Algal Applications in Human welfare

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Abstract: ***This paper deals with medicinal uses in Human welfare of different types of Algae. Algae have long been recognized as potent agents. An increasing number of research conducted in the last several years point to algae's promise in medicine. The objective of this study is to highlight the key developments in the use of algae to medicine. Algae, including macro- and microalgae, are useful for a wide range of applications because of their bioactive components, which include polyphenols and polysaccharides.***

Keywords: Algae, Antioxidant, Anticancer, Therapeutic, Bioactive potential, dentistry, medicinal applications, Human welfare.

1. INTRODUCTION

Algae are subgroup of thallophytic members. Algae are simple chlorophyllous, autotrophic (photosynthetic) plants. It has been demonstrated that algae fix 50% of carbon dioxide. They raise the oxygen concentration of their environment because they are autotrophic (photosynthetic). They provide as food for several creatures and are major producers. Algae are the source of several commercial items, including align. Algae exhibits a complete ranges of pigments. They are mostly found in aquatic (marine and fresh water) environment. They also exhibits in diverse environment such as on or below the soil layer, wet logs, hot waterfalls, moist rocks, snow (polar areas) etc. Variety of pigments are found in the algae. There is a long history of using algae for food, fodder, agriculture, industry, and medications. About 600 BC, it was consumed as food in China. Since ancient times, algae have been utilized in traditional medicine, and more and more researchers are realizing the benefits of algae. Algae are creatures that resemble plants and generate a variety of chemicals that have therapeutic uses. Since ancient times, algae have been recognized as effective agents. An increasing number of research conducted recently point to the potential uses of algae in medicine. The purpose of this study is to highlight the most significant developments in algae utilization for the health of humans. Algae, both micro- and macroalgae, have a multitude of applications because of their bioactive components (polysaccharides, polyphenols and more). They were employed as antiviral drugs, anticancer therapies, and their antioxidant effect was demonstrated. They have also been demonstrated to have anti-hypertensive and anti-hyperglycemic properties because of their polysaccharides. Several microalgal species have been successfully employed to treat infections of the bladder and kidneys. Certain algae are used in orthodontics. Because of their anti-microbial action, which can help prevent cavities, they were added to toothpaste to lower the risk of cavities. It was also shown that bioactive chemicals derived from algae has neuroprotective qualities.

2. ALGAE USE IN SINGLE CELL PROTEINS

Single cell protein (SCP) yields from many unicellular microorganisms such as bacteria, fungi, yeast and algae. SCP is a rich source of essential amino acids and may be utilized as a protein substitutes to both humans and animals. A single cell protein (SCP) has several therapeutic applications, including such as:

i. Enhancing Eye and Skin health: SCP promotes healthy skin. SCP, is beneficial in cosmetics and dermatological products to keep hair healthy and to make herbal beauty items like lipsticks and face lotions etc. Eyes health benefits of SCP are especially noteworthy.
ii. Managing obesity: SCP is an excellent dietary fiber source that's why Through lowering blood sugar and preventing the buildup of high-density lipids, SCP can contribute to the reduction of obesity.
iii. Supplements of Protein: For youngsters who are undernourished, SCP can be administered as a protein supplement.
iv. Pharmacological and therapeutic applications: SCP might be used medicinally and pharmaceutically to regulate stress, blood sugar, cholesterol and weight. [14]

3. DIFFERENT TYPES OF PIGMENTS EXTRACTS FROM ALGAE AND THERE APPLICATIONS

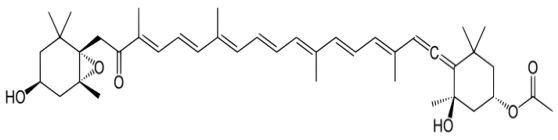
Algal pigments are classified into distinct categories: carotenoids, phycobilins, and chlorophylls. Among the well-known carotenoids with applications such as antioxidant, anti-inflammatory, immunoprophylactic, and anticancer properties are lutein, astaxanthin, fucoxanthin, zeaxanthin, canthaxanthin and β-cryptoxanthin.

