BIO - POTENTIALS OF GELIDIELLA ACEROSA

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ABSTRACT:

Seaweeds are considered as marine renewable sources and medicinal food of 21st century. The macrophytic algae known as seaweeds are very helpful and typically develop in shallow seas. *Gelidiella acerosa* is a member of the rhodophyta division and is found in the upper subtidal zone and shallow intertidal waters. It produces the highest-quality agar and is also a staple in ice cream, jelly candy, organic soap, and milk products. The phytochemical analysis of *Gelidiella acerosa* extracts revealed the presence of alkaloids, carbohydrates, phytosterols, tannins, quinones, sterols, coumarins, and cardiac glycosides, potentially contributing to antimicrobial, antioxidant, anti-inflammatory, and antiulcer activities. Aqueous extract displayed maximum antimicrobial activity against *Bacillus subtilis* and *Pseudomonas*, while acetonic extract showed enhanced activity against *Staphylococcus aureus*, *Pseudomonas*and *Mucor*. Ethanolic extract exhibited broad-spectrum antimicrobial activity, notably against *Staphylococcus aureus*, *Pseudomonas* and *Aspergillus*. Scavenging activity increased with concentration, with ethanolic extract demonstrating superior activity compared to the control, approaching standard vitamin C levels, possibly due to flavonoid presence. Highest scavenging activity (75.02%) was observed at 100µg/ml concentration, highlighting the potential antioxidant benefits of *Gelidiella acerosa*. Polysaccharides, phenols, and flavonoids have demonstrated extensive utility within the pharmaceutical sector. Numerous pharmacological actions, including antibacterial, antioxidant, and anti-inflammatory properties, have been found for *Gelidiella acerosa*. It was concluded that marine macro algae from the south coast of Tamil Nadu are potential sources of bioactive compounds and should be investigated for natural antibiotics.

KEYWORDS:*Gelidiella acerosa*, Rhodophyta, Taxonomy, Phytochemicals, Antimicrobial, Well Diffusion, Antioxidant.

INTRODUCTION

Algae are a group of plants collectively known as seaweeds. Seaweeds, sometimes referred to as marine algae, are divided into three groups based on their chemical compostition, pigments, and nutritional content phaeophyta (brown algae), chlorophyta (green algae), and rhodophyta (red algae). Almost 841 species of marine algae are found in both inter-tidal and deepwater regions of the Indian coast (Oza RM, Zaidi HS.A., 2000). They are full of organic and inorganic materials that are beneficial to human health. According to recent research, seaweeds have long been used as a traditional medicine to cure a wide range of illnesses.

The emergence and spread of resistant microbes continue to be a major public health concern. Effective treatment alternatives, particularly from traditionally used medicinal seaweeds, are needed. The main objective to be a global and incisive review of how seaweed can be a next generation material for drug manufacturing, reducing pressure in a terrestrial environment and promoting a healthier solution using the larger ecosystem in the planet Earth. seaweed would bring greater benefits with the continuous development and improvement of applications in various fields. It is an effective breakthrough to alleviate future resource crises. Terrestrial plants have yielded a variety of materials and applications. Food, medicine, fertiliser, colours, and many more areas are seeing an increase in these. Nonetheless, compared to terrestrial plants, marine algae are less frequently shown to have pharmaceutical and therapeutic applications.

At the moment, seaweed is the subject of numerous investigations. The research specifically describes investigations on the red seaweed *Gelidiella acerosa's* ability to inhibit the growth of microorganism. Gelidiella acerosa (Forsskal) is a genus of red algae with high economic value found in sub tidal areas in many parts of India and other countries. (Figure 1).

Thecurrent study is to conduct phytochemical screening, antimicrobial activity and anti-oxidant, evaluation of selected traditionally used medicinal seaweed in gulf of mannar region. In the present study, beneficial aspects of marine red algae of *Gelidiella acerosa* have been discussed.

