Annals of R.S.C.B., Vol. 24, Issue 1, 2020, pp. 218 - 226
Received 18April2020; accepted 23June2020

Screening And Characterization Of Antibacterial And Antifungal Activity Of Marine Seaweed

Devi.R[1], Revathi. K[2*], J.Jasmin Vigila [1], K.Sundaravalli [1] A. Anitha [1]

[1]Research Scholars, Meenakshi Academy of Higher Education and Research (Deemed to be University), Chennai, Tamil Nadu, India.

[2*]Director of Research, Meenakshi Academy of Higher Education and Research (Deemed to be University), Chennai, Tamil Nadu, India.

*Corresponding Author: reva63@rediffmail.com

ABSTRACT

To study the antimicrobial activity of different species from the group of islands in Rameshwaram Mandapam, India to study their potential for bioactivity . *Ulva reticulata, Gracilaria corticata* and *Sargassum tenerimum* algae were selected. *Ulva reticulata* act as dietary food and food ingredient, *Gracilaria corticata* marked as Natural or industrial agar and *Sargassum tenerimum* has nutritious rich source of bioactive compounds like Carotenoids, proteins, vitamins and minerals. Extraction was prepared by using chloroform, methanol, ethanol for evaluating the antimicrobial activity of *Streptococcus mutans, Bacillus subtilis, Staphylococcus aureus, Candida albicans, Aspergillus niger* and *Mucor racemous* strains were selected. In the current study antimicrobial activity of seaweed extraction can be used for the production of remodelling drugs for mankind.

Key words: Green, Red, brown algae, Anti microbial activity, Solvent extraction.

1. INTRODUCTION

Seaweeds algae are non-flowering plants and it's not having true root stem and leaves. Microalgae belong to three different major groups. They are *Ulva reticulata* (green algae), *Gracilaria corticata* (red algae) and *Sargassum tenerimum* (brown algae). These three algae differ in their nutrient contents and chemical composition. [1] Commonly marine algae has non-starch polysaccharides, vitamins and minerals [2, 3]. Extracted seaweeds supply very little energy. On utilization of marine algae it can expand the dietary fiber intake and it decreases the risk of some chronic infections [4]. Sea weed algae in common produces bioactive metabolites and different compounds obtained from them has progress of newer drugs by the Pharmaceutical Industries [5].Marine macro algae are found to be bioactive as it produces a broad spectrum of microbiological activity. Nowadays Sea weed algae extractions are used to treat the antifungal, antiviral and antibacterial activities [6]. The Ulva groups are edible algae widely distributed worldwide in the oceans [7]. Broad varieties of bioactive compounds are derived from seaweed microalgae. Seaweeds have wide variety of secondary metabolites and has many spectrums of biological activities. Red, green and brown algae having cytostatic, and antimicrobial activity [8,9]. Red seaweeds basically having pigments are phycoerythrin and phycocyanin is mainly used for agar preparation and preservatives [10]. In brown seaweeds they act as food feed, fertilizer and healthcare benefits [11, 12]. Marine seaweeds have medicinal properties,

bacteriostatic and bactericidal properties [13]. Antibiotics from marine sources that act as therapeutic agents. Marine compounds have high commercial value [14]. Some microalgae having specific bio-active components kill the bacterial germs and some pathogenic bacteria. In clinical and hospitalized patients having health issue for antibiotic resistance and multi-resistant bacteria, treating is difficult [15]. Higher valuable medicinal effect is achieved from powder seaweed samples and its microbial activity is highert when compared to fresh algae extraction. Plants and seaweeds are used to reduce the risk of chronic diseases and cancer. An attempt was made to study the in-vitro antibacterial and anti fungal properties from seaweed extraction.

