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# LARVICIDAL EFFICACY OF *SCINDAPUS OFFICINALIS* AGAINST *AEDES AEGYPTI*, A DENGUE FEVER VECTOR

**P. Sreedev, K. Misvar Ali, and E. M. Aneesh**♦

*Abstract*: The larvicidal efficacy of petroleum ether extract of *Scindapus officinalis* against the fourth instar larvae of *Aedes aegypti* was studied. Insecticidal susceptibility tests were done according to WHO standard procedure and the mortality was observed after 24 hours of exposure. The extract showed potential larvicidal efficacy with $LC_{50}$ value of 3.18 mg/L. This is a pioneer attempt to explore the larvicidal activity of this plant. The petroleum ether extract of its fruit showed potential larvicidal efficacy even at very low concentrations. Further, the biochemical mechanism and mode of action are under investigation and warrants extensive study. The development of an effective eco-friendly mosquitocide of plant origin may reduce the risk of wide use of synthetic insecticides as mosquito control agents.

*Keywords*: *Aedes Aegypti,* Eco-Friendly, Herbal Insecticide, Larvicidal Activity, Mosquito Control, *Scindapus Officinalis*.

## 1. Introduction

*Scindapus officinalis* is one of the plants used in traditional Indian system of medicine which belongs to the family Araceae. It is common in the Midnapore district of West Bengal and cultivated for its fruit, which is cut into transverse pieces, dried and used only medicinally. It is found all along the sub-Himalayan tract between the altitudes of 330-1000 m. Fruit is used as raw drug in both Ayurvedic and Unani systems of medicine. The fruit of

♦**P. Sreedev, K. Misvar Ali, and E. M. Aneesh** work at Communicable Disease Research Laboratory, Department of Zoology, St. Joseph's College, Irinjalakkuda.

*Scindapus officinalis* is known as Gajpeepal in Ayurveda. The Gajpeepal consists of dried, transversely cut pieces of mature female spadix. Fruit occurs in transversely cut circular pieces of about 2.0-3.0 cm in diameter and 2.0-3.5 cm thick, brownish grey, **rough** and scaly. It has the significant antioxidant property due to presence of flavonoids and phenolic compound and has ability of cytoprotection due to antioxidant property.[1]

One of the major problems faced by tropical and subtropical regions is mosquito-borne diseases, which will contribute significantly to disease burden, death, poverty, and social debility in those countries.[2] Mosquitoes are the carrier of a number of vector-borne diseases, such as malaria, filariasis, yellow fever, brain fever, dengue fever, etc.[3] India alone contributes 39% of 120 million cases of lymphatic filariasis.[4] Dengue is one of the most significant viral diseases transmitted by *Aedes aegypti*; it affects human beings worldwide whose symptoms range from mild fever to potentially life threatening hemorrhagic disease. *Aedes aegypti* is of supreme concern because of its wide distribution and close association with human beings.[5] Misvar Ali *et al.* reported the bioecology and

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[1]B. D. Patel, R. Shekhar, P. Sharma, A. Singh, S. Tyagi, R. K. Singh and Y. S. Shakya, "Anti-inflammatory and Analgesic Activity of Scindapsus officinalis fruit in Experimental Animal models," *American-Eurasian Journal of Toxicological Sciences* 2, 3 (2010), 158-161.

[2]J. Young-Su, K. Moo-Key and A. Young-Joon, "Larvicidal activity of Brazilian Plants against Aedes aegypti and Culex Pipiens Pallens (Diptera: Culicidae)," *Agricultural Chemistry and Biotechnology* 45 (2002), 131-134.

[3]A. Jaswanth, P. Ramanathan, and K. Ruckmani, "Evaluation of the Mosquitocidal Activity of Annona Squamosa Leaves against Filarial Vector Mosquito *Culex Quinquefasciatus*," *Indian Journal of Experimental Biology* 40 (2002), 363-365.

[4]D. H. Molyneux, P. J. Hotez, A. Fenwick, R. D. Newman, B. Greenwood and J. Sachs, "Selected Tropical Diseases and the Global Funds," *Lancet* 373 (2009), 296-297.

