



A Systematic Review To Unveil Therapeutic Potential Of Some Common Green Seaweeds

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Abstract

The increasing demand of mankind for a healthier life and increased longevity has led humans to consume functional foods with plenteous sources of biochemical compounds and other nutraceuticals. Among these famous natural resources, seaweeds are considered as one of the most precious natural resources for macronutrients (carbohydrates, proteins, and lipids), micronutrients (vitamins and minerals), and other significant bioactive substances for animal and human health. Green seaweeds are commonly classified as “Chlorophyta” because of their green pigment dominance. Green seaweeds also known as green algae are considered as an important marine biological resource possess a variety of medicinal and biological actions including anti-inflammatory, anti-oxidant, analgesic, immuno-regulatory etc. They are a rich source of nutritional and bioactive components which are responsible for numerous therapeutic activities. Despite of the magnificent advancement in alternative medicines, land plants are more extensively, frequently, and commonly explored for biological and medicinal activities as compared to marine plants. This systematic review is constituted after comprehensively reviewing peer-reviewed publications of renowned and authentic online databases including Elsevier, Scopus, Web of Science, Pubmed, etc. Records of present and potential medicinal, bio-medical and pharmaceutical uses of green seaweeds from 2000 to the present had been reviewed and considered to constitute this review. This review will highlight some common green seaweeds including *Bryopsis plumosa*, *Chaetomorpha antennina*, *Acrosiphonia orientalis*, *Ulva fasciata* and *Ulva prolifera*. The basic purpose of this review is to provide updated knowledge and information about marine green seaweeds which will be valuable for the scientists working in the field of pharmacology, pharmacognosy and biomedicine. This review will also help the marine scientists and pharmacologists to explore these seaweeds further to evaluate and discover their true efficacy and therapeutic potential in human beings and in different disease models.

Keywords: Seaweeds, Green algae, Marine plants, Green seaweeds, Chlorophyta, Marine pharmacology

INTRODUCTION

Nature has gifted the mankind with countless nutritious and medicinal plants [1]. These plant based medicines are a nature’s reward to us so that we can have a healthy and disease free life [2][3]. Marine plants are natural herbs that usually grow in or near water environment and are considered as one of the most ancient form of food and medicine used by the mankind [1]. Seaweeds are classified as eukaryotic organisms commonly found and live in salty water. They have been used traditionally as food, fodder, fertilizer and as a source of medicine since pre-historic era [4]. Medicinal uses of seaweeds have been reported 2500 years ago and these ancient evidences are still present in Chinese medical literatures. Amongst other natural substances including plants and animals, seaweeds hold a significant value in traditional and alternative medicine system because of its health promoting benefits and nutrient rich compositions [5]. These seaweeds are famous for their nutrient rich nature as they are an excellent source of both water and fat soluble vitamins including Retinoic Acid, Thiamine, Riboflavin, Folic Acid, Cobolamin, Ascorbic Acid, Vitamin-D and E, essential minerals

including iodine, iron, calcium, phosphorus, selenium, potassium, magnesium, copper, zinc, fluoride etc., dietary fibers, polyphenols, proteins and some essential aminoacids [6]. During the last 3 decades, extensive research has been done to investigate and evaluate the therapeutic potential of these seaweeds and up till now numerous active metabolites and compounds have been isolated from these seaweeds with pronounced biological and pharmacological activities [7].

Global utilization of marine seaweeds has become a multi-billiondollar business. These marine seaweeds has gained commercial recognition both in food and pharmaceutical industries due to their unique characteristics, chemical composition and medicinal properties. Many industries are using these seaweeds due to their physical properties such as gelling, emulsifying property and water retentive nature. Pharmaceutical industries have been extensively exploring and investigating these seaweeds to discover novel therapeutic agents and establish novel pharmacological uses [7].