Taxonomic Hierachy Of *Gelidiellaacerosa*:

Kingdom	-	Plantae
Subkingdom	-	Biliphyta
Division	-	Rhodophyta
Subdivision	-	Eurhodophytina
Class	-	Florideophyceae
Subclass	-	Rhodymeniophycidae
Order	-	Gelidiales
Family	-	Gelidiellaceae
Genus	-	Gelidiella *(Forsskal)*
Species	-	*Gelidiella acerosa*

Figure1:Gelidiella acerosa

in its original marine habitat

Distribution and Habitat :

Gelidiella acerosa is found in the Indo-pacific and Atlantic oceans, growing at a depth of 0-47m. It grows in exposed or shaded areas, inhabited in shallow waters of intertidal and upper sub tidal zone, attached to calcareous substrates such as rocks covered by crustose algae, coralline rocks, and on sandstones or shells of molluscs. It is also found in tide pools with relatively high changes in water temperature, pH, salinity, and degree of exposure to air are influenced by tides. It is an abundantly growing seaweed in Coastal areas of south India. It occurs in inter tidal region of Gulf of Mannar, Southeast coast of India. Tropical climate is favorable for its growth.

Morphological Characteristics

The plants of Gelidiella acerosa are elastic, cartilaginous or prostate, which grow along shorelines on dead corals or rocks in the intertidal zones with strong wave activity. These plants are of reddish to purple colour in shaded upper and lower intertidal regions

while greenish brown to yellowish brown in upper intertidal areas and shallow waters. The branches are decumbent, erect and prostate and are pinnately arranged. Ramuli are the filiform lateral branchlets which are 1-6 mm long, acuminate and upcurved. Second degree ramuli may develop from the few lateral branches.

MATERIALS AND METHODS:

Sample Collection:

Collection of sea weed materials from keelakarai coast, Tamil Nadu, India and Certified by Department of Botany at St.Mary's College (Autonomous) Thoothukudi. Individually it was handpicked and washed thoroughly with seawater on the shore and washed again with a tap water to remove salt on the surface of the samples and under shade dried for 15-25 days. After drying it was ground thoroughly to powder and used for further analysis.

Preparation of solvent extraction:

The air dried powder of the red algae of *Gelidiella acerosa* was weighed and it was subjected to soxhelet extraction with aqueous, acetone and ethanol as solvent for up to 8 hrs the extraction process was continued. To 500 ml of the solvent 50 gm of dried powder was added toobtain10% concentration of the extract. The solution after 8hrs with mixture of *Gelidiella acerosa* seaweed powder and solvent was evaporated at room temperature in a flat tray for 24-48hrs. The crude extract was collected and stored at 4˚C for further analysis after it evaporated.

Phytochemical Activity:

The sea weed of *Gelidiella acerosa* was shade dried then powdered and subjected to soxhlet extraction with aqueous, acetone and ethanol as solvents. *Gelidiella acerosa* with aqueous, acetone and ethanol were subjected to various qualitative test for the identification of seaweed constituent present in the species.

Qualitative analysis of phytochemicals:

1.Test for Alkaloids

To1ml of theseaweedextract, drop of Major's reagentwas added on the side of the the test

tube. Acreamy or white precipitate indicates the test is positive.

2.Test for Carbohydrates:

To 2 ml of the seaweed extract, 1ml of Molish reagent and few drops of conc.H_2SO_4were added. Presence of purple or reddish brown colour indicate the presence of carbohydrates.

3.Test for Saponins:

To2mlofseaweedextract,2ml of distilled water was added and gently shaken for10mins. length wise. Formation of 1cm layer of foam indicate the presence of saponins.

4.Test for Phytosterols:

To 2ml of seaweed extract 1ml of 2N acetic hydroxide was added. To this 1 or 2 drop of concentrated sulphuric acid added slowly along the sides of the test tube. An array of colour change indicate the presence of phytosterols.

5.Test for Ferric Chloride:

A few drops of 1ml of seaweedextract, 2ml of $Fecl_2$ was added. Formationof dark blue or greenish black color indicate presence of phenolic compounds.

