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Larvicidal and pupicidal activity of crude ethyl acetate extract fraction-7a of Cymodocea serrulata on Culex quinquefasciatus

Muthuraman Ramanathan [a], Monikandon Sukumaran [b], Mathiyazhagan Narayanan [c], Natarajan Devarajan [d], Arunachalam Chinnathambi [e], Sulaiman Ali Alharbi [e], Nguyen Thuy Lan Chi [f] ✉, Mythili Saravanan [g], Kathirvel Brindhadevi [h] ✉

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Highlights

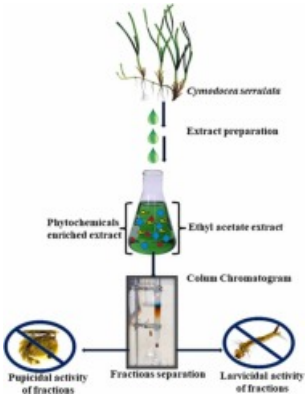
- Crude ethyl acetate extract of *Cymodocea serrulata* contain 7 major fractions
- The fraction-7a contain 2 major and 25 minor peaks under HPLC analysis
- Fraction-7a of ethyl acetate extract possess larvicidal activity as 98.66%
- *C. serrulata* ethyl acetate extract fraction-7a possess 98% o pupicidal activity
- Fraction-7a has fine larvicidal and pupicidal activity on *C. quinquefasciatus*

Abstract

Finding a potential bioactive compound against a specific mosquito vector is an urgent requirement. Thus, this research was designed to separate the significant compounds present in the crude ethyl acetate extract of *Cymodocea serrulata* through Thin Layer Chromatography (TLC), Column Chromatography (CC), and High Performance Liquid Chromatography (HPLC). Furthermore, the larvicidal and pupicidal activity of different concentrations (100, 300, 500, 700, and 900 gmL^{-1}) of separated fraction against 4th instar larvae of Culex quinquefasciatus in 24h of treatment. Interestingly, 7 fractions were obtained from crude ethyl acetate extract by TLC. One fraction (7a) from out of 7 was further separated into fractions 7a and 7b through CC and preparative TLC. Furthermore, the HPLC analysis result revealed that the fraction-7a contained 2 major peaks and 25 minor

peaks. The fraction 7a was selected based on the R_f value and examined their larvicidal and pupicidal activity on 4th instar larvae and pupa of *C. quinquefasciatus.* Interestingly, the increased concentration (900µgmL^{-1}) of fraction-7a of ethyl acetate extracts of *C. serrulata* showed excellent larvicidal and pupicidal activities as 98.66±1.88% and 98±5.65%, respectively. These findings imply that the fraction 7a of *C. serrulata* ethyl acetate extract could be used as a mosquito vector control agent.

Graphical abstract



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Introduction

The *Culex quinquefasciatus* is an ectoparasites mosquito that is sparsely populated far off from the human residential area, and this feeds on the bird, vertebrates, or human hosts [1]. The larvae are frequently found in the eutrophic water of man-made reservoirs such as constructed wetlands, drainage channels, and drainages containing human or animal effluents [2]. As a result, *Culex quinquefasciatus* was emerged towards the environment of chronological sailing ships fully equipped for extended trips in areas with contaminated water and farm animals [3]. Because elderly mosquitoes can fly short distances to the coast and juvenile aspects can be managed to carry up on shore in liquid barrels brought to be replenished, such a mosquito was most likely rapidly spread across the globe by commercial sailing ships engaged in commercial activities in the 17th and 19th centuries [4]. *C. quinquefasciatus* seems to be the primary vector of *Wuchereria bancrofti,* and a human filarial nematode found across the tropical and subtropical continents [5] (Fig. 1). Globally around 1.3 billion individuals suffer from lymphatic filariasis and most probably among poor people from the poor and developing countries and also suffered by malaria, West Nile encephalitis, Rift Valley fever, and so on [6]. The most possible and easiest method to control the population of *C. quinquefasciatus* is by destructing the habitat. The majority of residential environments can be eradicated to restrict mosquito access. In contrast, peridomestic environments connected with farming activities can be disinfected to diminish mosquito production [7]. Before introducing the organochlorine insecticides DDT, petroleum products were frequently employed to control mosquito larvae [8]. Today, highly purified oils are being used, despite being often more expensive [9]. Organochlorines were widely employed and quite efficient against larval *Culex quinquefasciatus* for a decade [10]. Organophosphates like malathion, chlorphyrifos, diazinon, fenthion, and temephos were employed to manage adults when organochlorine resistance evolved [11]. Several microsporidia, microorganisms, and nematodes were also investigated for *C. quinquefasciatus* larvae control in the field [12]. Biopesticides or mosquitocidal toxins associated with the bacterium *Bacillus thuringiensis* (BTi) and *B. sphaericus* were among the most effective agents for controlling *C. quinquefasciatus* [13]. Increased levels of organic compounds in the medicated larvae environment decrease the efficiency of BTi on *C. quinquefasciatus* [14]. Nevertheless, in certain field populations, tolerance to each of these biopesticides has rapidly evolved. *C. quinquefasciatus* is one of the world's largest most investigated organisms [15]. Identifying its genomes as well as the significance of its endosymbionts could help

researchers better comprehend population reduction and vectors competency [16]. Hence, researchers are finding a suitable biopesticides from various plant sources against mosquito vectors [17]. Hence, in this study the *Cymodocea serrulata* is a sea grass subjected to extraction and assess their larvicidal and pupicidal activities against *C. quinquefasciatus.* This is the first report on the mosquitocidal (larvicidal and pupicidal) potential of *C. serrulata* crude extract. The *C. serrulata* marine grass had historically used this to cure fevers and skin disorders, muscle aches, injuries, gastrointestinal difficulties, and stings from many types of rays [16]., as well as a baby sedative [18]. Bioactive chemicals belong to various phytochemicals such as alkaloids, flavonoids, phenols, quinones, saponins, tannins, steriod, and terpenoids in *C. serrulata* extracts have already been reported to exhibit antimicrobial, antilarvicidal, chemotherapeutic, anti-inflammatory, anti - allergic and antidiarrheal properties [19]. Hence, this research was designed to separate the major components of crude ethyl acetate extract of *C. serrulata* and evaluate the larvicidal and pupicidal activities against *C. quinquefasciatus.*

