of root extract, concentrations between 0.1 and 6.0% were used against all the three mosquito species.

Table 1 : Concentration mortality response data of fruit and root extracts of S. xanthocarpum against three mosquito vector species

Extract/Mosquito species	Concentration (%)	No. exposed	No dead	Percentage mortality*
Fruit extract				
An. culcifacies	0.0 0.05 0.01 0.4 0.6	65 70 62 52 75	00 08 26 51 75	00.0 11.14 41.9 98.1 100.0
An. stephensi	0.005 0.01 0.05 0.1 0.5 1.0	70 64 81 86 80 75	00 07 37 58 72 75	00.0 10.9 45.7 67.4 90.0 100.0
Ae. aegypti	0.005 0.01 0.05 0.1 0.5 1.0	60 70 66 75 80 70	00 08 35 50 78 70	00.0 11.4 53.0 66.6 97.5 100.0
Root extract				
An. culicifaceis	0.1 0.5 1.0 2.0 4.0 6.0	75 115 105 115 125 106	00 15 43 93 116 106	00.0 13.0 40.9 80.9 92.8 100.0
An. stephensi	0.1 0.5 1.0 2.0 4.0 6.0	100 140 165 155 145 125	00 21 74 129 136 125	00.0 15.0 44.8 83.2 93.8 100.0
Ae. aegyti	0.1 0.5 1.0 2.0 4.0 6.0	80 80 80 80 80 80	00 08 42 58 74 80	00.0 10.0 52.5 72.5 92.5 100.0

* No mortality was observed in control

The experiments were conducted according to WHO methods(WHO, 1975). The larvae used in the experiments were laboratory reared. Tests were conducted during the month of September. In the experiments, the late third and early fourth instar larvae of *An. culicifacies*, An. *stephensi* and *Ae. aegypti* were used. Observations were made after 24h. In case of individual species, three to four replicates were performed for each concentration. For each species, against a particular extract, six concentrations were used to obtain concentration mortality data, for deter mining the lethal concentrations at LC_{50} and LC_{90} levels by log-probit analysis (Finney, 1972). Laboratory temperature and relative humidity during the experiments were recorded 27±2°C and 60±5% respectively.

Result and Discussion:

The results of the tests conducted for evaluating the larvicidal efficacy of fruit extract of *S. xanthocarpum* revealed that the extract has larvicidal activity against two tested anopheline species, viz. *An. culicifacies* and *An. stephensi*, and one culicine species *Ae. aegypti*. Data on the concentration mortality response of fruit extract are given in Table 1. The lethal concentrations of fruit extract at LC_{50} and LC_{90} levels against *An. culicifacies*, *An. stephensi* and *Ae. aegypti* were determined as 0.112 and 0.258, 0.058 and 0.289 and 0.052 and 0.218% respectively (Table 2).

Table 2 : Log-probit analysis of larvicidal efficacy of fruit and root extracts of *S. xanthocarpum* against different mosquito vector species

Extract/ mosquito	Regression coefficient	Regression equation	Chi-square (df)	LC_{50}* with fiducial limits	LC_{90}* with fiducial limits
Fruit extract					
An. culicifacies	3.56	Y= -2.29+3.56X	0.06 (4)	0.112 (0.090-0.141)	0.258 (0.166-0.400)
An. stephensi	1.84	Y=1.74+1.84X	0.90(4)	0.058 (0.041-0.084)	0.289 (0.156-0.535)
Ae. aegypti	2.04	Y=1.50+2.04X	1.73(4)	0.052 (0.036-0.073)	0.218 (0.120-0.397)
Root extract					
An. culicifacies	2.87	Y=-3.80+2.87X	0.88(4)	1.160 (0.950-1.417)	3.237 (2.215-4.732)
An. stephensi	3.11	Y=-4.43+3.11X	0.34(4)	1.080 (0.915-1.275)	2.789 (2.056-3.784)
Ae. aegypti	2.59	Y=-2.94+2.59X	3.14(4)	1.150 (0.893-1.481)	3.581 (2.281-5.621)

* Values of LC_{50} and LC_{90} are percentages of fruit and root extracts.

Tests conducted for evaluating the larvicidal activity of root extract against anopheline and culicine mosquito species revealed that this extract also has larvicidal properties, though at higher concentrations in comparison to fruit extract. Data on concentration-mortality sponse of root extract are given in Table 1. The LC_{50} and LC_{90} values against An. culicifacies, An. stephensi and Ae. aegypti were determined as 1.160 and 3.237%, 1.080 and 2.789% and 1.150 and 3.581% respectively (Table 2).

It is clear from the data obtained that fruit extract was 12.5, 9.7 and 16.4 times more toxic than root extract to *An. culicifacies*, *An. stephensi* and *Ae. aegypti* respectively, at LC_{90} level. However, at LC_{50} level, the corresponding values were 10.4, 18.6 and 22.1 respectively. The chi-square test values revealed that none of the tested anopheline species has significant heterogeneity in the population. The result of the present study are similar with the study done by Bansal ad Singh (2004), Lalit et al., (2005), Bansal et al., (2009a and 2009b).

Results of the experiments envisaged larvicidal property in both fruit and root extracts of *S. xanthocarpum*. As the plant is distributed throughout the country and the fruits are available most of the time, the larvicidal properties of this plant species can be well utilized while planning alternate vector control strategies, based on integrated vector control measures through community-based approaches. The plant is easily available to the local people and being an ayurvedic herb with multiple medicinal properties (Govindan et al., 1999 and Gupta et al., 1966), it may be easily acceptable to them, since during application it would neither cause any toxic effect nor any additional economic burden. The study suggests that the active ingredient(s) of the extract responsible for causing mortality in mosquito larvae should be identified and utilized, if possible, in preparing a commercial product/formulation to be used as a mosquito larvicide.

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