Green seaweeds also known as green algae are considered as an important marine biological resource possess a variety of medicinal and biological actions including anti-inflammatory, anti-oxidant, analgesic, immuno-regulatory etc. They are a rich source of nutritional and bioactive components which are responsible for numerous therapeutic activities. Polysaccharides, polyphenols (catechins, flavonoids, pholortannins, bromophenols, sargassin), terpenes (diterpenes, sesquiterpenes), pigments (chlorophyll, carotenoids, xanthophylls), sterols (cholesterol, ergosterol) etc are some common bioactive components in green algae. These green algae are also serve as a source of many secondary metabolites [8][9][10].

Regardless of the magnificent advancement and discoveries in alternative medicines, comparatively land plants are more extensively, frequently and commonly explored for biological and medicinal activities. This might be the common reason that marine plants are still underrated, undervalued and unrecognized in alternative medicine system as compared to land plants despite being a significant source of valuable and unique metabolites and compounds [11]. This review is designed to highlight and recognize green seaweeds with pharmacological and biological activities to help researchers and scientist in discovering novel activities and drugs from these sources.

METHODOLOGY

This systematic review is written after thoroughly reviewing peer-reviewed publications of well-known and authentic online databases including Elsevier, Scopus, Web of Science, Pubmed etc. Records of present and potential medicinal, bio-medical and pharmaceutical uses of green seaweeds from 2000 to present had been reviewed and considered to constitute this review. English records were extracted using the list of search terms: *Marine plants, *Seaweeds, *Aquatic plants, *Marine algae *Green algae *Green seaweeds *Macroalgae etc.

BIOLOGICAL AND THERAPEUTIC ACTIVITIES OF GREEN SEAWEEDS

Green seaweeds are commonly classified as “Chlorophyta” because of their green pigment dominance. They are valuable source of bioactive constituents, secondary metabolites and nutritious compounds but still underutilized in nutraceuticals and pharmaceuticals. Following are some common green seaweeds with significant therapeutic activities [8].

1) *Bryopsis plumosa*

Bryopsis plumosa is classified as a green algae or green seaweed commonly distributed in tropical regions of the world including Taiwan, Baltic sea, Adriatic sea, Balearic island, Black sea, Bulgaria, France, Greece, Italy, Portugal, Malta, Turkey, Spain, Cuba, Argentina, Morocco, Columbia, Chile, Peru, Egypt, Algeria, Ghana, Gambia, Senegal, Kenya etc. This seaweed belongs to the phylum Chlorophyta. This seaweed is not extensively explored and screened for biological activities. Very few studies have been conducted to conclude therapeutic activity and very limited data about it is available. In-vitro and preclinical studies reported strong antioxidant action of *B. plumose*. One study reported that *Bryopsis plumosa* possesses antibacterial activity against the pathogen *Saprolegnia parasitica*, an oomycete that causes saprolegniasis in aquatic animals. One study also reported antiviral activity of *B. plumosa* against HIV infection. Anticoagulant activity of *B. plumosa* has also been reported in literatures. These studies and evidences represents biological potential of *B. plumose*. However, more detail studies in future are required to screen it for therapeutic activities in human and disease models to evaluate its true efficacy [12][13][14][15][16][17][18].



Figure 1: *Bryopsis plumosa*

2) *Chaetomorpha antennina*

Chaetomorpha antennina is a genus of green algae belongs to the family of Cladophoraceae. The algae of this genus have cylindrical cells with macroscopic filaments, characterized by unbranched filaments, which make them very distinctive from its closest relatives that are branched species under the genus *Cladophora*. *C. antennina* have been reported to have various biological activities. Antioxidant and free radicle scavenging potential of *C. antennina* is well-established. Studies have reported its efficacy in management of metabolic disorders. *C. antennina* has shown significant antidiabetic activity both in-vivo and in-vitro and its mechanism resembles conventional antidiabetic drugs α -glycosidase inhibitors and dipeptidyl peptidase-4 inhibitors. It has been found to possess marked antibacterial activity against the pathogen causing Urinary Tract Infections (UTIs). Few studies have reported anticoagulant and antithrombotic activity of *C. antennina*. Preclinical studies confirmed its analgesic and anti-inflammatory effects. *C. antennina* can be explored in future in different disease models to evaluate its true efficacy in human beings [19][20][21][22][23] [24][25][26].



