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Mosquito larvicidal activity of *Tridax procumbens* and *Solanum nigrum* ethanol extract – A comparative study

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Abstract
Millions of people die from deadly diseases carried by mosquitoes every year, and their ability to spread disease is increased as they acquire resistance to chemical pesticides. Another source of insecticides for mosquito control might be plants. *Aedes aegypti*, *Anopheles stephensi*, and *Culex quinquefasciatus* are the most prevalent mosquito species that spread disease globally and are known to carry a variety of vector-borne illnesses. The use of chemical pesticides to control mosquitoes pollutes the environment and poses health risks. The present importance of the hunt for ecologically safe and efficient plant-based pesticide solutions to control mosquitoes has been brought about by researchers. The purpose of this study was to investigate the larvicidal efficacy of ethanol extracts from *Tridax procumbens* and *Solanum nigrum* against mosquito vectors. *Aedes aegypti*, *Anopheles stephensi*, and *Culex quinquefasciatus* were the three mosquito larvae against which the medicinal plant ethanol extract had the highest fatality rate. In contrast to *Solanum nigrum*, *Tridax procumbens* has demonstrated encouraging larval inhibitory action.

Keywords: *Aedes aegypti*, *Anopheles stephensi*, *Culex quinquefasciatus*, *Tridax procumbens*, *Solanum nigrum*, Ethanol extract and larvicidal activity

Introduction

The *Tridax* genus of plants has been utilised as a remedy for a variety of ailments; several widely circulated accounts attest to the plant's capacity to prevent a host of ailments. Species of the genus are employed as immunological, antifungal, antidiabetic, and repellent in traditional medicine. Tridax procumbens is one of the species in the genus *Tridax* that offers a viable alternative to counteract insect vectors (Abdul Wadood, 2010) [1]. Global plant *Solanum nigrum* L. is a member of the Solanaceae family. The black nightshade is the popular name for the plant. It is a little, delicate annual plant with smooth, soft stems and branches that grows upright (Rajashekar, 2012) [2]. This plant has been researched for its potential medical benefits, which include hepatoprotective, anti-inflammatory, antioxidant, antinociceptive, antipyretic, anticancer, and antiulcerogenic activities.

Infectious disorders spread by a variety of arthropods are known as insect vector diseases. In most of the world's poorer nations, the impact of these infectious illnesses on human communities is severe. Malaria, dengue, chikungunya, elephantiasis, lymphatic filariasis, Japanese encephalitis, visceral leishmaniasis, and other diseases are among the most crippling illnesses. Insect-borne illnesses can contribute to lower productivity, absence from school, frustration with poverty, excessive medical costs, and strain on public health systems. Mosquito-borne infections continue to be a major global health concern. These illnesses have a major global impact on the prevalence of sickness, mortality, poverty, and social fragility in tropical nations (Devanesan, 2018) [3]. Since pesticides are found in nature, they will play a significant part in the successful development of future pesticides that will protect not only agricultural crops but also the environment and public health. Plants that are biologically active have shown a lot of promise as larvicides. Using plant-derived insecticides to control mosquitoes, particularly their larvae, suggests a more environmentally friendly approach to bug management than using synthetic pesticides (Kumar, 2010) [4].

Major carriers of filariasis, schistosomiasis, yellow fever, malaria, dengue fever, and Japanese encephalitis are mosquitoes (Hemant, 2011) [5]. Mosquitoes are the source of several deadly diseases that kill millions of people annually (Samba Shiva *et al.*, 2015) [6]. One of the most crucial strategies to keep mosquitoes at bay in their breeding grounds is to use natural items like medicinal herbs, since their larvicidal action has been shown to have an adverse effect on both beneficial and non-target creatures (Sharma *et al.*, 2005) [7]. With the growing interest in creating insecticides derived from plants as a substitute for chemical ones, the current study aims to investigate the larvicidal properties of two therapeutic herbs against mosquito larvae. The larvicidal effectiveness of ethanol extracts from *Tridax procumbens* and *Solanum nigrum* against mosquito vectors was evaluated in the current investigation.

Materials and Methods

Collection of plants

Two different Medicinal plants *viz.*, *Tridax procumbens* and *Solanum nigrum* were
Collected from Tiruvannamalai, Tamil Nadu, India.

Plant processing and Extraction method

After carefully cleaning and air drying in the shade, the collected leaves of *Solanum nigrum* and *Tridax procumbens* were combined. The 40 g of dried leaves were physically ground into a powder using a commercial electrical stainless

steel blender. The leaves were then extracted one at a time using 200 ml of Ranchem ethanol in a Soxhlet device until all of the ethanol was removed. Rota-vapour was used to concentrate the extract at 45 °C under decreased pressure (22 – 26 mm Hg), with the residue being kept at 4 °C.

Collection of Third Instair Larvae

The Third-class larvae of *Culex quinquefasciatus*, *Anopheles stephensi*, and *Aedes aegypti* were obtained at Thoraipakkam in Chennai, Tamil Nadu, India.

Larvicidal activity

The larvicidal activity of plants extract was evaluated as per the protocol previously described by WHO (2012) [8]. Five distinct test concentrations (50 ppm, 100 ppm, 150 ppm, 200 ppm, and 250 ppm) were made from the stock solution and tested against newly moulted (0 – 6 hours) III instar *Aedes aegypti* larvae. In order to produce the test medium (500 ml plastic cups), 1 ml of the appropriate test concentration dilution was added. This was combined with 249 ml of dechlorinated water to create 250 ml of test solution. An amount of 50 mg/L of dry yeast powder was supplied to the larvae at the water's surface. Parallel to every replication were the Control tests, which lacked plant extracts. Five replicates were kept at a time for every experiment. For every experiment, a minimum of 25 larvae per concentration were employed. A 24 hour period following treatment was given to monitor and report the larval mortality. The mortality data was used to determine the percent mortality, and if any mortality was under control, adjusted mortality was also derived (Abbot, 1925) [9].

