جامعة جنوب الوادي
South Valley University

Medicinal Algae

for postgraduate students

Faculty of Science

By

Dr. Hani Saber

INTRODUCTION

Algae are one of the primary producers; it is the divisions of lower plants that contains chlorophyll in plant cells. They can be divided broadly into macro-algae (macroscopic algae) and microalgae (microscopic algae). Algae are important producers of vitamins, minerals and proteins and fatty acids etc. Amidst all these facts the facts pertaining to algae are not concentrated and focused to the level it has to be.

Marine algae have been used as food, and medicine from centuries. The species of algae find its applications in food, dairy, pharmaceutical, cosmetic, and industry. Algae can be in the preparation of Biodiesel, Bioethanol, biobutanol and Hydrogen gases, and could be used as antioxidants, antibiotics, and/or virostatic agents. Food products prepared from algae could involve positive negative or disputable effects in mammalian organism. Hence higher contents of toxic elements (e.g. cadmium) or fucotoxins (algal protective compounds against herbivore attack and pathogens) in algal food products are to be avoided. Thereby the digestibility and the contents of dietary fiber and bioactive compounds in algae play an important role in the evaluation of algal food quality. Digestibility is studied on the basis of nitrogen consumption before and after the process of digestion, using enzymes namely pepsin under *in vitro* conditions. Several analytical methodologies are available for the study of bioactive compounds in algal material.

Overview of algae

Algae are a large and diverse group of chlorophyll bearing, simple, photosynthetic, thalloid organisms largely aquatic with no differentiation of true roots, stems and leaves, belonging to the division Thallophyta.

Algae are mainly aquatic found in both marine water and fresh water. Algal habitats include terrestrial, such as wet rocks and moist soil and sub aerial, like tree barks; they can flourish at low temperatures. Some algae are found in symbiotic association with fungi (*Lichens*) and animals e.g. sloth bear.

Algae may be free floating such as *Chlamydomonas* or they can be attached to substratum e.g. *Ulothrix* and *Sargassum*. Algae have different form and size from unicellular (e.g. *Chlamydomonas*) to multicellular (e.g. *Laminaria*), colonial (e.g. *Volvox*) to filamentous forms (e.g. *Ulothrix*) and microscopic to massive plant bodies. Algae are covered by mucilage just as other aquatic plants. Algae lack vascular tissues and mechanical tissues because being aquatic, they do not require water conduction and buoyancy keeps them upright in water.

Reproduction of algae can be vegetative, asexual and sexual. Vegetative reproduction takes place through fragmentation. A sexual reproduction in algae is accomplished by spores called zoospores, which are of two types: mitospores and meiospores. Sexual reproduction involves isogamy, anisogamy and oogamy.

Algae can be used as food and food supplement for humans and they are primary producers for aquatic animals. Some marine algae also produce hydrocolloids (water holding substances) such as algin

(from *Laminaria*), carrageenan (from *Chondrus*) and agar (from *Gracilaria* and *Gelidium*) which can be used in production of variety of commercial products. Algae can photo synthesize, fix CO_2 and they release enormous amount of oxygen.

Algae used as Medicine and Food

Algae are primary producers which are a source of many nutrients and it has high protein content. Algae assigned higher contents of dietary fibers. Certain beverages are prepared from sea algae. Mainly marine algae have been used as food and medicine for many centuries. They are not only used as food but also used as extracts in food, dairy, cosmetics, and industrial uses. Algae are used as one of important medical source due to its antioxidant, anticancer, antiviral properties. Therapeutic properties of algae are used for promotion of health. Edible algae are recognized as complete foods which provide correct balance of proteins, carbohydrates, vitamins, and minerals.

Algae have been used for centuries, especially in Asian countries, as a remedy to cure or prevent various physical ailments. Scientific research has established a connection between these nutrient-rich sea plants and the body's immune system response. It all started when intensive studies of marine life began in the 1970s to locate potential sources of pharmacologically active agents. Researchers found that algae contain a remarkable amount of components valuable for human health.

Algae are beneficial in the following ways:

1. It is a complete protein with essential amino acids (unlike most plant foods) that are involved in major metabolic processes such as energy and enzyme production.

2. It contains high amounts of simple and complex carbohydrates which provide the body with a source of additional fuel. In particular, the sulfated complex carbohydrates are thought to enhance the immune system's regulatory response.

3. It contains an extensive fatty acid profile, including Omega 3 and Omega 6. These essential fatty acids also play a key role in the production of energy.

4. It has an abundance of vitamins, minerals, and trace elements in naturally-occurring synergistic design.

With all these benefits, it is no wonder why extensive research is being conducted on algae as a medical treatment.

