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Antibacterial activity of seaweeds collected from South Andaman, India

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Abstract

Antibacterial activities of five seaweeds comprising of two green algae *Dictyosphaeria cavernosa*, *Acetabularia calyculus*, two red algae *Portieria hornemanni*, *Corallina* sp and one brown algae *Galaxura marginata* were tested against human pathogenic bacterial strains of *E.coli*, *Staphylococcus aureus*, *Salmonella typhi*, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*. Crude methanolic extract of *Dictyosphaeria cavernosa* exhibited highest zone of activity against *Staphylococcus aureus* (18mm) and 16mm against *Klebsiella pneumoniae*, whereas *Portieria hornemanni* showed moderate activity against all the pathogens. The present study shows appreciable antibiotic activity by all the three groups of algae against certain human pathogens.

Keywords: Antibacterial, Seaweeds, Pathogens

Introcution

Seaweeds or macro algae are available in the intertidal, shallow and deep waters in the marine environment (Kaliyaperumal, 1998). They have been reported to contain many important compounds which act as antibiotics, laxatives, anticoagulants, anti-ulcer products (Chanda *et al*, 2010). Seaweeds are known to produce a variety of secondary metabolites which have been characterised as a broad spectrum of antibacterial agents (Cox *et al*, 2010; Ibtissam *et al*, 2010; Rhimou *et al*, 2010; Jebasingh *et al*, 2011; Lavanya *et al*, 2011; Omar *et al*, 2012; Sujatha *et al*, 2012; Zbakh *et al*, 2012) antiviral (Gomez *et al*, 2010), anticancer compounds (Boopathy and Kathiresan, 2010) antioxidant compounds (Heo *et al*, 2003; Vinayak *et al*, 2011) antifouling compounds (Manilal *et al*, 2010) pharmaceutical preparations (Yuvaraj *et al*, 2011). The occurrence of many species of seaweeds in Little Andaman and South Andaman has been documented (Mohanraju and Pujari, 2012, Karthick *et al*, 2013). The present study is to explore the potential source of antibacterial compounds from different groups of seaweeds in South Andaman, India.

Materials and Methods

Five seaweed samples *Dictyosphaeria cavernosa* (Forsskal) Borgesen, *Acetabularia calyculus* Lamouroux, *Portieria hornemanni* (Lyngbye) P.C. Silva, *Galaxura margianata*, *Corallina* sp were collected from the intertidal region of Wandoor (11º35.668' N, 92º 36.427'E) and Burmanallah (11º34.274'N, 92º44.212'E) South Andaman, India. Samples were brought to the laboratory and washed with running tap water to remove the sediments and epiphytic organisms and identified by based on the taxonomical identification keys (Srinivasan, 1969 and 1973; *Jha et al*, 2012).

Extraction procedure

The samples were shade dried at room temperature for two weeks. The dried samples were pulverized by using a mortar and pestle and the powdered sample was stored in refrigerator at 4 °C. These were removed and soaked in methanol for 10 days at room temperature and then filtered with Whatman No.1 filter paper. The filtrate obtained was evaporated, concentrated and stored at 4 °C for further studies.

Microbial cultures

Five pathogenic bacterial strains were used for this study (*Staphylococcus aureus* MTCC 96, *Salmonella typhi* MTCC 733, *Escherichia coli* MTCC 443, *Pseudomonas aeruginosa* MTCC 3216 and *Klebsiella pneumoniae* MTCC 109).

Inoculum preparation

Standard Microbial techniques were followed for media preparation. Bacterial strains were individually inoculated in sterilized nutrient broth and were incubated at 37°C for 24 hrs. Mueller Hinton Agar (HIMEDIA, MUMBAI) plates were prepared and were inoculated with 18-24 hrs old bacterial broth cultures with sterile cotton swab and the plates were incubated at 37°C for 24 hrs.

