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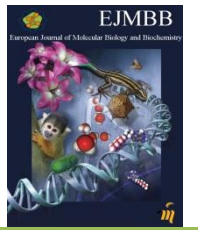

PHYTOCONSTITUENTS AND PHARMACOLOGICAL ACTIVITIES OF *GRACILARIA EDULIS* –A REVIEW

S Arun V, Pranabesh Sikdar*, Deepthi A

Department of Pharmaceutical Chemistry, Seven Hills College of Pharmacy, Venkataramapuram, Tirupati-517561, Andhra Pradesh, India.

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ABSTRACT
Marine algae play an important role in treatment and prevention of human diseases. Algaes are amazing sustainable resources which have been used as foodstuff and drug Experimental cultivation of *G.edulis* has been carried out in India by vegetative propagation for better yield of the marine species. *G.edulis*, rhodophyta species has proved to have wide range of pharmaceutical applications the different chemical constituents present were majorly alkaloids glycosides, phenolic compounds ,carbohydrates flavonoids etc, the different therapeutic activities were anti cancer, anti bacterial, anti inflammatory, anti fungal, anti viral, anti fouling, anti obesity, wound healing.

INTRODUCTION

Seaweeds are also called marine algae. Algae are relatively simple photosynthetic plants with unicellular reproductive structures. They range from unicellular organisms to non vascular they range from unicellular organisms to non vascular filamentous or thaloid plants. Seaweeds are large algae (macro algae) that grow in salt water or marine environment and lack true stems, roots and leaves. Seaweeds commonly grow on coral reefs or in rocky landscape or can grow at great depths if sunlight can penetrate through the water. Most of the seaweeds can be seen thriving in underwater beds floating along the sea surface attached to rocks [1-6].

Seaweeds play an important and vital role in the marine ecosystem, providing food and shelter for host of creatures, such as sea urchins, lobsters and young fishesadequate diets and healthy lifestyles from the time of conception to old age. Formulation of dietary goals and specific guidelines would help in providing required guidance to people in ensuring

Corresponding Author

Pranabesh Sikdar
Email: pranawesh@rediffmail.com

TYPES OF SEAWEED

Three major groups of seaweeds are recognized according to their pigments that absorb light of particular wavelengths and give them their characteristic colors of green, brown or red [7, 8].

Green Algae (Chlorophyta)

The green algae are truely green with no pigments to mask the chlorophyll. The green algae are very diverse and range from microscopic free-swimming single cells to large membranous, tubular and bushy plants. Green algae have a dark- to light-green coloration, which comes from having chlorophyll a and b, which they have in the same amounts as higher plants. Their overall coloration is determined by the amounts of other pigmentations including beta-carotene and xanthophylls. Like the higher plants, they store their food as starch.

Brown Algae (Phaeophyta)

Brown algae are the largest, most complex type of algae. This type of marine algae is brown, olive or yellowish-brown in color. Brown algae contains chlorophyll a and c and a pigment called fucoxanthin, which gives it its color. Fucoxanthin is not found in other algae or plants. Unlike red and green algae, brown algae

are in the Kingdom Chromista. Brown algae are often rooted to a stationary structure such as a rock, shell or dock by a structure called a holdfast, although species in the genus Sargassum are free-floating. Many species of brown algae have air bladders which help the blades of the algae float toward the ocean surface, allowing for maximum sunlight absorption. Brown algae are multi-cellular and are found in a variety of different physical forms including crusts and filaments. Like all photosynthetic organisms, brown algae contain the green pigment chlorophyll. They also contain other gold and brown pigments, which mask the green colour of chlorophyll. The dominant pigment found in brown algae is called fucoxanthin.

Red Algae (Rhodophyta)

Red algae are, not surprisingly, red, reddish or purplish in color. There are about 6,000 species of red algae and they are protists in the phylum Rhodophyta. Red algae species range from simple one-celled organisms to complex, multi-celled, plant-like organisms. Red algae get their energy from photosynthesis. One thing that distinguishes red algae from other algae is that their cells lack flagella. The red algae (Rhodophyta) in addition to chlorophyll contain the pigments phycocyanin and phycoerythrin which give the red colouration. Red algae are found in a variety of physical forms, including simple and branched filaments.

MORPHOLOGY OF SEAWEEDS

Seaweeds do not require support structures. Instead of roots seaweeds have holdfasts, which attach them to the sea floor. A holdfast is not necessary for water and nutrient uptake, but is needed as an anchor. The stalk or stem of seaweed is called as stipe. The function of the stipe is to support the rest of the plant. The structure of the stipe varies among seaweeds and they can be flexible, stiff, solid, gas filled, very long, short or completely absent

BIODIVERSITY OF SEAWEEDS IN THE INDIAN COAST LINE

Jha reports that India is bestowed with a long coast line (7,516 Km) and sizeable (2.5 million sqkm) Exclusive Economic Zone which is about two third of the main land area. The seaweed flora of India is highly diversified and comprises mostly of tropical species.