3.1 Fucoxanthin:

Fucoxanthin, (formula $C_{42}H_{58}O_6$), is a xanthophyll. Brown algae and most other heterokonts include it as an accessory pigment in their chloroplasts, which gives them an olive-green or brown coloration. Brown algae that is edible contains a marine carotenoid called fucoxanthin, which has a number of possible health advantages such as:

i. Anti-angiogenic: By preventing breast cancer from developing and tumor-related lymphangiogenesis, fucoxanthin may mitigate cancer.
ii. Hepatoprotective agent: Fucoxanthin can lower the amount of lipids in the liver and prevent the development of lipid droplets in the liver.
iii. Antioxidant: Strong antioxidant fucoxanthin shields cells from singlet molecular oxygen and free radical damage.
iv. Anti-inflammatory: There are anti-inflammatory qualities to Fucoxanthin.
v. Anti-obesity: Fucoxanthin increases energy expenditure, which may assists in preventing the obesity and type 2 diabetes.
vi. Metabolism of bones: Disorders connected to aberrant bone metabolism may be controlled with the use of Fucoxanthin.
vii. Mental abilities: Fucoxanthin has the potential to protect cognitive function by lowering oxidative stress on the brain.

viii. Anti cancer: Inhibiting the motility and invasion factors of cancer cells with fucoxanthin may help stop cancer cells from spreading. [1] [2] [6]

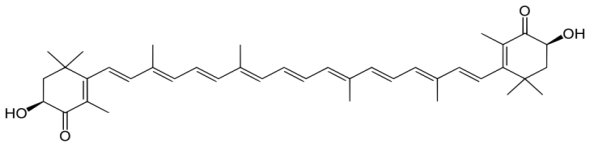


Chemical structure of fucoxanthin
(Source:
https://www.wikidata.org/wiki/Q96385#/media/File:Fucoxanthin.svg)

3.2 Astaxanthin:

Astaxanthin (formula $C_{40}H_{52}O_4$) belongs to a class of chemicals called carotenones or terpenes, which are keto-carotenoid molecules. Astaxanthin is a red-pigmented ketocarotenoid that is found in some types of algae (Haematococcus pluvialis) and yeast (Xanthophyllomyces dendrorhous).

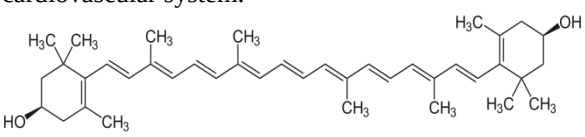
Age-related macular degeneration (visual loss) and stroke are among the conditions treated with Astaxanthin, along with excessive cholesterol, liver illnesses, Alzheimer's, Parkinson's diseases, and cancer prevention. Additionally, Astaxanthin is used to treat metabolic syndrome, which is a precursor to a number of diseases including diabetes, heart disease, and stroke, as well as to enhance exercise performance. [5]



Chemical structure of Astaxanthin
(Source:
https://en.wikipedia.org/wiki/Astaxanthin#/media/File:Astaxanthin.svg)

3.3 Zeaxanthin:

Many groups of microalgae, such as cyanobacteria, rhodophytes, chlorophytes (green algae), and certain species of heterokonts, contain Zeaxanthin (formula $C_{40}H_{56}O_2$). Zeaxanthin, a potent antioxidant, shields the body from erratic substances known as free radicals. Free radicals have been shown to damage cells, hasten aging, and increase the risk of heart disease, cancer, type 2 diabetes, and Alzheimer's.
Zeaxanthin is sometimes referred to as a "eye vitamin" since it instantly begins to benefit the eyes as soon as it enters the body. The mechanism enters the lens, macula, and fovea—the central region of the retina—in order to function.
Zeaxanthin has several applications and is clearly beneficial for the eyes, liver, skin, and cardiovascular system. [3] [4]



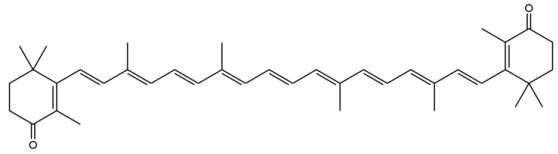
Chemical structure of Zeaxanthin
(Source:
https://en.wikipedia.org/wiki/Zeaxanthin#/media/File:Zeaxanthin2.svg)