Antibacterial assay disc diffusion method

Antibacterial activity was determined by following standard disc diffusion technique. Suspension of each lawn cultures were cotton swabbed on Muller Hinton Agar (HIMEDIA, MUMBAI) petri plates. Crude methanolic extract were used for testing the activity by loading 50 µl of samples to the (9mm) sterile disc (HIMEDIA, MUMBAI) and were placed on these Agar plate. Methanol was used as a negative and Gentamicin (HIMEDIA, MUMBAI) as positive controls. All the plates were incubated at 37°C for 24 hrs. Growth inhibition zone produced by the methanolic extracts of seaweeds were examined and the results were measured as zones of inhibition in millimetres. All assays were carried out in triplicates.

Results and Discussion

Methanolic extracts of the seaweeds *Dictyosphaeria cavernosa,, Acetabularia calyculus,, Portieria hornemanni, Galaxura margianata, Corallina* sp were tested against five human pathogens. Crude seaweeds extract showed activity against most of the human pathogens (Table 1). Maximum zone of inhibition was observed with *Dictyosphaeria cavernosa* showing maximum activity against Gram positive *Staphylococcus aureus* (18mm) and Gram negative *Klebsiella pneumoniae* (16mm) and the minimum activity was observed against *Acetabularia calyculus* (11mm) against Gram negative *E.coli. Coralline* sp did not show any activity against the tested human pathogens. Red algae *Portieria hornemanni* showed moderate activity against all the tested human pathogens.

Table 1- Antibacterial activity of crude methanolic seaweeds extract against human pathogens

Seaweeds	**A**	**B**	**C**	**D**	**E**	Negative control Methanol
E. coli	16mm	13mm	11mm	13mm	NO*	-
S. aureus	13mm	12mm	NO*	18mm	NO*	-
K. pneumoniae	NO*	12mm	NO*	16mm	NO*	-
S. typhi	12mm	15mm	NO*	13mm	NO*	-
P.aeruginosa	13mm	14mm	NO*	NO*	NO*	-

A- *Galaxura marginata*; B- *Portieria hornemanni*; C- *Acetabularia calyculus*; D- *Dictyosphaeria cavernosa*; E- *Corallina* sp; NO*- Not Observed

Seaweeds are known to be a rich source of secondary metabolites which may act as antimicrobial, antiviral, anti-cancer, antioxidant properties. Present study shows the antibacterial activities of certain seaweeds representing all the groups of seaweeds collected from South Andaman, India. Earlier studies by (Khandasamy *et al*, 2008; Jebasingh *et al*, 2011) with crude extracts of the Green algae *Ulva lactuca* showed higher activity against certain human pathogens. The same phenomenon was also observed in another species of *Ulva fasciata* against oral pathogens (Sujatha *et al*, 2012) and with fish pathogens (Priyadharshini *et al*, 2012). Most of the marine algae showed moderate to high level activity against *Staphylococcus aureus* (Jebasingh *et al*, 2011; Zbakh *et al*, 2012). In the present investigation also it was found that the green algae *Dictyosphaeria cavernosa* showed maximum activity (18mm) against *Staphylococcus aureus* and (16mm) against *Klebsiella pneumonia.* Whereas extract of brown algae *Stocheospermum marginatum* exhibited higher level of activity against *Klebsiella pneumonia* (Rhadikha *et al*, 2012) and *Himanthali elongate* showed maximum activity against *Listeria monocytogenes* (Cox *et al*, 2010). In our study brown algae *Galaxura marginata* showed maximum activity against *E.coli* (16mm) and minimal activity against *Pseudomonas aeruginosa* and *Staphylococcus aureus* (13mm). Earlier studies with red algae *Hypnea musciformis* showed higher level of activity against *E.coli, S.aureus and Enterococcus faecalis* (Zbakh *et al*, 2012) and our studies red algae *Portieria hornemanni* showed moderate activity against all the tested pathogens.

Conclusion

The Present investigation shows that green algae has activity against both the Gram positive and Gram negative bacteria whereas brown and red algae showed only moderate activities. Natural products from the marine algae could provide valuable secondary metabolites to control the life threatening human bacterial disease and fish pathogens in aquaculture. Further studies are to be undertaken to concentrate the compound's structure and functioning against the pathogens.

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