Result and Discussion

The "Green treasure" of our world, medicinal plants are renowned for their therapeutic qualities. It was employed as a traditional medicine in the past, but with the introduction of synthetic medications, the usage of medicinal plants has decreased recently. Medicinal plants are those that possess qualities similar to those of pharmaceutical drugs or medicines (Kovendan, *et al.,* 2014) [10]. Medicinal herbs have been utilised for different purposes to treat and prevent illnesses since ancient times. These days, the pharmaceutical industry makes extensive use of the bioactive substances that have been isolated from medicinal plants. Bioactive chemicals are present in all medicinal plants and are Important in the treatment and healing of illnesses. Pharma firms are interested in using medicinal plants because of their phytochemical content, which is highly valuable in the commercial production of new drugs. All plants, including their leaves, bark, stems, vegetables, and roots, naturally contain phytochemicals (Benelli, 2016) [11].

The current study examined the larvicidal properties of ethanol extracts from two medicinal plants, *Tridax procumbens* and *Solanum nigrum*, against three larvae: *Anopheles stephensi*, *Culex quinquefasciatus*, and *Aedes aegypti*. Five distinct concentrations of *Tridax procumbens* and *Solanum nigrum* were tested for their larvicidal effects: 25 ppm, 50 ppm, 75 ppm, 100 ppm, and 125 ppm. Tables 1 and 2 present the findings of *Tridax procumbens* ethanol extract's larvicidal efficacy against *Aedes aegypti*, *Anopheles stephensi*, and *Culex quinquefasciatus* larvae. It has been noted that the larvicidal activity of the chosen mosquito larvae rises with an increase in the concentration of ethanol plant extracts. *Anopheles stephensi*, *Aedes aegypti*, and the medicinal plant ethanol extract had the highest death rate among the three mosquito larvae against *Culex quinquefasciatus*. In contrast to *Solanum nigrum*, *Tridax procumbens* has demonstrated encouraging larval inhibitory action.

Ke-Xin Yu *et al*. (2015) [12] reported this study was to assess the effectiveness of seaweed *Bryopsis pennata* n-hexane, chloroform, ethanol, and aqueous abate extracts against *Aedes aegypti* and *Aedes albopictus* in terms of larvicidal and insecticidal properties. Kamakshi *et al.* (2015) [13] examined for their ovicidal and repellant properties against *Aedes aegypti* using hexane, petroleum ether, ethyl acetate, carbon tetrachloride, and aqueous extracts of *Cereus hildmannianus*. The effects of laboratory-produced fractions of *Annona senegalensis* leaf extracts on filarial mosquitoes and malaria immature stage development (Younoussa Lame *et al.,* 2015) [14]. An investigation has been made on the feasibility of using phytochemicals, as a larvicidal agent against *Culex sitiens* (Rathy *et al.,* 2015) [15]. Sakthivadivel *et al.* (2015) [16] examined the effectiveness of petroleum ether, chloroform, and acetone extracts from *Hyptis suaveolens* against *Culex quinquefasciatus* in terms of mosquito larvicidal activities. The anti-mosquito effects of *Tridax procumbens* extracts in hexane, ethyl acetate, chloroform, and ethanol have been evaluated in laboratories by Gokulakrishnan *et al.* (2016) [17].

Table 1: Larvicidal activity of Tridax procumbens Ethanol extract against larvae of Aedes aegypti, Anopheles stephensi and Culex quinquefasciatus

Mosquito larvae	Concentration of *Tridax procumbens* Ethanol extract (ppm)	Mortality (%)
Aedes aegypti	25	40.0
	50	52.0
	75	66.0
	100	83.0
	125	91.0
	Control	0
Anopheles stephensi	25	35.0
	50	47.0
	75	63.0
	100	73.0
	125	85.0
	Control	0
Culex quinquefasciatus	25	47.6
	50	63.2
	75	70.4
	100	82.4
	125	93.8
	Control	0

Table 2: Larvicidal activity of *Solanum nigrum* Ethanol extracts against larvae of *Aedes aegypti*, *Anopheles stephensi* and *Culex quinquefasciatus*

Mosquito Larvae	Concentration of Solanum nigrum Ethanol extract (ppm)	Mortality (%)
Aedes aegypti	*25*	*23.3*
	50	*37.1*
	75	*54.5*
	100	*59.3*
	125	*66.8*
	Control	*0*
Anopheles stephensi	*25*	*19.0*
	50	*27.3*
	75	*39.5*
	100	*54.4*
	125	*61.5*
	Control	*0*
Culex quinquefasciatus	*25*	*21.0*
	50	*30.0*
	75	*47.0*
	100	*58.0*
	125	*81.0*
	Control	*0*

Conclusion

Comparing *Tridax procumbens* to *Solanum nigrum*, the current study found that the former had more promising larvae inhibitory efficacy. *Aedes aegypti*, *Anopheles stephensi*, and *Culex quinquefasciatus* were the three mosquito larvae against which the medicinal plant ethanol extract had the highest fatality rate. The new medications that were identified from the *Tridax procumbens* will be utilised to treat yellow fever, filariasis, dirofilariasis, dengue fever, and malaria.

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