According to Untawale *et al* and Choo KS *etal* Indian coast line has 844 species of marine algae belonging to 215 genera and 64 families. Gulf of Mannar stands first in terms of diversity and density (302 species), followed by the Gulf of Kutch (202 species). The biodiversity of seaweeds in Gulf of Mannar is due to the large extent of coral reefs, which provide suitable substrate for its growth [11-13].

USES OF SEAWEEDS

Fertilizers and soil conditioners, Animal feed, Fish feed, Cosmetics, Integrated aquaculture, Wastewater treatment, Removal of toxic metals from industrial wastewater, Seaweed as a Source of Nutrition, Bio fuel.[14-16]

GRACILARIA SPECIES

Cultivation of *G.edulis* (Gracilariales, Rhodophyta) by Vegetative Regeneration

Experimental cultivation of *G.edulis* has been carried out in India by vegetative propagation. Limited work has been carried out in India and elsewhere in the reproductive propaga- tion of Gracilaria by using The earlier attempts to culture Garcilariaedulis from spores in India have been either a failure or met with limited success Healthy cystocarpic plants of G. edulis were collected from the nearshore area of the Gulf of Mannar near Thonithurai (9° 16 N and 79° E) and transported to the laboratory. A few healthy cystocarpic plants (approximately 100 g fresh weight) were se- lected, washed thoroughly in running seawater followed by sterilised seawater. Visible epiphytes were removed by brushing the plants before these were kept for spore output. Substrata such as polypropylene straw wound on a rectangular PVC frame, glass slides and circular cement blocks (9 cm dia) were placed in a 2501 fibreglass tank containing sterilised seawater.

The cystocarpic plants were spread on the nylon mesh, 20-25 cm above the substrata. This arrangement was to give a uniform distribution of spores on the substrata. After 24 hrs of spore output, the plants were removed and the substrata along with the attached spores were trans- ferred to the culture room. They were maintained under controlled conditions (temperature 23-25°C, light intensity 1000 lux and photoperiod 16:8 h L:D cycle) in enriched seawater. Culture medium was changed at weekly intervals. Regular observations under microscope were made on the growth of spores settled on glass slides and using an ocular micrometer the diameter of the spores were noted in mm. The spores were allowed to grow for 17 days in the laboratory till the erect frond developed from the parenchymatous disc of the dividing spores or the central medulla [17-19]

ACTIVITIES OF GRACILARIA EDULIS

Phytochemical Screening

Phytochemical screening the seaweed identification was confirmed based on the morphological characters. Hydroalcoholic extracts of seaweed G. edulis yielded a total amount of 6.3 gm of crude extracts respectively from 500 g of seaweed. The dry weight and wet weight ratio varied according to the bio-geographical factors and its extraction yield differ from species to species of different algal groups. From the above chemical tests we concluded that in the aqueous extract the presence of carbohydrate, proteins were confirmed. Moreover it was also confirmed that the carbohydrate so obtained was a non reducing sugar. More over the presence of glycosides, alkaloids, phenolic compounds, flavonoids were also found

in *Gracilaria edulis* [20-21].

ANTI-CANCER ACTIVITY

Meenakshi sundaram *et al* has carried out anti tumour activity with the ethanolic extract of *G.edulis* (Gmelin) on ehrlich ascites carcinoma-bearing mice. Ethanolic extract of *Gacilaria edulis* has increased the life span of EAC-bearing mice compared with that of the controlled mice it has also shown changes in the biochemical parameters and hepatic enzyme labels in the EAC-bearing mice compared with that of controlled group and scientifically proved the anti tumor activity of *G.edulis*. The mechanism of the cell death was due to apoptosis,with was seen as the morphological characteristics of the dead cells [22].

ANTI –BACTERIAL ACTIVITY

Kolanjinatham stated that Mainly these gracilaria species exhibit a good anti bacterial activity, Crude extracts were prepared using the solvent ethanol from the seaweeds viz., *G.edulis*, Calorphapeltada and Hydro-clothres sp. and screening for their antibacterial activity against six bacterial pathogens were also carried out. The test bacterial strains were Escherichia coli, Enterobacteraerogenes, Staphylococcus aureus, Pseudomonas aeruginosa, Streptococcus faecalis and Bacillus cereus. Ethanol extract of *G.edulis* inhibited growth of all the test organisms except Bacillus cereus and Enterobacteraerogenes. Seaweed extract of Calorphapeltada was found effective against a number of Gram negative and Gram positive bacteria such as Escherichia coli, Staphylococcus aureus and Streptococcus faecalis. Hydroclothres sp. extract inhibited the growth of Pseudomonas aeruginosa only out of the six tested pathogens [23].