[5]S. Ravikumar, M. Ali, and J. Beula, "Mosquito Larvicidal Efficacy of Seaweed Extracts against Dengue Vector of *Aedes Aegypti*," *Asian Pacific Journal of Tropical Biomedicine* 2011, 143-146.

vectorial capacity of *Aedes* mosquitoes in relation with disease transmission.[6] World Health Organization (WHO) stated that about 2/5 of the global human population are currently threatened by dengue. Due to the pathogenic diseases and serious harms caused by mosquitoes, controlling them has been the primary subject of several new researches over the past few years.[7] Controlling the larval stage of mosquitoes through biological agents is one of the best techniques and environment friendly method of disease control. The application of synthetic insecticides is a common and widely accepted approach to control mosquito population.

Chemical insecticides are hazardous, however, in the environmental point of view. When an insecticide is released into the environment a major portion will be broken down in the air, deposited on plants or soil in the target area and some will drift or runoff to non-target areas. The synthetic insecticides will contaminate the environment and reach non target organisms including flora and fauna.[8] The negative impact of these chemical insecticides shifted the research towards the development of naturalistic agents such as botanicides. Botanical insecticides are more environmental friendly; they are rapidly degradable and have less mammalian toxicity. They are more expensive and due to rapid degradation more frequent applications are required. Nowadays researchers have

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[6]K. Misvar Ali, A. V. Asha and E. M Aneesh, "Bioecology and Vectorial Capacity of *Aedes* Mosquitoes (Diptera: Culicidae) in Irinjalakuda Municipality, Kerala, India in Relation to Disease Transmission," *International Journal of Current Research and Academic Review*, 2014, 43-49.

[7]J. F. Invest, and J. R. Lucas, "Pyroproxyfen as a Mosquito Larvicide," *Proceedings of the Sixth International Conference on Urban Pests*, 2008.

[8]M. I. Arufe, J. Arellano, L. García, G. Albendín and C. Sarasquete, Cholinesterase Activity in Gilthead Seabream (Sparus Aurata) Larvae: Characterization and Sensitivity to the Organophosphate Azinphosmethyl," *Aquatic Toxicology* 84 (2007), 328–336.

intensified research towards plants and the plant kingdom is receiving renewed attention as mosquitocides. The extracts derived from plants have the potential ability to kill the mosquito larvae without affecting the other organism and environment.[9] Sukumar *et al* studied the action of various phytochemicals against mosquitoes.[10] Park *et al* carried out a detailed laboratory study on extracts of fruits of *Piper nigrum L.* (Piperaceae) against larvae of *Culex pipiens L., Aedes aegypti L.,* and *Ae. togoi T*.[11] Mulla and Su studied neem products' activity and bio-efficacy against arthropods of medical and veterinary importance. They noted that a variety of neem components exhibited effects such as antifeedancy, ovicidal effects and reproduction suppression in biological fitness in many species of arthropods.[12] Madhu *et al* reported the insecticidal activity of *Piper longum* against *Culex quinquefasciatus*.[13] We have not come across any study on the larvicidal efficacy of *Scindapus officinalis*. This pioneer attempt intended to bring out larvicidal efficacy of this plant against the larvae of *Aedes aegypti.*

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[9]P. A. Hedlin, R. M. Holingworth, E. P. Masler, J. Miyamoto and D. G. Thopson, "Phytochemicals for Pests Control," *American Chemical Society*, 1997, 372.

[10]K. Sukumar, M. J. Perich and L. R. Boombar, "Botanical Derivatives in Mosquito Control: A Review," *Journal of American Mosquito Control Association* 7 (1991), 210–237.

[11]I. K. Park, S. G. Lee, S. C. Shin, J. D. Park, and Y. J. Ahn, "Larvicidal Activity of Isobutylamides Identified in Piper Nigrum Fruits against Three Mosquito Species," *Journal of Agricultural Food Chemistry* 50 (2002), 1866–1870.

