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Larvicidal Activities of *Capparis divaricata* against Two Mosquito Species, *Aedes aegypti* and *Anopheles stephensi*

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Abstract

The insect-borne disease continues to be a major source of sickness and death worldwide. Resistance to chemical pesticides and their risks have been regarded as a setback in mosquito vector control. Due to the presence of various phyto compounds in plant species, botanicals can manage and prevent vector (insect) transmitted illness by killing insect eggs and larvae. An experiment was carried out to determine the possible toxicity of *Capparis divaricata* (Cappariaceae) extract against *Anophele stephensi* and *Aedes aegypti* larvae, as a result of treatment with *C. divaricata* extract. The larvicidal activity of *C.divaricata* extract against the larvae of *A. stephensi* and *A. aegypti* was determined according to the World Health Organization (WHO). Larval mortality was recorded after 12 and 24 hours of exposure. The inhibition effect of *C. divaricata* was assessed by determining the mortality of the treated. The crude extract of *C. divaricata* exerted 91% of mortality, LC_{50} 81.2 and LC_{90} 110.4at 250 µl/l and *A. aegypti* after 24h at 250µl/l, LC_{50} 72.3 and LC_{90} 144.7. The study provided information on various effects of *C. divaricata* extract against *A. stephensi* and *A. aegypti*.

***Key words*:** *Capparis divaricata*, Larvicidal activity, Insecticide, *A. stephensi*, *A. aegypti*

Medicinal plants are yielding herbal products that are becoming more popular. Herbal products have long been prized for their aromatic, medicinal, and flavouring properties. The significant side effects of synthetic therapeutic things made them unacceptable. Vector management is becoming more difficult due to the emergence of resistance to synthetic pesticides and their side effects. So, insecticides derived from plants could replace synthetic chemical approaches that are no longer effective. It is common in India and can be found in many different regions. It has therapeutic properties and can treat various ailments [1]. *Anopheles*, *Culex* and *Aedes* mosquito species are carriers of diseases including dengue fever, yellow fever, and chikungunya. Synthetic pyrethroids and organophosphates are increasingly used to manage public health pests. Insecticides have evolved into several pesticide-resistant forms. In India, malaria vectors have developed resistance to DDT, Malathion, and Deltamethrin. Encouraging mosquitoes to avoid biting people reduces disease transmission. This resistance can complicate malaria control efforts and may necessitate the development and deployment of alternative strategies. Biodegradable herbal formulations with no adverse effects on non-target species remain a top aim for alternative vector control specialists. These extracts of *Aegle marmelos*, *Calotropis gigantica*, *Murraya koenigii*, *Nyctanthes arbor-tristis*, *Balanites aegyptica* and *Plumbago zeylanica* were tested against *Aedes aegypti* and *Aedes aegypti* larvae [2].

According to the literature, phytochemicals have been shown to have various pharmacological effects on different illness conditions. These compounds have shown diverse therapeutic properties, including antioxidant, anti-inflammatory, antimicrobial, anticancer, cardioprotective, neuroprotective, and immunomodulatory effects, among others. To name a few of the side effects that can be caused by toxins, inflammation, arthritis, diabetes, cardiovascular illnesses, renal problems, hepatic toxicity, microbial infections, and cancer are just a few examples. Several studies have demonstrated that the sterols stigmasterol and beta-sitosterol have antibacterial properties [3]. For various cancers, including ovarian prostate, breast and colon cancers, the use of active phyto-compounds stigmasterol to prevent cancer has been advocated [4]. Adebisi *et al*. [5] demonstrated that *Eupatorium adenophorum* had insecticidal activity against the Diamondback moth, *P. xylostella* (L.), and the aphid, *Aphis craccivora*, by using the plant as a test subject. To screen the larvicidal property of the leaves of the *C. divaricata* Lam. among the variables studied were leaf intake, larval mortality, larval and pupal duration, larval and pupal development, pupation success, adult emergence, growth index, and level of protection.

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MATERIALS AND METHODS

A collection of *Capparis divaricata* was made from Lemabalakkudi (Latitude: 10.244033; Longitude: 78.747514), Pudukkottai District of Tamil Nadu, India. The plant was collected based on medicinal information provided by rural people. With the assistance of the Flora of the Presidency of Madras Gamble, the plant material that was collected was identified. The voucher specimen was deposited at the Department of Botany of the J. J. College of Arts and Science (Autonomous), Pudukkottai, Tamil Nadu, India. The larvicidal activity was tested using the WHO standard procedure (WHO 2005). In 1 ml methanol, the aqueous extract of *C. divaricata* leaves was dissolved and then diluted with double distilled water to achieve the following concentrations. Twenty-five early fourth instar larvae were dropped into (100 ml beakers) for each concentration, with the control in three replicates at 26–28°C. After 12 and 24 hours of exposure, the larvae died. The larvae were not fed during the two exposure periods, and the percentage of mortality was calculated for each period [6]. The data were analyzed using SPSS version 11.5 and presented as Mean Standard Deviation. The chi-square test and LC_{50} and LC_{90} were used to calculate the average larval mortality.

