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Antibacterial Activity of Some Selected Seaweeds from Pudumadam Coastal Regions

K. Vallinayagam, R. Arumugam, R. Ragupathi Raja Kannan, G. Thirumaran and P. Anantharaman

Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai-608 502, Tamil Nadu, India

Abstract: The antibacterial activities of four important seaweeds namely *Ulva lactuca*, *Padina gymnospora*, *Sargassum wightii* and *Gracilaria edulis* were screened against human bacterial pathogens *Staphylococcus aureus, Vibrio cholerae, Shigella dysentriae, Shigella bodii, Salmonella paratyphi, Pseudomonas aeruginosa* and *Klebsiella pneumonia.* The maximum activity (8.8 mm) was recorded from the extract of *G. edulis* against *S. aureus* and minimum (1.2 mm) by *U. lactuca* against *P. aeruginosa*. The ^{1}H-NMR analysis revealed the presence of signals corresponding to poly unsaturated esters in *Sargassum wightii* and *Gracilaria edulis* and poly saturated alcohols in *Padina gymnospora.*

Key words: Seaweeds · Antibacterial activity · Pudumadam and NMR studies

INTRODUCTION

Seaweeds or marine macroalgae are the renewable living resources which are also used as food, feed and fertilizer in many parts of the world. Seaweeds are of nutritional interest as they contain low calorie food, but rich in vitamins, minerals and dietary fibres [1]. In addition to vitamins and minerals, seaweeds are also potentially good sources of proteins, polysaccharides and fibres [2, 3]. The lipids which are present in very small amounts are unsaturated and afford protection against cardiovascular pathogens.

Seaweeds are considered as source of bioactive compounds and produce a great variety of secondary metabolites characterized by a broad spectrum of biological activities. Compounds with cytostatic, antiviral, antihelminthic, antifungal and antibacterial activities have been detected in green, brown and red algae [4, 5]. Many bioactive compounds can be extracted from seaweeds [6-8]. Seaweeds have been screened extensively to isolate life saving drugs or biologically active substances all over the world [9-16]. The present study was undertaken to investigate the antibacterial activities of chloroform extract of four seaweeds from Pudumadam coast against seven human pathogenic bacteria.

MATERIALS AND METHODS

Sample Collection and Preparation: Fresh plants of *Ulva lactuca* linn, *Sargassum wightii* Greville, *Padina gymnospora* (Kutz) Vicker and *Gracilaria edulis* (Gmelin) Silva, were collected from the intertidal region of the Pudumadam (Lat 9°15' N; Long 79° E) southeast coast of India. Then the plants were washed thoroughly with sea water to remove extraneous materials and brought to the laboratory in plastic bags containing water to prevent evaporation. Samples were then shade dried in till constant weight obtained and ground in an electric mixer. The powdered samples subsequently stored in refrigerator.

Extraction: Powdered samples were soaked in chloroform (1:4 w/v) and extracted for 1 week at room temperature and the extracts were collected and concentrated. The concentrates were reconstituted with the respective extractant (5 mg ml^{-1}).

Bacterial Strains Used: The bacterial strains *Staphylococcus aureus, Vibrio cholerae, Shigella dysentriae, Shigella bodii, Salmonella paratyphi, Pseudomonas aeruginosa* and *Klebsiella pneumoniae* used for the present study were received from Department

Corresponding Author: P. Anantharaman, Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai-608 502, Tamil Nadu, India

of Microbiology, Rajah Muthiah Medical College and Hospital, Annamalai University, Annamalainagar, Tamil Nadu, India.

Antibacterial Assay: The agar disc diffusion method was followed for antibacterial susceptibility test [17]. The 6 mm discs were impregnated with 20 µl of the extracts and placed in the inoculated Muller Hinton agar. The inoculated plates were incubated at 35°C for 24-28hrs and the inhibition zones measured around the discs (mm diameter).Control was maintained with solvent alone.

NMR Analysis: NMR spectroscopy was performed on samples (~5mg) dissolved in CDCL3 (Chloroform) filtered through a 0.45mm syringe filter, freeze dried twice from Chloroform to remove exchangeable protons and transferred to Shigeni tubes. One dimensional (1D) ^{1}H-NMR experiments were performed on a 300K equipped with NMR Nuts (Pc computer) processing and plotting software.