[12]M. S. Mulla, and T. Su, "Activity and Biological Effects of Neem Products against Arthropods of Medical and Veterinary Importance," *Journal of American Mosquito Control Association* 15 (1999), 133–152.

[13]S. K. Madhu, V. A. Vijayan and A. V. Shaukath, "Bioactivity Guided Isolation of Mosquito Larvicide from Piper Longum," *Asian Pacific Journal of Tropical Biomedicine* 2011, 112-116.

**2. Materials and Methods**

Fruits of *Scindapus officinalis* were purchased from a market in Thrissur. All the organic solvents used in the experiments were of analytical grade and purchased from Merck Chemicals, India. *Aedes aegypti* larvae used in the experiments were maintained in Communicable Disease Research Laboratory, St. Joseph's College, Irinjalakkuda.

Soxhlet extraction was carried out using petroleum ether until exhaustion and extract concentrates were further evaporated to complete dryness at room temperature. The extract was assayed for larvicidal efficacy with variable concentrations and doses were fixed to give larval morality ranging from 10 to 98 percent. As petroleum ether extract was found to be the most bioactive, it was selected for further analysis. This is an eco-friendly method because the solvents take part in extraction will not be part of the product thus may come from. The plant extraction uses a series of solvents with differential polarity beginning from non-polar petroleum ether or hexane (Polarity Index=0.1) to most polar water (Polarity Index=10.2). This is normally done to ensure every secondary metabolite with varying polarity index dissolves to the testing sample and thus take part in assessing the larvicidal efficacy.

Larval susceptibility tests of different solvent extracts and isolated compounds were performed employing WHO standard procedure.[14] Various concentrations of the extracts were prepared by serial dilutions of a stock solution in acetone. Batches of 25 early fourth instar larvae were released into glass beakers of 500 mL capacity containing 249 mL of dechlorinated tap water and 1.0 mL of extract. The WHO protocols like the use of 25 larvae, use of only early fourth instars, 249+1mL composition, 24h observation, concentration determination etc. were strictly followed. Toxicity of each extract was determined with three various concentrations ranging from 2.5 to7.5mg/L

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[14]World Health Organization: Guidelines for Laboratory and Field Testing of Mosquito Larvicides, Geneva: WHO/CDS/ WHOPES /GCPP/2005, Geneva: WHO 2005.

that provided a range of 10% to 98% mortality. Control beakers contained 25 test organisms and 249 mL of tap water along with 1.0mL acetone. Treated (the sample to which plant extract is dissolved) and control (the sample to which plant extract is not dissolved but solvent does) beakers were maintained at same conditions at (25±2)° C, 12 h light/dark regime. No food was provided to the larvae during the test period of 24 h till the mortality was monitored. Normally, mosquito larvae do not show mortality due to 24h starvation (WHO). Because we maintain control samples and triplicates the mortality of any cause can be corrected using Abbot's formula accordingly. All treatments were replicated three times. The larvae were considered as dead or moribund, if they were not responsive to gentle prodding with a fine needle. The results were expressed as percent mortality.

## 3. Results

The results for the toxicity of petroleum ether extract of *Scindapus officinalis* against the fourth instar larvae of *Aedes aegypti* larvae are presented in Table 1. The $LC_{50}$ and $LC_{90}$ values of petroleum ether extracts were 3.18mg/L and 8.63 mg/L respectively.

