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Antimicrobial and Mosquitocidal Potential of Seaweeds Collected from Pudumadam, Tamil Nadu

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Abstract

The seaweeds (Sargassum wightii, Sargassum muticum, Ulva lactuca and Ulva fasciata) were screened against potential harmful pathogens such as Staphylococcus aureus, Escherichia coli, Bacillus subtilus, Pseudomonas aeruginosa and Klebsiella pneumonia. Chloroform, methanol, ethanol, acetone and butanol are the solvents used to extract the seaweeds. Eight different phytochemical compounds were present in the seaweeds. The prominent activity was observed Sargassum wightii (22 mm) followed by Ulva fasciata (18 mm), Ulva lactuca (15 mm) and Sargassum muticum (10 mm). The compound were subjected to evaluate their larvicidal potential against Aedes aegypti and Anopheles.

Keywords: Seaweed, Antimicrobial, Mosquitocidal

Introduction

Seaweeds are marine macro algae and primitive type of plants, growing abundantly in the shallow waters of sea and are the extraordinary sustainable resources in the marine ecosystem, which have been used as a source of food, feed and medicine (Dhargalkar and Neelam, 2005). Seaweeds used as ornamental plant but it is also proved to contain medicinal value like antibacterial activity and (Mostaqul *et al*., 1999), anti inflammatory activity (Erdemoglu *et al*., 2003). Marine algae are the excellent source of bioactive compounds such as carotenoids, protein, dietary fibre, essential fatty acids, vitamins and minerals (Viron *et al*., 2000; Sanchez – machado *et al*., 2002; Fayaz *et al*., 2005; Illiopoulere *et al*., 2002; Metzger *et al*., 2002). The phenolic compounds are the most effective antioxidants present in the brown algae (Nagai and Yukimoto, 2003) and also play an important role in various diseases (Kohen and

Nyska, 2002). Many metabolites isolated from marine algae have been shown to possess bioactive efforts (Oh *et al*., 2008; Venkateswarlu *et al*., 2008 and Yang *et al*., 2006). Seaweeds have recently received significant attention for their potential as natural antioxidants. Seaweeds have been screened extensively to isolate lifesaving drugs or biologically active substances all over the world. Biomolecules from seaweeds were found to be active against human bacterial pathogens (Kolanjinathan *et al*., 2009, Chellaram *et al*., 2015). The present study was undertaken to investigate the antimicrobial and mosquitocidal potential activities of five solvent extracts of four seaweeds from pudumadam against five human pathogens.

Materials and Methods

***Collection and preparation*:** *Sargassum wightii*, *Sargassum muticum*, *Ulva lactuca* and *Ulva fasciata* were collected from Pudumadam, Tamilnadu. Seaweeds were washed thoroughly with seawater and then with distilled water to remove unwanted impurities. The collected samples were cut into small pieces then shade dried for 7-10 days and powdered in a mixer grinder.

***Solvent extraction of seaweed*:** Powdered samples were socked in the solvents chloroform, methanol, ethanol, acetone and butanol and extracted for 1 week at room temperature. The concentrated were reconstituted with the respective extractant (5 mg ml^{-1}).

***Bacterial strains used*:** The bacterial strains *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilus*, *Pseudomonas aeruginosa* and *Klebsiella pneumonia* used for the present study were received from Department of Microbiology, Madurai Medical College, Madurai.

***In vitro* antibacterial assay:** The antibacterial activity of extract was performed by using well diffusion method described by Schillinger and Lucke (1989) against *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilus*, *Pseudomonas aeruginosa* and *Klebsiella pneumonia*.

***Larvicidal activity*:** The bioassay was carried out by the method sholte *et al.*, (2003) with minor modificants using different concentration of chloroform extract of seaweed *Sargassum wightii*, against the third instar larvae *Aedes aegypti* and *Culex quinquefaciatus*. For the bioassay, a total of 25 third instar larvae were transferred into 250 ml glass beaker containing different concentration (100µl to 500µl) covered with a mosquito net. Five replication were maintained for each concentration. The set up was maintained at 27 ± 2°C and 77 ± 4% RH. The mortality of mosquito larvae was noted at 24 hours intervals control and a separately set up was maintained simultaneously treatment.

Results

The results show that, all the selected seaweeds possessed carbohydrate, alkaloids, saponin and phytosterol. Whereas in *Sargassum wightii*, protein, phenolic and terpenoids were absent. Similarly, *S. muticum* and *Ulva lactuca* were lack of flavonoids and terpenoids respectively. The highest zone of inhibition observed in chloroform extract of seaweeds (*S.wightii* and *U.faciata*) are 21 mm and 20 mm with respect to *Pseudomonas aeruginosa* and *Bacillus subtilis.* Whereas methanol extract of *S. wightii* showed maximum of 16 mm of zone of inhibition against *Staphylococcus aureus*. The antibacterial efficiency of the ethanol extract (18mm) was comparatively higher to methanol and below to the chloroform extracts (Figure.1). The acetone extract showed a similar antibacterial (20mm in) effect to that of the chloroform extract. Among the extract tested, butanol extract expressed an extraordinary antibacterial effect having the zone of inhibition of 22 mm in *S.wightii* against *E. coli*. Besides, they had a wide range of activity against the selected bacterial human pathogens except *Klebsiella pneumonia*.