3.4 Canthaxanthin:

The keto-carotenoid pigment canthaxanthin (formula $C_{40}H_{52}O_2$) is present in bacteria, green algae, and blue-green algae. Fish, crabs, and edible mushrooms all contain it. Strong antioxidant canthaxanthin is a food coloring ingredient used in several nations, including the EU and the US. Additionally, it is a component of chicken, salmon, and trout diet. Canthaxanthin can be utilized for reducing photosensitivity, or sensitivity to sunlight, in individuals with erythropoietic protoporphyria (EPP), a rare hereditary illness. In certain individuals, exposure to sunlight might result in skin responses including eczema, rashes, and itching. Additionally, canthaxanthin is utilized to lessen light sensitivity brought on by some drugs and medical conditions.

Canthaxanthin is added to animal feed to enhance the color of salmon, trout, egg yolks, and chicken skins. It is used as a food pigment in food.

Cathaxanthin is utilized in the production of pharmaceuticals and cosmetics. [7]



Chemical structure of Canthaxanthin
(Source: https://en.wikipedia.org/wiki/Canthaxanthin#/media/File:Canthaxanthin.svg)

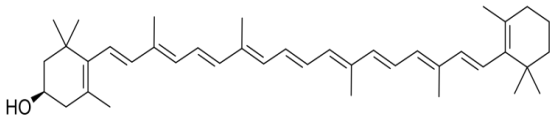
3.5 β-cryptoxanthin:

β-cryptoxanthin (formula $C_{40}H_{56}O$) is a natural carotenoid pigment that is found in several types of algae such as green algae (Caulerpa racemosa) and marine alga (Nanochlorum eucaryotum). β-Cryptoxanthin is a carotenoid pigment with several possible health advantages, such as:

i. Antioxidant: Strong antioxidant β-cryptoxanthin could be beneficial in preserving the body from harmful free radicals.
ii. Inflammation: Rheumatoid arthritis and inflammation may be decreased by β-cryptoxanthin.
iii. Anti cancer: It is possible that β-cryptoxanthin lowers the risk of non-small-cell lung cancer, among other malignancies.
iv. Bone health: By promoting bone formation and preventing bone resorption, β-cryptoxanthin might potentially aid in the prevention of osteoporosis.

β-cryptoxanthin is regarded as a provitamin A since it is transformed by the body into vitamin A (retinol). Like other carotenoids, β-cryptoxanthin is an antioxidant that may aid in preventing DNA and cell damage caused by free radicals and in promoting the repair of oxidative DNA damage.

The negative relationship between β-cryptoxanthin and the risk of lung cancer, as seen in several observational epidemiological research, raises the possibility that β-cryptoxanthin might serve as a chemopreventive agent for lung cancer. Conversely, a moderate to high intake of β-cryptoxanthin (for second tertile and for highest tertile compared to lowest tertile, in all cases) was linked to a worse survival rate in the Grade IV histology group of adult patients diagnosed with malignant glioma. [8] [9]



Chemical structure of β-cryptoxanthin
(Source: https://en.wikipedia.org/wiki/%CE%92Cryptoxanthin#/media/File:Cryptoxanthin.svg)

3.6 Lutein:

Lutein (formula $C_{40}H_{56}O_2$) is found in different types of microalgae such as Chlorophyceae (Chlorella zofingiensis, Muriellopsis, Scenedesmus), Ulvophyceae, Charophyceae, Chlorellaceae (auxenochlorella protothecoides).

The yellow-orange pigment lutein offers a number of possible health advantages, such as lowering the risk of cancer, promoting heart health, protecting the, Neurodegenerative Diseases, skin and promoting eye health. Lutein is a potential agent against Inflammation and Cancer.

