

Algae in Medicine and Human Health

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ABSTRACT

Microalgae generally grow autotrophically and are ubiquitous in nature. They represent a major untapped resource of genetic potential for valuable bioactive agents and fine biochemicals. This proven ability of microalgae to produce these compounds places these microorganisms in the biotechnological spotlight for applications and commercialization as in the pharmaceutical industry. The production of microalgal metabolites, which stimulate defense mechanisms in the human body, has spurred intense study of the application of microalgal biomass and products thereof in various food preparations, pharmacological and medical products. There is, therefore, a huge scope for further study of the identified algal compounds and their activities in the treatment and prevention of various diseases. Pharmaceutically valuable products from microalgae and its industrial commercialization today is still in its infancy and can be seen as a gateway to a multibillion dollar industry.

KEY WORDS: Microalgae, Applications, Medicine

INTRODUCTION

Algae are a very simple chlorophyll-containing organism composed of one or group of cells together in colonies which are basically not much related to each other making it polyphyletic in nature. Natural products from algae have been widely explored, since long time, for human use as food and as medical treatments. Many chemicals and products from algae have economic importance and are broadly used as it is a good source of fibre, minerals, antioxidants, vitamins, pigments, steroids, lectins, halogenated compounds, polysaccharides, proteins, polyunsaturated fatty acids and other lipids; thus, they are even consumed in many countries.

Algae are a rich and varied source of pharmacologically active natural products and nutraceuticals. Currently these products are very valuable in the market. Many products are now being commercialized such as carotenoids, phycobilins, fatty acids, polysaccharides, vitamins, and biologically active molecules for use in human and animal health. Even marine algae which are categorized into micro/macro algae are being very beneficial to the pharmaceutical industries. Marine algae are potential sources of highly bioactive secondary metabolites that might represent useful leads in the development of new pharmaceutical requirements. Many studies are now being carried out on the chemicals which are being extracted from marine algae for human benefits and welfare. Many researchers are working on production of biologic drugs by therapeutic pharmaceuticals to replace expensive drugs. Algae always had the potential to be beneficial to mankind; especially the use of cyanobacteria (blue-green algae), for antibiotics and pharmacologically active compounds has received ever increasing interest. Large ranges of products are being derived from algae which include; Antimicrobials, Antivirals, Therapeutic proteins, drugs, Antifungals and many more(1,2)

METABOLITES OF ALGAE AS MEDICINES

Cyanobacteria and algae having complex photosynthetic systems can channelize absorbed solar energy into other forms of energy for production of food and metabolites. In addition, they are promising biocatalysts and can be used in the field of "white biotechnology" for enhancing the sustainable production of food, metabolites, and green energy sources such as biodiesel. The significance of various metabolites like phenolics, phytoene/terpenoids, phytols, sterols, free fatty acids, photoprotective compounds (MAAs, scytonemin, carotenoids, polysaccharides, halogenated compounds, etc.), phytohormones, cyanotoxins, biocides (algaecides, herbicides, and insecticides) etc has been discussed many times. Apart from this, the importance of these metabolites as antibiotics, immunosuppressant, anticancer, antiviral, anti-inflammatory agent has also been discussed. Metabolites obtained from cyanobacteria and algae have several biotechnological, industrial, pharmaceutical, and cosmetic uses. Which have aggravated interest in cyanobacterial and algal secondary metabolites. Thus, due to high pharmaceutical values, a new perspective of utilizing cyanobacteria and algae in the field of medicine has risen. The pathways utilized by these organisms for metabolite productions are different. For instance, mevalonate pathway is involved in isoprenoids synthesis in algae, but in case of prokaryotes, they are synthesized by non-mevalonate pathway.

The most powerful water soluble antioxidants found in algae are polyphenols, phycobiliproteins and vitamins. Antioxidants help in the inhibition of cancer growth by causing regression of premalignation. A study has found out that many algal species have helped in prevention of oxidative damage by the process of scavenging free radicals and active oxygen which helps in cancer prevention. Antioxidants are the key to fight out various diseases including chronic disorders, cardiovascular diseases, and inflammations. Polyphenols found mostly in marine algae are having good antioxidant properties. The sulphate polysaccharides which are isolated from marine algae release radical scavenging activities. Several methods of extraction are designed out by researches for this. Filamentous green algae have great antioxidant properties. Seaweeds contain a wide variety of bioactive compounds, which has this property and is very well used commercially worldwide.