2. MATERIALS AND METHODS

Seaweed collection

Fresh seaweed samples *Ulva reticulata, Gracilaria corticata* and *Sargassum tenerimum* were obtained from the group of islands in Rameshwaram Mandapam. Blooming and matured grown plants were collected with seawater in specific polythene packs. After collection impurities, debris and sand particles were removed with the help of purified sea water. Again it was washed with double distilled water, dried and powdered. Antimicrobial activity was studied after the solvent extraction.

Extract preparation of seaweeds

Well powdered different species of seaweeds were mixed with different solvents. Chloroform, Ethanol, Methanol solvents were used. These three solvent extractions were done in Soxhlet apparatus for 24 hrs evaporation. Then it's marked properly and the extracted samples were stored at -20ºC .

Evolution of Antibacterial and Antifungal activity

For antibacterial activity mainly three Gram positive organisms were selected. They are *Streptococcus mutans, Bacillus subtilis* and *Staphylococcus aureus* strains.For antifungal activity candida albicans, Mucor racemous and Aspergillus niger were selected.

Antimicrobial Activity

Antimicrobial activity of the seaweeds were studied using the pathogenic organisms by agar plate diffusion method. Sample having three different solvent extracts were tested by 100mg/ml. The basal nutrient agar medium was used for the agar diffusion method. Selected three bacterial strains were grown in the nutrient broth medium at 37ºC for 24 hrs incubation. Nutrient agar plates prepared and the purified stains were done by spread plate method. After 24 hrs of incubation, 6mm diameter having four extracted sterile filter paper samples were placed in the agar plates. One disc was set as a control for all the plates. For Each and every strain the same procedure was followed in different plates. Every disc was kept in aseptic condition and followed by respective distance. Antifungal activity was carried out by Potato Dextrose Agar medium and the same procedure was followed. Bacterial strain plates were kept at 37ºC for 24

Annals of R.S.C.B., Vol. 24, Issue 1, 2020, pp. 218 - 226
Received 18April2020; accepted 23June2020

hrs Incubation. Fungal strain plates were maintained in room temperature at 25ºC for 48 hrs. Antibiotic, standard Chloramphenicol (100mg/ml) and solvents were used as control [16].

2. RESULTS

Antimicrobial activity of *Ulva reticulata*

Ulva reticulata, Gracilaria corticata and *Sargassum tenerimum* (Figure 2: a,b&c) sea weeds were selected for antimicrobial activity. In *Ulva reticulata*, (Figure 1: a) *Streptococcus mutans* organism show higher resistance value in chloroform compared to other two solvents. *Bacillus subtilis* and *Staphylococcus aureus* were highly resistance to methanol. In fungi *candida albicans*, and *Mucor racemous* observed the higher resistance activity for methanol. *Aspergillus niger* showed resistance to ethanol.

Antimicrobial activity of *Gracilaria corticata*

In *Gracilaria corticata*, (Figure 1: b) *Streptococcus mutans, Bacillus subtilis* and *Staphylococcus aureus* were highly resistance to methanol. In fungal activity *candida albicans* shows equal resistance to ethanol and methanol. *Aspergillus niger* noted higher activity of ethanol. *Mucor racemous* showed resistance to chloroform. *Gracilaria corticata*, bacterial activity of the *Streptococcus mutans, Bacillus subtilis* and *Staphylococcus aureus* were resistant to methanol.

Antimicrobial activity of *Sargassum tenerimum*

In *Sargassum tenerimum*, (Figure 1: c) *Streptococcus mutans, Bacillus subtilis, Staphylococcus aureus* and *Aspergillus niger* were resistant to methanol. C*andida albicans* showed higher activity to ethanol and the Mucor racemous was highly resistant to chloroform. Except *candida albicans* and *Mucor racemous* others were highly resistant to methanol.