6.Test forTannins:

About 0.25 gram of dried powerded sample was boiled in 20ml of water in test tube then filtered. A few drops of 0.1mlofferric chloride was added and observed the brownish green or blue back colouration.

7. Test for Flavonoids:

To 2ml of seaweed extract 1ml of 2N sodium hydroxide was added. Presence of yellow colour indicate the presence of flavonoids.

8. Test for Terpenoids:

To 0.5 ml of extract ,2ml chloroform was added along with concentrated sulphuric acid carefully. Formation of reddish brown colour at the interface indicate presence of terpenoids.

9. **Test for Phlobatannis:**

Formation of red precipitate when seaweed extracts of the sample was boiled with 1% aqueous hydrochloric acid indicates the presence of phlobatannis.

10.Test for Quinones:

To 1mlofextract 2mlofdistilled water and few dropsof10% $Fecl_2$ was added. Formation of blue or green colour indicate the presence of quinones.

11.Test for Sterols:

5mlofextract was mixed with 2ml of chloroform and 3ml of conc.H_2SO_4 was carefully added to forma layer. A reddish brown coloration is observed at the interface in presence of sterols.

12. Test for Coumarins:

To 1ml of extract and 1 ml of10% NaOH was added. Formation ofyellow colour indicate the presence of coumarins.

13.Test for Cardiac Glycosides:

To 0.5ml of the seaweed extract 2ml of glacial acetic acid and few drops of $Fecl_2$ was added. It was layered with 1ml conc. H_2SO_4.Formation of brown color indicate the presence of cardiac glycoside.

14.Test for Anthraquinones:

To 1mlofseaweed extract, fewdropsof10% ammoniasolutionwereadded. Appearanceofpink colour precipitateindicate the presence of anthraquninone.

Antimicrobial Activity- Well Diffusion Method:

Well diffusion assay was carried out to check the antimicrobial activity of *Gelidiella acerosa* against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterobacter* and fungal species of *Aspergillus and Mucor.* The antibacterial activity was done using Muller Hinton Agar and the antifungal activity was done using Sabouraud Dextrose Agar. Overnight bacterial culture was added to the surface of agar plates. Culture was spread to from a uniform bacterial lawn. 5mm diameter hollow tube was used to prepare the wells on each plate, and then the aqueous, acetonic and ethanolic extracts of *Gelidiella acerosa*, positive (Streptomycin antibiotic) and negative control (DMSO) were added into the respective wells. The plates were then incubated for 18-24 hrs at 37°C in an incubator. After incubation observed as zones of inhibition and measured the diameter.

Antioxidant Activity:

Chemicals and reagents:

2,2-Diphenyl-1-picrylhydrazyl (DPPH) and ascorbic acid was purchased from Sigma-Aldrich. Phosphate buffer (pH-7.4) and Methanol. **A**ll the chemicals and solvents used were of analytical grade.

DPPH free radical scavenging activity:

DPPH solution (0.004 %), sample extracts and standard (vitamin C) was prepared in methanol. Sample extract and standard (vitamin C) solution were prepared in different concentrations 20, 40, 60, 80 and 100 µg/ml. 0.5ml of different concentrations of standard solution or sampl eextracts was taken in different test tubesandthen0.5mlofDPPH(0.004%)solutionwasaddedandkeptindarkfor30min.andabsorbancewas recorded at 517 nm. The decrease in absorbance of the DPPH radical caused by antioxidant was due to the scavenging of the radical by hydrogen donation. It was visually noticeable as a colour change from purple to yellow. (Majo., 2008) The percentage inhibition activity was calculated using the formulae below:

$$\%\text{DPPH free radical scavenging} = \frac{(\text{Absorbance of control} - \text{Absorbance of test})}{\text{Absorbance of control}} \times 100$$

RESULT AND DISCUSSION:

Table1. Presence of phyochemicals inaqueous, acetone and ethanolic extracts of *Gelidiella acerosa.*