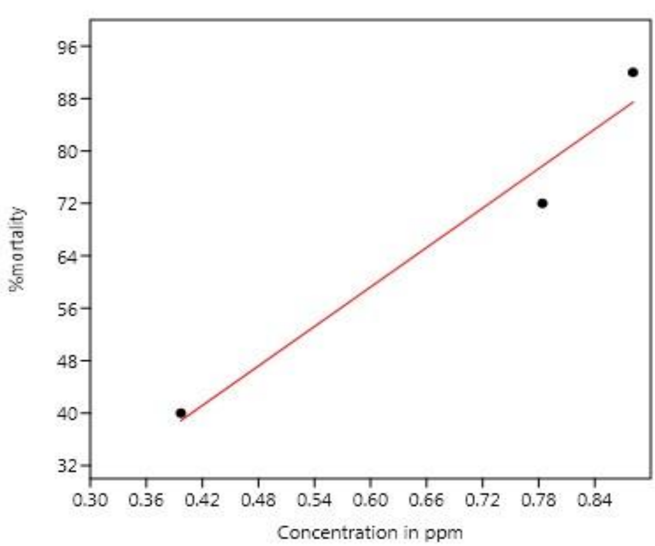
Table 1. Efficacy of petroleum ether extract of *Scindapus officinalis* leaf extract against fourth instar larvae of *Aedes aegypti*

| Concentration in (mg/L) | Mortality | | | Percentage mortality | Control |
|---|---|---|---|---|---|
| | 1st replicate | 2nd replicate | 3rd replicate | | |
| 2.5 | 10/25 | 10/25 | 10/25 | 40 | 0 |
| 6 | 17/25 | 18/25 | 18/25 | 72 | 1 |
| 7.5 | 23/25 | 22/25 | 24/25 | 92 | 0 |

Table 2. Probit mortality response of petroleum ether leaf extract of *Scindapus officinalis* against fourth instar larvae of *Aedes aegypti.*

| Concentration (mg/L) | Percentage mortality | Slope± SE | $LC_{50}$ (mg/L) | $LC_{90}$ (mg/L) | χ2 (df) | Regression equation |
|---|---|---|---|---|---|---|
| 2.5 | 40 ±0.00 | 2.9547 ±0.96 | 3.18 | 8.63 | 6.01 | Y = 2.9312 X + 3.5382 |
| 6.0 | 72 ±0.57 | | | | | |
| 7.5 | 92 ±1.00 | | | | | |

Effect of Petrolium ether extract of *Scindapus officinalis* against *Aedes aegypti*.



**4. Conclusion**

Plants are chemical factories of nature and the plant metabolites are used in pest control since early historical times. Some plant metabolites have strong medicinal and pesticidal property; by using plant extracts in recent times human beings are been able to control certain pests and vectors. The efficacy of phytochemicals on the field of vector control against different mosquito species has been proved by a number of researchers. The biological activity of plant extracts must be due to its secondary metabolites which play a predominant role in plant defence mechanisms.[15] Aivazi and Vijayan[16] studies in oak gall extracts and Prathibha and Vijayan[17] studies in *Euodia ridleyi* leaf extracts reported the converse relationship of increasing efficacy with decreasing polarity. The current study tested the larvicidal efficacy of petroleum ether extract (Polarity index- 0.1) of *Scindapus officinalis.*

There is no previous work done on the larvicidal efficacy of *Scindapus officinalis*. This is a pioneer work to explore the larvicidal efficacy of this plant. The petroleum ether extract of its fruit showed potential larvicidal efficacy even at low concentrations. The larvicidal efficacy of this plant is promising and might form an eco-friendly weapon in vector management program. Further, the biochemical mechanism and mode of action are under investigation and warrants extensive study.

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[15]L. Rafael, N. Teresinha, J. C. Moritz, I. G., Maria, M. D., Eduardo, and S. F. Tania, "Evaluation of Antimicrobial and Antiplatelet Aggregation Effect of Solidago Chilensis Eyen," *International Journal of Green Pharmacy* 3 (2009), 35-39.

[16]A. A. Aivazi, and V. A. Vijayan, "Larvicidal Activity of Oak *Quecus Infectoria* Oliv (Fagaceae) Gall Extracts against *Anopheles Stephensi* (Liston)," *Research Journal of Parasitology* 104 (2009), 1289-129.

[17]K. P. Prathibha, B. S. Raghavendra and V. A. Vijayan, "Evaluation of Larvicidal Effect of Euodia Ridleyi Hochr Leaf Extract against Three Mosquito Species at Mysore," *Research Journal of Biological Sciences* 5, 6 (2010), 452-455.