In order to prevent cataracts and macular degeneration and to keep the eyes healthy, lutein is essential. [3]

3.7 Phycobilins:

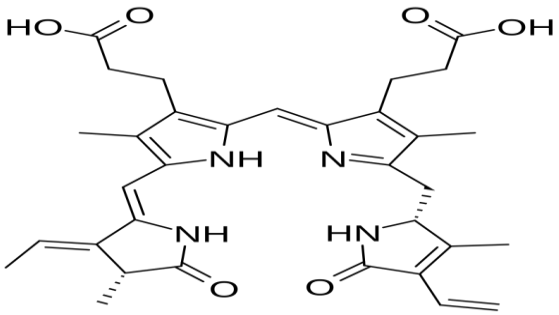
Algae and cyanobacteria have pigments called phytobilins (formula $C_{33}H_{38}N_4O_6$) that absorb light and aid in photosynthesis. Red algae and cyanobacteria have auxiliary photosynthetic pigments called phycobilins. These are water-soluble proteins with vibrant colors.

Phycobilins, also known as phycobiliproteins (PBPs), have many uses, such as:

i. Photodynamic therapy: In photodynamic treatment, phytobilins function as photosensitizers for treating cancer.
ii. Cosmetics: Phycobilins can be found in lipsticks, eye cosmetic powders, and fragrances.
iii. Food coloring: Phycobilins are naturally occurring colorants found in desserts, ice cream, and drinks.
iv. Nutraceuticals: Phycobilins have anti-inflammatory, antiviral, anticancer, and liver-protective characteristics, indicating their potential as nutraceuticals.
v. Fluorescent tags: Phycobilins are employed as fluorescent dyes in immunology and flow cytometry, as well as fluorescent tags in these fields.

There are four types of phycobilins:

a. Phycoerythrobilin, which is red in color.
b. Phycourobilin, which is orange in color.
c. Phycoviolobilin (also known as phycobiliviolin) found in phycoerythrocyanin.
d. Phycocyanobilin (also known as phycobiliverdin), which is blue in color. [10] [11]

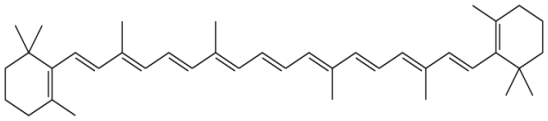


Chemical structure of Phycoerythrobilin
(Source: https://en.wikipedia.org/wiki/Phycoerythrobilin#/media/File:Phycoerythrobilin_v2.svg)

3.8 β-carotene :

The β-carotene (formula $C_{40}H_{56}$) found in Dunaliella salina is abundant in nature. It is a green, the halophilic microalga that grows in coastal, hypersaline environments. The pigment known as β-carotene is the substance that gives fruits and vegetables their yellow, orange, and red hues. Among its many applications such as:

i. Antioxidant: β-carotene shields cells from free radical damage, which can result in long-term health problems.
ii. Vitamin A: The body transforms β-carotene into vitamin A (retinol), which is necessary for healthy skin, eyes, and immune systems.
iii. Food coloring: The butter and other foods are colored by β-carotene. [13]



Chemical structure of β-carotene
(Source: https://en.wikipedia.org/wiki/%CE%92-Carotene#/media/File:Beta-Carotin.svg)

4. CONCLUSION

The medical industry can benefit from the bioactive potential of algae, including macro- and micro-algae. In addition to its usage in dentistry (toothpaste), algae have antibacterial and antiviral properties. They also have an anti-hyperglycemic impact. Additionally, they are recommended for anti-hypertensive therapy due to their propensity to assist with angiotensin enzymes.

In our culture, cancer is getting more and more prevalent. Cancer therapies can cause further cell damage and are frequently difficult. Certain algae may have anti-cancer properties, and in the near future, simpler and more effective vaccinations will be available to assist lessen patients' suffering. The quality of life is frequently reduced in individuals with neurodegenerative disorders.

Due to its high protein, vitamin, mineral, and fat content, chlorella is utilized as food. Minerals including P, K, Ca, Mg, Fe, Zn, Co, and Mo are present, along with vitamins A, B, C, and E.
Agar-Agar, also known as polysaccharide, is derived from some rhodophyceae plants, including Geladium, Gracilaria, and Gigartina. It functions is used in culture mediums as well as in the treatment of constipation as a laxative. It is also used in making cosmetics, leather and textile industries.

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