The presence of alkaloids, saponins, flavonoids, carbohydrates, phytosterols,

S.NO	PHYTOCHEMICAL TEST	AQUEOUS EXTRACT OF *GELIDIELLA ACEROSA*	ACETONE EXTRCT OF GELIDIELLA ACEROSA	ETHANOLIC EXTRACT OF *GELIDIELLA ACEROSA*
1	ALKALOIDS	-	+	+
2	CARBOHYDRATE	+	+	+
3	SAPONINS	-	-	+
4	PHYTOSTEROL	+	+	+
5	FERRIC CHLORIDE	-	+	-
6	TANNINS	-	+	+
7	FLAVONOIDS	+	-	+
8	TERPENOIDS	-	+	+
9	PHLOBATANNIS	-	-	-
10	QUINONES	+	+	+
11	STEROLS	+	+	+
12	COUMARINES	-	+	+
13	CARDIAC GLYCOSIDES	+	+	+
14	ANTHRAQUINONE	-	-	-

quinones, sterols, coumarines, cardiac glycosides and tannins in the ethanolic extract of *Gelidiella acerosa*in the present study indicated that the secondary metabolites of these sea weed may be used for the treatment of various diseases. mFlavonoids are also known as vitamin which were present in high quantities. Carbohydrate is reported to have numerous role in living things, such as the storage and transport of energy and structural components. Saponins present in seaweed, have been suggested as possible anticarcinogenic. Steroids may beshow cytotoxic activity against a wide range of organisms, ranging from bacteria and fungi.

Antimicrobial Activity-Well Diffusion Method:

After incubation of agar plates, zone of inhibition was shown by Aqueous, Acetonic and Ethanolic extract of *Gelidiella acerosa* against the bacterial pathogens of *E.coli, Staphylococcus aureus* and *Pseudomonas aeruginosa* and *Enterobacter* and the fungal pathogens of *Aspergillus* and *Mucor*.

Table 2. Invitro antimicrobial activity of the ethanolic extract of theseaweed *Gelidella acerosa* against the selected pathogens.

Human Pathogen			Zone of inhibition (mm)			
		Negative control	Positive control	Aqueous	Acetone	Ethanol
Gram positive bacteria	*Staphylococcus aureus*	-	29mm	16mm	25mm	27mm
	Bacillus	-	24mm	18mm	09mm	12mm
Gram negative bacteria	*Pseudomonas*	-	28mm	18mm	23mm	25mm
	Escherichia coli	-	28mm	16mm	21mm	23mm
	Enterobacter	-	27mm	14mm	16mm	17mm
Fungi	*Aspergillus*	-	26mm	0	0	24mm
	Mucus	-	23mm	0	12mm	18mm

Bacteria - Positive control(Streptomycin)

Fungi - Positive control(Ketoconazole)

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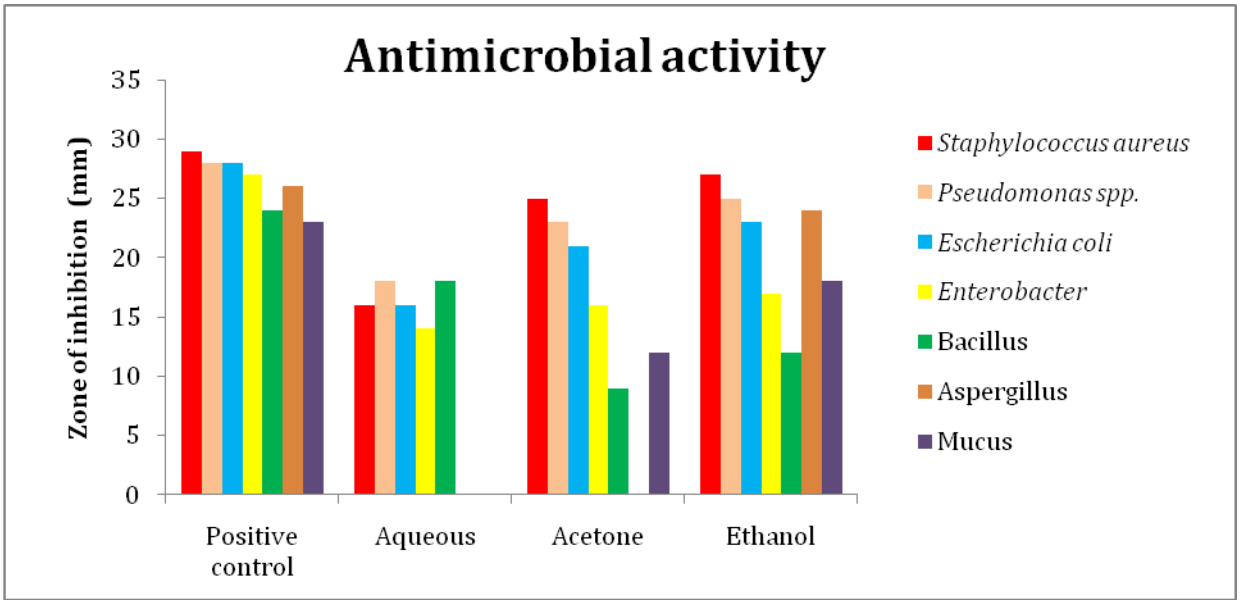