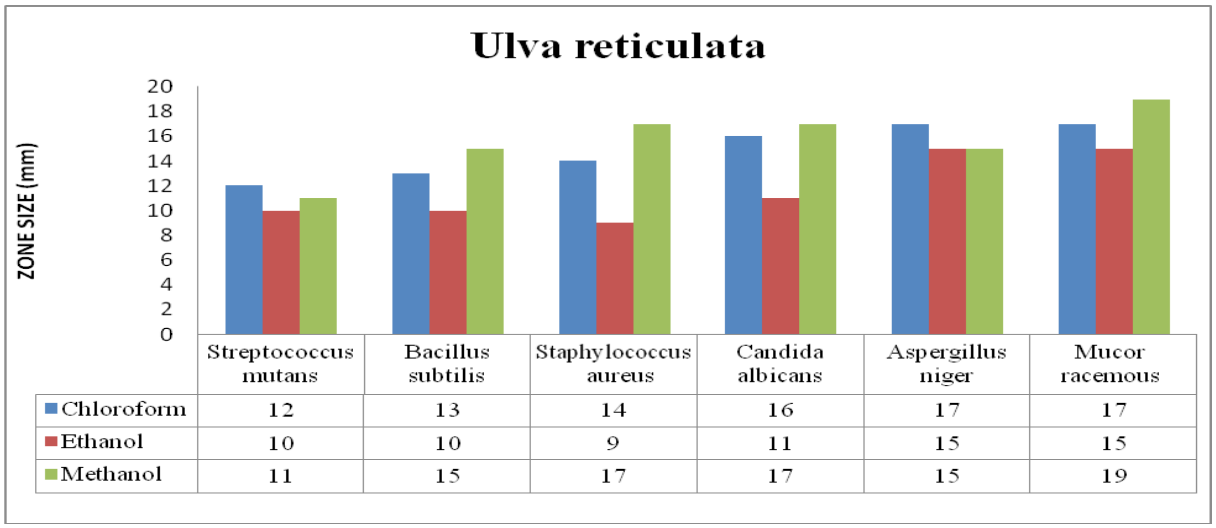
3. DISSCUSSION

More than 1,50,000 microalgae species are found in the ocean worldwide and few of them only were identified and isolated. Secondary or primary metabolites of these microalgae having bioactive compounds are valuable for pharmacological industry. The extraction of active components having various algae were chosen to study the antibacterial activity. Seaweeds have potential source of bioactive natural products. In current study, anti-bacterial and anti-fungal activity of three solvents like chloroform, ethanol and methanol were evaluated against pathogenic organisms. In the current study solvent extractions were used to identify the activity of the pathogenic organisms. Three selected microalgae were treated by six different microorganisms. Both fungi and bacterial organisms were selected. In microorganisms having purified plates were placed by solvent extracted seaweeds and the incubation zone was noted in mm. In our study *Ulva reticulata* was more resistant to all the organisms for antimicrobial activity followed by methanol, chloroform and ethanol. *Gracilaria corticata*, antimicrobial activity was more resistant to methanol followed by ethanol and chloroform. In *Sargassum*

Annals of R.S.C.B., Vol. 24, Issue 1, 2020, pp. 218 - 226
Received 18April2020; accepted 23June2020