ANTICANSER PROPERTIES OF ALGAE

Marine algae are involved in ANTICANSER activity as it has wide range of properties. They have good antibiotic properties which are inhibiting many dangerous diseases. Oral cancers can be treated by the use of algae which exhibits antioxidant properties such as β - carotenes, floral compounds of algae are being used as therapeutics, cyanobacteria *S. platensis* shows the highest antioxidants which leads to anticancer efficiency,. Algae could be used to make complex, targeted cancer drugs, their photosynthetic organelles, chloroplasts make it more helpful. Researches and scientists are working vigorously on genetically engineered tiny algae. These are helpful in killing harmful cancer cells, leading to tumour treatments. This is a major outbreak in the development of cancer drug therapy. Algae have a great ability of folding proteins into complex three dimensional structures. In San Diego human antibodies were successfully produced by algae, human therapeutic drugs, such as human vascular endothelial growth factor, were used to treat patients suffering from pulmonary emphysema.

Microalgae play a big role in development of anti-cancer drugs; a compound named cryptophycin has been isolated from the blue green algae which is a strong component for an anti-cancer drug development. They even produce alkaloidal neurotoxins such as saxitoxin and polyketide, having anti-inflammatory and anti-cancer properties. Whereas, Macro algae contain alkaloids giving way to anti-cancer drugs (6).

Antiviral properties

When limitations arose on vaccines it led way to many synthetic antiviral compounds for the treatment of active herpetic infections, but this was too unsuccessful. Researches then found out the antiviral property in brown algae, as it has a wide spectrum of activity which completely inhibits virus. This discovery has led to antiviral chemotherapy. Polysaccharides are derived which are used against particular virus(9).

Algae as nutraceuticals

The current value of algal nutraceuticals is very high in the market. Though the expansion of strains is very small, basic nutraceuticals from algae include food supplements, dietary supplements, value-added processed foods as well as non-food supplements such as tablets, and soft gel. The major products derived from algae are Omega 3 polyunsaturated fatty acids (PUFA), β -Carotene, Astaxanthin, Carotenoids etc. (3,4).

- **Carotenoids:** Microalgae is being widely used for nutraceutical supplements, species of *Chlorella*, *Dunaliella*, *Haematococcus*, *Spirulina*, *Aphanizomenon*, are widely evaluated by researchers for its potential. It generally depends on the protein content of the species which determines its credibility towards nutraceutical development. Extracts of *Chlorella*, *Spirulina* have good antioxidant, anti-inflammatory, anti-tumor properties. *Haematococcus* has many vitamins in it which makes it more interesting towards nutraceutical development. *Aphanizomenon* plays a huge role in cholesterol controlling, stimulation of liver functions and also is a cure for many dermatological problem.
- **Astaxanthin:** Natural Algae Astaxanthin Association (NAXA), is playing a major role in determining the benefits and value of astaxanthin. It is laying stress on differences between natural algal astaxanthin and other synthetic sources. Astaxanthins are built from carbon precursors, its high lipid soluble pigment, it's basically an antioxidant with slightly low activity but has good free radical terminating of each carotenoid. Astaxanthins are used as food supplements .
- **Omega 3 polyunsaturated fatty acids:** PUFA is very important for body metabolism in humans. Chlorophyticalgae is used for the extraction of these healthy and essential fatty acids. N-6 PUFA is a diet rich fatty acid which is derived from the above. The fatty acid content in algae makes it a well-known bioactive compound which is very useful in the pharmaceutical industry.

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SOME MARVELLOUS BLUE GREEN ALGAE AND THEIR USES

- **Enteromorpha:** It can be used to treat hemorrhoids, parasitic disease, goiter, coughing and bronchitis; fever reducing capacity and ease pain.
- **Acetabularia:** This can be used to treat urinary diseases and edema.
- **Laminaria:** It can be used for thyroid problems and urinary diseases.
- **Sargassum:** It can be used to treat cervical lymphadenitis, edema; diminishes inflammation; induces urination; contains both iodine and potassium
- **Gelidium:** can be used to extract agar
- **Corallina:** It can be used as pesticides
- **Grateloupia:** Blood sugar lowering capability
- **Gloeopeltis:** Treatment for tonsils, goiter.

CONCLUSION

Upcoming trend, and looking at the above applications it's becoming friendlier. Seeing the ability of bioactive compound production, especially by green algae is a boon to the pharmaceutical industry.

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