Section snippets

Collection and processing of seagrass

The fresh *Cymodocea serrulata* (sea grasses) leaf sample was obtained from Thondi (9.7764° N, 79.0078° E) coastal area of Ramanathapuram District, India. The collected leaf samples were rinsed with clean tap water to eliminate all epiphytes, shells, surface salts, and sand particles. The well-cleaned sample was then dried under shadow conditions until completely dehydrated and ready for pulverization using an electric pulverizer to acquire fine grinded sample. The pulverized samples were sealed …

Separation of predominant components by TLC

The predominant components present in the crude ethyl acetate extract of *C. serrulata* were analyzed by standard Thin Layer chromatography in solvent systems of toluene/acetone at a ratio of 9:1. The results obtained from this study revealed that the presence of active 7 fractions (Fig. 2) with the various different resolution of the components in the sample. The R_f values and visible color of each fraction of ethyl acetate extract of *C. serrulata* were calculated and presented in Table 1.

The …

Conclusion

The results obtained from this study conclude that a total of 7 fractions were obtained from crude ethyl acetate extract of *C. serrulata.* Based on the R_f values a single fraction-7a was separated and studied their larvicidal and pupicidal activity on 4th instar larvae and pupa of *C. quinquefasciatus* and compared with crude ethyl acetate extract larvicidal and pupicidal activity. Interestingly, the ethyl acetate extract fraction-7a possesses excellent larvicidal and pupicidal activity against …

Acknowledgments

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Assessment of antidiabetic, anti-inflammatory, antioxidant and anticancer activity competence of methonolic extracts of Trianthema ortulacastrum and Andrographis paniculata

2024, Environmental Research

Citation Excerpt :

…Insulin is best recognized for its metabolic possessions, and also has significant mitogenic properties (Egbuna et al., 2021). Diabetes caused by insulin resistance, inflammatory cytokines, oxidative stress, and sex hormone dysregulation may all contribute to in cancer progression, as well as increased glucose concentrations promote the propagation of different solid tumour cells (Ramanathan et al., 2022; Rostamtabar et al., 2021). Because insulin can be transported towards liver through the pulmonary veins after being released from pancreatic cells, the liver as well as pancreas have been subjected to increased insulin concentrations (Kumarasamy et al., 2020)….

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Synergism and toxicity of iron nanoparticles derived from Trigonella foenum-graecum against pyrethriod treatment in S. litura and H. armigera (Lepidoptera: Noctuidae)

2023, Environmental Research

Citation Excerpt :

…The mortality data of the tested larvae were subjected to probit analysis (SPSS statistical package, version 16.0) to determining the LC50 and LC90 values. The synergism ratio (SR) was assessed by dividing the insecticide LC50 value with insecticide plus synergist (FeNPs) LC50 (Ramanathan et al., 2022; Chompunut et al., 2022). The mean and SD value of the antifeedant activity of nanoparticles and detoxification enzyme activity was calculated by the analysis of variance (One-way ANOVA) using Tukey test and Dunnett's multiple comparison test at $p< 0.05$ and $p<0.001$ (Graph Pad- PRISM version 5.0)….

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Effect of melatonin and luzindole antagonist on fipronil toxicity, detoxification and antioxidant enzyme system in different tissues of Helicoverpa armigera (Lepidoptera: Noctuidae)

2023, Environmental Research

Citation Excerpt :

…It has been reported that H. armigera have manifest less sensitivity to many chemical insecticides and unsatisfactory control by high resistance frequency to type I and type II pyrethroids (Freeman et al., 2021). Resistance in insects can be attained by detoxification enzymes like acetylcholinesterase (AChE), esterase (Est), glutathione S- transferase (GST) and cytochrome P450 monooxygenases (CYP450), these enzymes are detoxify the chemical insecticides through phase I and phase II reaction and rendering them in to less toxicity (Narayanan et al., 2020; Ramanathan et al., 2022). Melatonin (N-acetyl-5-methoxytryptamin) is a secretary hormone from pineal gland of vertebrates; its classical role is to intimate day and night length, which endures an integration of physiological boundary to environmental factors and also functioning in circadian rhythm regulation (Tiwari et al., 2020)….

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Anti-Candida, antioxidant and antidiabetic potential of ethyl acetate extract fraction-7a from Cymodocea serrulata and its bioactive compound characterization through FTIR and NMR

2023, Environmental Research

Citation Excerpt :

...The existence of polyphenolic compounds, flavonoids, coumarins, terpenoids as well as other substances that reduce blood sugar levels has been related to medicinal plants' anti - diabetic properties (Egbuna et al., 2021; Toma, 2022). Interestingly, a previous report also states that this fraction 7a from C. serrulata possess fine larvicidal and pupicidal activity on C. quinquefasciatus mosquito (Ramanathan et al., 2022). The compounds namely allyl propyldisulfide as well as S-methylcysteine sulfoxide that are derived from garlic, could perhaps lower blood sugar levels (Bastaki et al., 2021)....

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Antidiabetic, Genoprotective Potential, and Phytoconstituents of Cymodocea serrulata (R. Brown): In vivo, Drug Target Prediction, and ADME Studies

2025, Thalassas

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