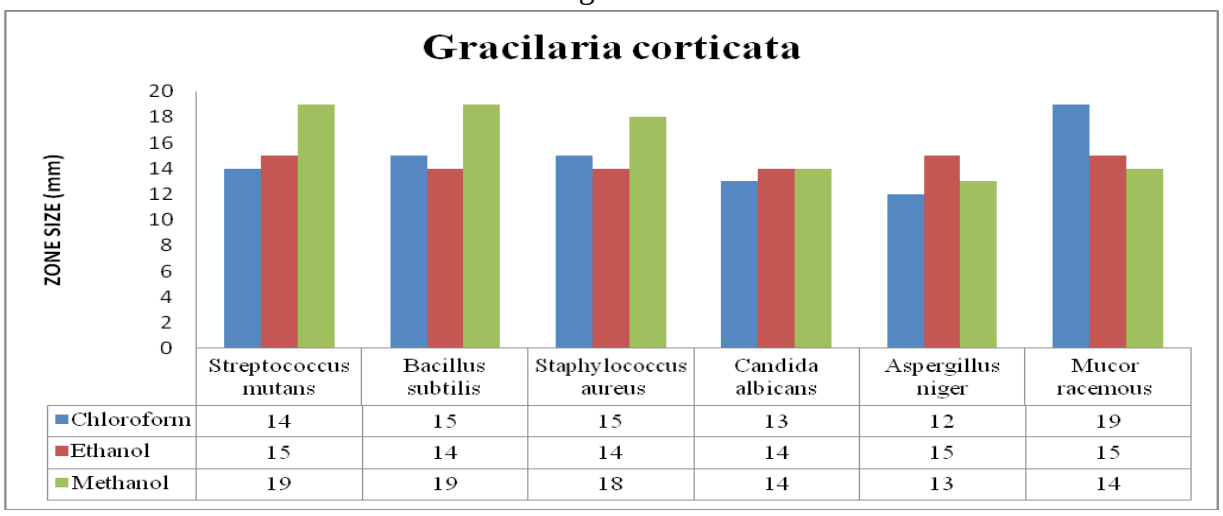
tenerimum, antimicrobial activity was more resistant to methanol followed by chloroform and ethanol. These three extracts having antimicrobial activity are more resistant to methanol. It was also concurrent with the earlier works [17]. Among three solvents extract tested, methanol showed the greatest inhibition diameters against bacteria and fungi isolation. In extraction with methanol seaweed preparation gives better results for seaweeds. In methanol extraction bacteria and fungi were found to be more susceptible for different seaweeds [18]. Due to difference in their polarity and solubility, solvents show different antimicrobial activity. Hence, three different solvents were used to extract these seaweeds. Further research can be done for isolation of active compounds and to study their activity.

Figure : 1:a



	Streptococcus mutans	Bacillus subtilis	Staphylococcus aureus	Candida albicans	Aspergillus niger	Mucor racemous
Chloroform	12	13	14	16	17	17
Ethanol	10	10	9	11	15	15
Methanol	11	15	17	17	15	19