ANTI INFLAMMATORY ACTIVITY

Radhika studied as sea weeds are usually exhibit the anti inflammatory activity. Methanol extracts of four seaweeds namely *Padina tertastomatica*, *Sargassum wightii*, *G.edulis* and *Caulerpa racemosa* were subjected to paw edema anti- inflammatory test. The extracts were injected into albino rats and the percentage inhibition of paw edema was calculated shown under table no 3. Results revealed that all the seaweed extracts had equally good anti-inflammatory effects in the carageenan induced paw edema compared to those of standard drug (Diclofenac) ($P<0.05$). Maximum inhibition of 35.38% was found in the first hour after carageenen injection in *Caulerpa racemosa* extract. Similar percentage of inhibition (29.23 and 23.07) was also found in *Padina tertastomatica* and *Sargassum wightii*, after the first phase. The anti-inflammatory activity had its peak in the first phase and deceased as the hours increased. In *G.edulis* anti-inflammatory activity showed a high level after third hour [24].

ANTI OXIDANT ACTIVITY

The evaluation of the antioxidant activity of ten aqueous and methanol extracts of the red seaweeds, *Pterosiphonia complanata*, Boergeseniellathuyoides, *Sphaerococcus coronopifolius*, *Asparagopsis armata*, Halopity sincurvus, *Hypnea musciformis*, *Gelidium spinulosum*, *Plocamium cartilagineum*, *Gelidium pulchellum* and *Ceramium rubrum* was realized through three different tests. Using the DPPH (2,2-diphényl-1-picrylhydrazyl) test, four methanol extracts allowed the transformation of DPPH radical in reduced form with an EC50 between 96 and 862 µg.mL-1. With respect to the β-carotene test, 7 methanol extracts showed activity against peroxide radicals with an EC50 between 9 and 176 µg.mL-1. In the deoxyribose test, the inhibition percentage of hydroxyl radicals varies between 25 and 68% for five aqueous extracts; the most important being the extract of A. armata.

Among marine organisms, marine algae have been identified as an under-exploited plant resource, although they have long been recognized as valuable sources of structurally diverse bioactive compounds. Here summarized what are the compounds, methods and recent research on antioxidant activities of marine algae [25-27]

ANTI FUNGAL ACTIVITY

Aswathi EM and Jamila P have carried anti fungal and repellent effects in *G.edulis*. Acetone extract of *G.edulis* was prepared by soxlet apparatus. The acetone extract has shown highest anti fungal activity against A. *flavus* followed by A.*terreus* and F.*semitectum*. moderate activity with ethanolic extract against A.*niger*, Mucorsps T.*viride*. at 4%concentration 100%repellency rate was observed with the ethyl acetate and the chloroform extract at the 5th hour [28-29].

WOUND HEALING ACTIVITY

Pranabesh sikdar recently stated a lot of attentions have been drawn by the marine algae because it contain different bioactive compounds which are useful in the medicinal field. *G.edulis* (Gmelin) Linn belonging to family Rhodophytaceae various disease like cancer, acquired immune-deficiency syndrome (AIDS), inflammation, pain, arthritis, as well as viral, bacterial, and fungal infections. Their fore purpose of present study was to evaluate wound healing activity of *G.edulis* (Gmelin) extract against excision and dead space wound model on wistar rats. Both concentrations of hydro-alcoholic extracts showed significant response in both the wound type tested when compared with control group They were compared with vitamin E in the dead cell wound method and nitrofurazone in excision method. In both the model the HAE have shown significant activity compared to the standard. The excision methods have shown 92.12% at 200mg/kg and 97.89% at 400mg/kg concentrations. While the dead cell wound model has shown 63.83±0.7032 and 36.17±0.8333as wet weight and dry weight respectively at

200mg/kg and 41.67±0.6667 and 24.17±0.9458 weight of wet and dry weight respectively

The red algae *G.edulis* was collected from the Tuticorin Island of Tamilnadu. The algae were shade dried and were coarse powdered. The hydro alcoholic extraction was carried out and the extract was concentrated. Later kept in a cool and dried place. The hydro-alcoholic extracted was tested for the wound healing activity by two different methods. The excision method and the dead cell wound model. The two different concentration of the HAE was taken (200mg/ kg and 400mg/kg). They were compared with vitamin E in the dead cell wound method and nitrofurazone in excision method.[30-31]

CONCLUSION

Marine source is now widely used for different purpose to fulfill the needs of the living being. Apart from traditional food marine algae is also widely used in the field of medicine to treat different diseases. Here we have updated some developments that has taken place in the place of medicines by Gracilaria species such as Anticancer, Antibacterial, Anti microbial, Anti inflammatory, Anti oxidant, Anti obesity, Anti ulcer, Anti fungal, Anti viral, Anti fouling, Wound healing, Hepatoprotectivity. This report will further help us to do a new research with the Gracilaria species for betterment of mankind.

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