Figure 1 representing the mortality percentage of solvent extracts of the seaweed *Sargassum wightii* against III instar larvae of *Aedes aegypti* and *Culex quinquefaciatus*. The bioassay studies exemplified that, acetone extract (200.97µl) showed lowest LC50 value followed by butanol (212.32µl), chloroform (224.46µl) and ethanol (234.53µl) against *Ae. Aegypti*. Whereas *Cu. quinquefaciatus*, it was 198.97µl (acetone), 212.33µl (chloroform), 232.14µl (butanol) and 298.45µl (ethanol). Beside, treatments showed the positive slope. Similarly, the chi-square values were also found significant.

Discussion

Many studies were reported on biological activities of algal extracts from different coastal regions around the world (Harada *et al.,* 1997). Seaweeds are rich in secondary metabolites which include alkaloids, glycosides, flavonoids, saponins, tannins, steroids, related active metabolites, which are of great medicinal value and have been extensively used in the drug and pharmaceutical industry (Eluvakkal *et al.,* 2010). Farook Basha and Muthukumar, (2014) reported alkaloids play an important role defence mechanisms against pathogenic organism and herbivores.

The present investigation has studied the phytochemical profile as well as antibacterial and larvicidal activity of different solvent extracts of seaweeds. The presence of carbohydrate, protein, flavonoids, alkaloids, saponin, phenolic compounds, phytosterol and terpenoids in the selected seaweed extracts, except lipid. Normally, presence or absences of different chemical

constituents in extracts were responsible for different biological activities. Saponin possesses specific physical, chemical and biological activities that make them useful as drugs. Some of these biological properties include antimicrobial, anti-inflammatory, antifeedent, and hemolytic effects (George *et al.*, 2002; Xu *et al.*, 1996). Similarly, flavonoids, the major group of phenolic compounds reported for their antimicrobial, antiviral and spasmolytic activity (Sauza *et al.*, 2007).

The acetone extracts and chloroform extracts also unveiled good antibacterial activity against tested bacterial human pathogens (Jebasingh *et al.*, 2011). Selvi *et al*., 2014 proved that *Sargassum wightii, Ulva fasciata, Caulerpa racemosa* and *Padina gymnospora* extracted in different solvents (chloroform, methanol, petroleum ether, acetone and butanol) and tested against human pathogens like *Staphylococcus aureus, S. mutants, B. subtilus, P. aeruginosa, K. pneumoniae, E.coli* and *Salmonella typhimurium* shows maximum inhibitory activities.

Antimicrobial assay revealed that, butanol extract showed higher antibacterial potential followed by chloroform and acetone extract. Manilal *et al.*, (2010) studied the antimicrobial potential of marine organisms collected from the southwest coast of India. The antibacterial effect of the crude extracts and purified fractions of *Cladophora glomerata* against human pathogen was investigated by Yuvaraj *et al*., **(**2011). Similarly, the present investigation has exemplified that, the all the tested extracts showed higher antibacterial activity towards gram positive bacterial species. It was due to the more complex structure of the gram negative bacteria (Pesando and Caram, 1984; Reichelt and Borowitzka, 1984; Chakraborty *et al.*, 2010) possessing peptidoglycon containing n-acetyl glucosamine and n-acetyl muramic acid.

The seaweeds have been also explored to larvicidal activity against different vector species. The marine plant extracts contain promising agent against larvicidal activity (Selvin and Lipton, 2004; Uzair Mukhtar *et al*., 2015). Manilal *et al*., **(**2011) had evaluated the methanol extract of the brown algae, *Lobophora variegata* against mosquito pupae, nematodes and plant seeds. Similarly, Ravikumar *et al*., **(**2011) studied the larvicidal effects of seaweeds such as, *Enteromorpha intestinalis*, *Dictyota dichotoma* and *Acanthopora spicifera* against 3rd instar larvae of *Aedes aegypti*. Abbassy *et al*., (2014) investigation revealed that ethanol and chloroform extracts of *U. lactuca* recorded the highest percentage of larval mortality in *Spodoptera littoralis* larvae (36.66 and 23.33 %, respectively) at 25 mg/ml. Thus the present study has demonstrated the potential antibacterial and larvicidal agent from non-commercial eco-friendly sources. The study would be further elevated to elute the potential antibacterial fraction

from seaweed extracts as novel antimicrobial as well as eco-friendly non-chemical larvicidal agent to curb the prevalence of bacterial as well as vector borne diseases.

Further research studies are being carried out on the other species seaweeds from the same habitat in order to provide complete data of the antimicrobial and mosquitocidal potential seaweeds of Pudumadam. It is also necessary for successful separation, purification and characterization of biologically active compounds using chromatographic and spectroscopic techniques for the synthesis novel antibiotics.

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Fig: 1 The antibacterial efficiency