Figure: 1: b

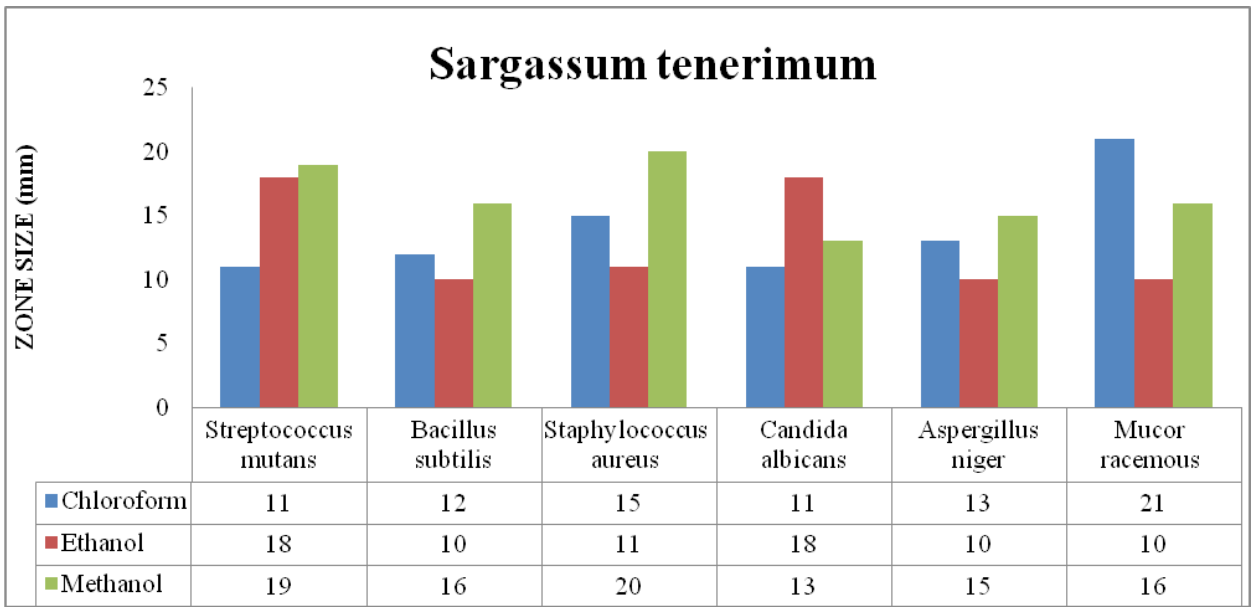


	Streptococcus mutans	Bacillus subtilis	Staphylococcus aureus	Candida albicans	Aspergillus niger	Mucor racemous
Chloroform	14	15	15	13	12	19
Ethanol	15	14	14	14	15	15
Methanol	19	19	18	14	13	14

Annals of R.S.C.B., Vol. 24, Issue 1, 2020, pp. 218 - 226
Received 18April2020; accepted 23June2020

Annals of R.S.C.B., Vol. 24, Issue 1, 2020, pp. 218 - 226
Received 18April2020; accepted 23June2020

Figure : 1:c



	Streptococcus mutans	Bacillus subtilis	Staphylococcus aureus	Candida albicans	Aspergillus niger	Mucor racemous
Chloroform	11	12	15	11	13	21
Ethanol	18	10	11	18	10	10
Methanol	19	16	20	13	15	16

Figure : 2
(a) Ulva reticulata (Green Algae)

Annals of R.S.C.B., Vol. 24, Issue 1, 2020, pp. 218 - 226
Received 18April2020; accepted 23June2020

(b) Gracilaria corticata (Red algae)

(c) Sargassum tenerimum (Brown algae)

4. CONCLUSION

The results indicate methanol extracted microalgae has active compounds. This supresses the growth of both bacteria and fungi. Results from methanol extracted seaweeds can be used to treat different pathogenic organisms.

REFERENCES

Annals of R.S.C.B., Vol. 24, Issue 1, 2020, pp. 218 - 226
Received 18April2020; accepted 23June2020

[1]. Gonzalez, A.D., Basilio, P.G.A., Cabello, A., Gorrochategul, J., Suay, I., Vicente, F., Portillo, E., Rio, J.D.M., Garcia, R.G., Pelaez, F., 2001. Screening of antimicrobial activities in red, green and brown macroalgae from Gran canaria (Canary Islands, Spain). Int.Microbiol. 4, 35–40.

[2]. Darcy-Vrillon, B. 1993. Nutritional aspects of the developing use of marine macroalgae for the human food industry. International Journal of Food Science and Nutrition. 44: 23-35.

[3]. Fleurence J. 1999. Seaweed proteins: biochemical, nutritional aspects and potential uses. Trends in Food Science and Technology 10: 25-28.

[4]. Southgate D.A.T. 1990. Dietary fiber and health. pp.10-19. In D.A.T. Southgate, K. Waldron, I.T. Johnsons, and G. R. Fenwick. Dietary Fiber: Chemical and Biological Aspects. The Royal Society of Chemistry. Cambridge.

[5]. Abedin RMA, Taha HM. Antibacterial and antifungal activity of cyanobacteria and green microalgae. Evaluation of medium components by Plackett-Burman design for antimicrobial activity of *Spirulina plastensis*. *Glob J Biotechnol Biochem* 2008; **3**: 22-31.