Figure 2: *Chaetomorpha antennina*

3) *Acrosiphonia orientalis*

Acrosiphonia orientalis commonly called as Acrosiphonia is a genus of chlorophytes in the family Ulotrichaceae. It is a green seaweed approximately 6.2 -6.6 cm high, attached via mat of rhizoidal branches usually arising from lower parts of filaments, which form rope like stalks to the lobes of the thallus, filaments repeatedly branched, branches subdichotomous, pseudodichotomous or tridichotomous, lower cells of branches very long, up to 2.5-3 mm long, 200-300 μ m broad towards the top and gradually tapering downwards to 100-200 μ m, cell wall 10-25 μ m thick. *A. orientalis* possesses some unique biological activities. Few studies have reported antiviral and antibacterial (vibriocidal) activity of *A. orientalis*. One study has established and reported larvicidal activity of *A. orientalis*. It has also shown cytotoxicity in-vitro and can be screened for anticancer activity in future [27][28][29][30][31][32][33].



Figure 3: *Acrosiphonia orientalis*

4) *Ulva fasciata*

Ulva fasciata Delile a green seaweed belongs to phylum Chlorophycota, class Ulvophyceae, order Ulvales, family Ulvaceae. Traditionally *U. fasciata* is consumed raw in salad, soup and used for garnishing in Asian countries of the world. It is also used for dressing wounds and cuts. *Ulva fasciata* possesses numerous biological activities which can be

applied and utilized both in food and pharmaceutical industries. It is a potent antioxidant and exhibits strong free radicle scavenging action. *Ulva fasciata* has been found to exhibit mild to moderate antibacterial and antifungal action against *Klebsella pneumonia* and *Candidia Albican*. One study reported potent anti-arthritic activity of *Ulva fasciata*. Anti-hyperlipidemic effects *Ulva fasciata* has been reported recently making it a novel marine source with hypolipidemic potential. Among the seaweeds of green algae, it is the most dominant and unique for its medicinal uses and thus can be a potential candidate of research for discovery of novel therapeutic uses and drugs [34][35][36][37][38].



Figure 4: *Ulva fasciata*

5) *Ulva prolifera*

Ulva prolifera O. F. Müller is a green macroalgae or green seaweed. It is classified to the order Ulvales and family Ulvaceae. It is a bloom-forming seaweed commonly associated with the occurrence of the green tide phenomenon. *Ulva prolifera* is among the major members of the green algae. It contains numerous bioactive compounds such as carotenoids, fucoidans, and phlorotannins with multiple biological activities in pharmaceutical, nutraceutical, cosmeceutical and functional foods industries. It exhibits strong antioxidant and immunomodulatory actions. It also possesses antibacterial action tested and effective against multiple pathogens and can be a beneficial source in future in the field of infectious disease. Hypolipidemic effects of *U. prolifera* has also been reported making it a novel addition in alternative medicine for the treatment of dyslipidemia. This macroalgae is a unique source of bioactive constituents and can be explored and screened further in future to evaluate its clinical efficacy in human beings and in disease models [39][40][41][42][43][44].



Figure 5: *Ulva prolifera*

CONCLUSION

Seaweeds are currently very frequently and extensively explored as novel and sustainable sources of bioactive compounds. Because of their nutritional rich contents and presence of valuable bioactive compounds they exhibit significant biological and pharmacological activities. This review has discussed some common green seaweeds including *Bryopsis plumosa*, *Chaetomorpha antennina*, *Acrosiphonia orientalis*, *Ulva fasciata* and *Ulva prolifera* to highlight their established biomedical and therapeutic effects. However, these macro-seaweeds should be further screened and explored in future to determine their true efficacy in humans and in different disease conditions and to discover novel medicinal activities, bioactive compounds and drugs from these resources.

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