ve control for bacteria and fungi

In the present study, the antimicrobial activity was analysed in the seaweed extracts of *Gelidiella acerosa.* These extracts demonstrated bactericidal and bacteriostatic and fungaistatic activities against microbial isolates, with the ethanolic extract displaying maximum inhibition against *Staphylococcus aureus* and *Aspergillus* sp.Ethanolic extract of *Gelidiellaa cerosa* showed maximum activity against gram positive *Staphylococcus aureus* (27mm), gram negative *Pseudomonas* (25mm) and *Aspergillus* (24mm), minimum activity against gram positive *Bacillus subtilis* (12mm),gram negative *Enterobacter* (17mm) and *Mucus*(18mm).

Antioxidant Activity:

Table3.Antioxidanteffectof sample-(*Gelidiella acerosa* extract)on DPPH

Treatment	Dose(µg/ml)	Absorbance @ 517 nm	%activityagainst DPPH radicals
Control	---	DPPHcontrol= 0.993	---
Vit C	100	0.188	80.36
Sample2	20	0.452	54.48
Sample2	40	0.394	60.32
Sample2	60	0.302	69.58
Sample2	80	0.262	73.61
Sample2	100	0.248	75.02

Suganthy *et al*., (2013), evaluated in vitro antioxidant potential and metal chelating activity of various solvent fractions of Gelidiella acerosa**.** In the present study the scavenging activity was increasing concentration from 20-100 µg/ml but the scavenging activity of the ethanolic extract of *Gelidiella acerosa* showed good result than the control but more or less to standard. The result indicates that the experiment reduce the radical to the corresponding hydrazine exhibiting better free radical scavenging activity near to the standard vitamin C.

The highest scavenging was observed in the 100µg/ml concentration of ethanolic extract 75.02% and the lowest activity was observed in 20µg/ml concentration of ethanolic extract 54.48% respectively. The anti-oxidant activity may be due to presence of flavonoids. The effect of antioxidant on DPPH radical scavenging is through to be due to their hydrogen denoting ability. Phyto constituents like tannins, flavonoids, terpenoids have been implicated as antioxidants in the scavenging radical.

CONCLUSION:

The comprehensive analysis of *Gelidiella acerosa* extracts unveiled a rich array of secondary metabolites with potential therapeutic benefits. The potential for using marine resources for human benefit is enormous. Rhodophyta Gelidiella acerosa is said to contain a wide range of phytoconstituents, such as phenols, flavonoids, alkaloids, tannins, and terpenoids, among others, which help to explain its potent pharmacological effects. The demonstrated antimicrobial and anti-oxidant suggest its promising role in pharmaceutical and agricultural industries. The potential for using marine resources for human benefit is enormous.

Further research should be done to identify and confirm additional possible phyto constituents and pharmacological properties from various solvent extracts of the seaweed Gelidiella acerosa, such as anti-diabetic, anti-obesity, anti-viral, and wound-healing properties.

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