[6]. R.D.J. Solomon, V.S. Santhi; Purification of bioactive natural product against human microbial pathogens from marine seaweed *Dictyota acutiloba*. J. Ag. World. J. Microbiol. Biotechnol, 2008; 24: 1747-1752

[7]. Lustigman, B., Brown, C., 1991. Antibiotic production by marine algae isolated from the New York/New Jersey coast. Bull. Environ.Contam. Toxicol. 46, 329–335.

[8]. Newman, D., Cragg, G., Snader, K., 2003. Natural products as source of new drugs over the period 1981–2002. J. Nat. Prod. 66, 1022–1037.

[9]. Chakraborthy, K., Lipton, A.P., Paulraj, R., Vijayan, K.K., 2010. Antibacterial diterpernoids of Ulva fasciata Delile from South-western coast of Indian Peninsula. Food Chem. 119, 1399–1408.

[10]. El Gamal AA. Biological importance of marine algae. Saudi Pharm J. 2010;18:1–25.

[11]. Smit A.J. Medicinal and pharmaceutical uses of seaweed natural products: A review. J. Appl. Phycol. 2004;16:245–262. doi: 10.1023/B:JAPH.0000047783.36600.ef.

[12]. Kadam S., Prabhasankar P. Marine foods as functional ingredients in bakery and pasta products. Food Res. Int. 2010;43:1975–1980. doi: 10.1016/j.foodres.2010.06.007.

[13]. Gorban, E., Kuprash, L., Gorban, N., 2003. Spirulina: perspectives of the application in medicine. LikSprava 7, 100–110.

[14]. Smit, A., 2004. Medicinal and Pharmaceutical used of seaweed natural products: a review. J. Appl. Phycol. 16, 245–262.

[15]. Levy, S., 2002. Factors impacting on the problems of antibiotic resistance. J. Antimicrob. Chemother. 49, 25–30.

[16]. Berghe, V.A., Vlietinek, A.J., 1991. Screening methods for antibacterial and antiviral agents from higher plants. In: Methods for Plant Biochemistry, vol. 6, pp. 47–48.

[17]. Rangaiah GS, Lakshmi PA, Sruthi keerithia K. (2010). The antimicrobial activity of the crude extracts of *Chlorophyceacan* Seaweeds *Ulva*, *Caulerpa* and *Spongontorpha* spp. against clinical and phyto pathogens. Drug Invent. Today :2:311-314.

[18]. Kandhasamy, M. and K.D. Arunachalam, 2008.Evaluation of *in vitro* antibacterial property of seaweeds of southeast coast of India. African Journal of Biotechnology, 7(12): 1958-1961.

[19]. Differential expression of Helios, Neuropilin-1 and FoxP3 in head and neck squamous cell carcinoma (HNSCC) patients A.A.Mohamed Adil, Anil Kumar Bommanabonia, Anandraj Vaithy, Sateesh Kumar 3biotech 9 (178)

[20]. Protagonist of Immuno-Profiling, Immuno-Scoring, and Immunotherapy Towards Colitis-Associated Cancer: Systematic Review, Mohamed Adil a.a, AK Pandurangan, M Waseem, N Ahmed Diagnostic and Treatment Methods for Ulcerative Colitis and Colitis 2020

[21]. Emerging Role of Mitophagy in Inflammatory Diseases: Cellular and Molecular Episodes, Mohamed Adil AA, S Ameenudeen, A Kumar, S Hemalatha, N Ahmed, N Ali 2020 Curr Pharm Des. 2020;26(4):485-491. doi: 10.2174/1381612826666200107144810

[22]. Increased Expression of TGF-β and IFN-γ in Peripheral Blood Mononuclear Cells (PBMCs) Cultured in Conditioned Medium (CM) of K562 Cell Culture AAM Adil, L Vallinayagam, K Chitra, S Jamal, AK Pandurangan, N Ahmed Journal of Environmental Pathology, Toxicology and Oncology 38 (2)

[23]. Cancer immunotherapy: Targeting immunosuppressive tumor microenvironment NA A.A Mohamed Adil Oncobiology and Targets 2014