RESULT AND DISCUSSION

The antibacterial activity of chloroform extract of four seaweeds against seven bacterial strains was presented in Table-1. The zone of inhibition ranged between 8.8-1.23mm. The maximum activity (8.8mm) was recorded from the extract of *G. edulis* against *S. aureus* and minimum (1.23mm) by *U. lactuca* against *P. aeruginosa*. In the present investigation, higher activity was recorded from the red alga *G. edulis* followed by the brown alga *S. wightii.* It has been very well established by several scientific teams that seaweeds belonging to red, brown and green algae exhibited inhibitory action against both Gram positive and Gram negative bacteria. The present study, highest antibacterial activity was noted in brown alga, similarly [18] noted highest antibacterial activity in Rhodophyta. Antibacterial activity of nine species of seaweeds belonging to brown, red and green algae revealed that red and brown seaweeds had greater antibacterial activity than the green algae [12]. But [19] has reported that the brown algal extracts showed higher activity than the extracts of red algae. But in the present investigation the red alga showed higher activity than the brown algae and green alga. There was no inhibitory effect from *U. lactuca* extract against *S. paratyphi* and *K. pneumoniae, S. wightii* extract against *S. aureus* and *P. aeruginosa* and *P. gymnospora* extract against *S. dysenteriae*. *G. edulis* was the only seaweed active against all the tested pathogens. This may be due to active components which are present in plant extracts. However, some plant extracts were unable to exhibit antibacterial activity against tested bacterial strains. As suggested by [20] these bacterial strains may have some kind of resistance mechanisms e.g. enzymatic inactivation, target sites modification and decrease intracellular drug accumulation or the concentration of the compound used may not be sufficient. Brown algae show higher degrees of antibacterial activity rather than extracts obtained from red and green algae [21] which is in contrast to the present investigation. Thus these seaweeds could be utilized effectively in product preparation for the beneficial of mankind. Further research studies are being carried out on the other species of seaweeds from the same habitat in order to provide complete data on the nutritive and antimicrobial potential of these plants.

The ^{1}H-NMR analysis revealed the presence of signals corresponding to Poly unsaturated esters (7.263 ppm, 5.371 ppm and 1.254 ppm) in *Sargassum wightii*, (7.239 ppm, 5.322 ppm and 1.227 ppm) in *Gracilaria edulis* and Poly saturated alcohol (7.23 ppm 1.256 and 1.226 ppm, 0.827ppm) in *Padina gymnospora.* The present investigation brings out adequate data on the antibacterial potential of chloroform extract of four seaweeds. 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 potential seaweeds of Pudumadam coast. It is also necessary for successful separation, purification and characterization of biologically active compounds using chromatographic and spectroscopic techniques for the synthesis novel antibiotics.

Table1: Antibacterial activity of some economically important seaweeds

Seaweeds	*S. aureus*	*V. cholera*	*S. dysentriae*	*S. paratyphi*	*S. bodii*	*P. aeruginosa*	*K. pneumoniae*
U. lactuca	2.1±0.36	0.00±0.00	2.56±0.40	0.00±0.00	1.36±0.20	1.23±0.15	0.00±0.00
S. wightii	0.00±0.00	4.46±0.35	3.06±0.40	3.33±0.35	2.13±0.15	0.00±0.00	2.53±0.05
P. gymnospora	6.56±0.30	5.46±0.20	0.00±0.00	2.4±0.4	3.63±0.25	2.9±0.2	1.8±0.37
G. edulis	8.8±0.21	5.63±0.35	3.83±0.15	3.53±0.35	3.73±0.25	3.56±0.30	1.7±0.02