RESULTS AND DISCUSSION

Determination of LC_{50} and LC_{90} Percent mortalities, obtained for each concentration at 30 min, were plotted in a log-probit graphic using Polo-plus 2.0 (LeOra Software Company, Petaluma, CA). Percent mortalities and LC_{50} and LC_{90} analyses were calculated by combining the total individuals and number of individuals (assuming each sex was represented equally) that responded (¼ died) during each assay (i.e., total individuals and total that responded in each bottle were analyzed using the aggregate of the four treated bottles per assay). Control mortality was entered into Polo-plus as the total of the five replicates for each concentration. Parameters for data files analyzed by Polo-plus were as follows: probit model, natural response, and concentrations converted to logarithms. The LC_{50} and LC_{90} were then obtained together with 95% confidence in the upper and lower limits. An investigation into the larvicidal efficacy of aqueous extracts of *Capparis divaricata* leaves was conducted. The results (Table 1) revealed that the extracts were effective against fourth-instar larvae after 12 and 24 hours of exposure. It was found that the larvicidal activity of the extract was 84.3; LC_{90} = 161.1 on 250µl/L against *Aegypti* after 12 hours of exposure time, and that the activity was 198.2; LC_{90} = 246.2ppm against *Aegypti stephensi* after 12 hours of exposure time. LC_{50} = 72.3; LC_{90} = 144.7 ppm against *Aegypti* after 24 hours of exposure time, and LC_{50} = 81.2; LC_{90} = 110.4 ppm against *Aegypti stephensi* after 24 hours of exposure time. At 250 µl/L, the larvicidal activity of the plant *Capparis divaricata* was expressed as 93.1%. When tested against *Aegypti*, the larvicidal activity of leaf extract was significantly higher. Since vectors can develop resistance to common insecticides, vector management has become a major concern.

Table 1 Larvicidal activity of *Capparis divaricata* leaf extract against *Aegypti stephensi* and *A. aegypti*-reared larvae

Name of the mosquito species	Exposure period (h)	Conc.(µl/L)	% Mortality ± Standard error	LC_{50} (LCL-UCL)[a]	LC_{90} (LCL-UCL)[a]	$v^2(d=4)$[b]
Anopheles stephensi	12	Control	0±0	85.1	161.1	7.6
		50	16.1±0.12[a]	(71.2-121.3)	(142.8-1802.4)	
		100	33.4±0.32[ac]			
		150	45.4±0.32[bc]			
		200	59.2±0.31[a]			
		250	84.3±0.46[ec]			
	24	Control	0±0	72.3	144.7	1.22
		50	22.0±0.78[ac]	(59.1-86.2)	(114.0-140.2)	
		100	40.2±0.33[b]			
		150	55.9±0.15[e]			
		200	82.1±0.64[d]			
		250	93.1±0.81[c]			
Aedes aegypti	12	Control	0±0	198.2	146.2	4.17
		50	12.4±0.19[bc]	(68.5-93.7)	(96.1-136.4)	
		100	23.1±0.75[ab]			
		150	37.1±0.65[cd]			
		200	51.1±0.33[b]			
		250	71.4 ±0.51[a]			
	24	Control	0±0	81.2	110.4	3.9
		50	16.0±0.11[a]	(61.5-86.4)	(79.1-136.7)	
		100	28.2±0.15[b]			
		150	43.0±0.18[c]			
		200	59.2±0.14[e]			
		250	33.0±0.61[ab]			

Control-nil activity, SE-standard error, LCL-lower confidence level, UCL-upper confidence level.
[a] 95% confidence interval. Values are different. The Superscript letters indicate Significant differences at p<0.05 (Tukey tests)

Because of the ability of vectors to develop resistance to commonly used insecticides, vector management is one of the most pressing problems [6]. The larvicidal activity of leaf extracts was investigated, and the results revealed that the extracts possessed effective larvicidal properties. After 12 hours of exposure, *Aegypti stephensi* and *A. aegypti* were combined to form LC_{50} and LC_{90} concentrations. The findings revealed that the extract of *Capparis divaricata* was more effective against the larvae of the 4th instar. The larvicidal activity of the plant *Capparis divaricata* extracts was expressed as 93.1 per cent at 250µl/L. In their study, Balakrishnan *et al*. [7] discovered that *Avicennia maria* leaf extract had larvicidal activity against *Aegypti aegypti* (LC_{50}= 481.2 and LC_{90}= 110.4) and *Aegypti stephensi* (LC_{50} = 7.40 and LC_{90} = 9.865 ppm) in

their *Aegypti* Egypt. The larvicidal activity of the leaves of *Eclipta prostrata* was found to be the most effective against the fourth instar larvae of *Culex quinquefasciatus* (LC_{50} = 27.49 and LC_{90}= 70.38 ppm) and *A. subpictus* (LC_{50} = 27.85 and LC_{90}= 71.45 ppm) [8-9]. This demonstrates that the extracts of *Capparis divaricata* can suppress the rested larvae. Using chemical agents in sources is harmful to the environment and humans. So, plant-based pesticides are the potential candidates, especially for mosquito larvae management [10].

CONCLUSION

To summarize, the *In vitro* larvicidal efficacy of *Capparis divaricata* leaf extract reveals that a biological pathway for the large-scale larvicidal product is an eco-friendly, time-consuming, and cost-effective alternative to chemical procedures. The research on the in vitro larvicidal efficacy of *Capparis divaricata* leaf extract suggests that it presents a promising and eco-friendly alternative to chemical procedures for large-scale larvicidal production. The study emphasizes the efficiency of this biological pathway while highlighting its time and cost-effectiveness. Additionally, the research advocates for a detailed phytochemical investigation using various extracts to identify functional compounds within the plant samples that exhibit larvicidal properties. This exploration aims to uncover more insights into the plant's chemical composition, aiding in the development of novel larvicidal candidates with minimal toxicity to both humans and ecosystems.

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