REFERENCE

1. Ito, K. and K. Hori, 1989. Seaweed: chemical composition and potential uses. Food Review International, 5: 101-144.
2. Lahaye, M., 1991. Marine algae as a source of dietary fibers: Determination of soluble and insoluble dietary fiber contents in some 'sea vegetable'. J. Sci. Food and Agric., 54: 587-594.
3. Darcy-Vrillon, B., 1993. Nutritional aspects of the developing use of marine macroalgae for the human food industry. Intl. J. Food Sci. Nutrition, 44: 523-535.
4. Lindequist, U. and T. Schweder, 2001. Marine Biotechnology. In: Rehm, H.J., Reed, G. (Eds.), Biotechnology, vol. 10. Wiley-VCH, Weinheim, pp: 441-484.
5. Newman, D.J., G.M. Cragg and K.M. Snader, 2003. Natural products as source of new drugs over the period 1981-2002. J. Natural Products, 66: 1022-1037.
6. Chapman, V.J. and D.J. Chapman, 1980. Seaweeds and their Uses, 3rd edn. Chapman and Hall, New York: pp: 34.
7. Chennubhotla, V.S.K., S. Kalimuthu and M. Selvaraj, 1986. Seaweed culture its feasibility and industrial utilization Proc. Symp. Coastal Aquaculture, 4: 1206-1209.
8. Chennubhotla, V.S.K., B.S. Ramachandru, P. Kaladharan and S.K. Dharmaraj, 1987. Seaweed resources of Kerala coast. *Seminar on Fisheries Research and Development in kerala.* Trivandrum (Abstract).
9. Martinez-Nadal, N.G., L.C. Rodriguez and C. Casillas, 1963. Sarganin and Chonalgin. New antibiotic substances from marine algae Puerto Rico. Antimicrobial Agents and Chemotherapy, pp: 68-72.
10. Bhakuni, D.S. and M. Silva, 1974. Biodynamic substances from marine flora. Botanica Marina, 17: 40-51.
11. Caccamese, S., R. Azzolina, G. Furnari, M. Cormaci and S. Grasso, 1980. Antimicrobial and antiviral activities of extracts from Mediterranean algae. Botanica Marina, 23: 285-288.
12. Padmini Sreenivasa Rao, P., 1991. Biological investigation of Indian marine algae and screening of some green, red and brown seaweeds for their antimicrobial activity. Seaweed Research and Utilization, 14(1): 37-43.
13. Padmini Sreenivasa Rao, P., 1995. Biological investigation of Phaeophyceae 12. Antimicrobial activities of frozen samples of genus Sargassum collected from Okha, west coast of India. Seaweed Research and Utilization, 17: 105-109.
14. Padmini Sreenivasa Rao, P., 1998. Biological investigation of Indian Phaeophyceae 17. Seasonal variation of antibacterial activity of total sterols obtained from frozen samples of *Sargassum johnstonii* Setchell et Gardner. Seaweed Research and Utilization, 20(1 and 2): 91-95.
15. Shanmugam, M., K.H. Mody, R.M. Oza and B.K. Ramavat, 2001. Blood anticoagulant activity of a green marine alga *Codium dwarkense* (Codiaceae, Chlorophyta) in relation to its growth stages. Indian J. Marine Sci., 30:49-52.
16. Khotimchenko, S.V., V.E. Vaskovsky and T.V. Titlyanavo, 2002. Fatty acids of marine algae from the Pacific coast of North California. Botanica Marina, 45: 17-22.
17. Karting, T., F. Still and F. Reinthaler, 1991. Antimicrobial activity of the essential oil of young pine shoots (Picea abis L.). J. Ethnopharmacol., 35: 155-157.
18. Kannapiran, E. and M. Nithyanandan, 2002. Antibacterial activity of different fractions of extracts from Palk Bay Seaweeds. Seaweeds Research and Utilization, 24(1): 177-181.
19. Caccamese, S., R.M. Toscana., G. Funari and M. Cormaci, 1985. Antimicrobial and antiviral activities of some marine algae from southern Italy coast. Botanica Marina, 24: 505-507.
20. Schwarz, S. and W.C. Noble, 1999. Aspects of bacterial resistance to antimicrobials used in veterinary dermatological practice. Veterinary Dermatol., 10: 163-176.
21. Reichelt, J.L. and M.A. Borowitzka, 1984. Antimicrobial activity from marine algae: Results of large scale screening programme. Hydrobiol., 116/117: 158-168.