Ever since the ancient times in China, kelp has been considered an elixir of longevity because it is rich in iodine and potassium that can help treat goiter and prevent high blood pressure. In fact, *Digenea simplex Agardh* is often used as an ascaricide for children. In recent years, some research studies have shown that algae can reduce fever, diminish inflammation, prevent cancer and thrombus. It has been proven that algae have antibacterial, ecbolic, hemostatic and diuretic properties. Phycolloids extracted from algae are often used to treat injuries. It is also an ingredient in medicines used to treat ulcer, to help enhance the formation of connective tissue, to treat hemostasia, to help lower cholesterol levels and lower blood pressure.

Brown algae are used in various goiter medicines due to their high iodine content. *Sargassum* which is used against goiter and other glandular troubles. Insect diseases to humans are treated with extract from *Corallina, Digenia, Codium, Alsidium* and *Durvillea*. Algae are used in the treatment of kidney, bladder and lung disease in China and Japan. *Gelidium* is used in stomach disorders and in heat induced illness.

The following table lists various algae used in medicine and their respective uses:

Phyllum	Genus	Use
Chlorophyta	*Enteromorpha*	Can be used to treat hemorrhoids, parasitic disease, goiter, asthma, coughing and bronchitis; they reduce fever and ease pain
	Ulva	Can be used to treat goiter; reduce fever, ease pain, induce urination
	Codium	Can be used to treat urinary diseases, treat edema, expel ascarid; is an ecbolic
	Acetabularia	Can be used to treat urinary diseases and edema
Phaeophyta	*Ishige*	Can be used to treat cervical lymphadenitis, to diminish inflammation and to induce urination
	Laminaria	Can be used to treat goiter, urinary diseases; is an ecbolic; contains iodine and potassium
	Endarachne	Can be used to treat urinary diseases, edema, gastric diseases and hemorrhoids
	Sargassum	Can be used to treat cervical lymphadenitis, edema; diminishes inflammation; reduces fever; induces urination; contains iodine and potassium

Rhodophyta	*Porphyra*	Can be used to treat goiter, bronchitis, tonsillitis and cough
	Gelidium	Laxative; can be used to treat tracheitis, gastric diseases and hemorrhoids; can be used to extract agar
	Pterocladiella	Laxative; can be used to treat tracheitis, gastric disease and hemorrhoids; can be used as an agar extract; can be used to make coating for pills
	Eucheuma	Can be used to treat goiter, tonsillitis, bronchitis, asthma, cough, gastric diseases and hemorrhoids
	Corallina	Marl, parasiticide
	Gracilaria	Can be used to treat goiter, edema, urinary diseases, can prevent ulcer; can be used to as an agar extract and make coating for pills
	Hypnea	Can be used to treat bronchitis, gastric diseases and hemorrhoids; can be used to make carragenate
	Chondrus	Can be used to treat bronchitis, tonsillitis, gastric diseases, asthma and cough; is an adhesive, can be used to make carragenate
	Centroceras	Can be used to treat gastro-intestinal intolerance
	Chondria	Ascaricide
	Grateloupia	Ascaricide; lowers blood pressure
	Gloeopeltis	Can be used to treat goitre, tonsillitis and bronchitis; prevents high blood pressure and scurvy

Biological activity of algae

Algae produce variety of chemically active metabolites in their surroundings as a weapon to protect themselves against other settling organisms. There are lots of reports on macro-algae derived chemical compounds that possess ranges of biological activities, out of which some could be used in pharmaceutical industries. During the last several decades, many novel compounds have been isolated from seaweeds and some of these substances have been identified to possess interesting biological activities. Some examples of different bio-activities derived from algae are given in the following sections.

Antioxidant Property and Anticancer Activity

Antioxidants can protect human health against damage by reactive oxygen species (ROS). Oxidative processes promote carcinogenesis. Antioxidants play prominent role in the later stages of cancer development. The antioxidants may be able to cause the regression of premalignant lesions and inhibit their development into cancer. It is found that, several algal species have prevented oxidative damage by scavenging free radicals and active oxygen and hence able to prevent the occurrence of cancer cell formation, these antioxidants are considered key compounds to fight against various diseases (e.g. cancer, chronic inflammation, atherosclerosis and cardiovascular disorder) and ageing processes. The most powerful water soluble antioxidants found in algae are polysaccharides, polyphenolic compounds, phycobiliproteins and vitamins. The antioxidative activities of polyphenolic compounds from marine macroalgae have also been well investigated. Different types of

polyphenolic compounds (e.g. catechins, flavonols and flavonol glycosides) have been isolated from organic solvent extracts of several brown and red algae species. Polyphenols in marine brown algae are called phlorotannins and known to act as potential antioxidants. The antioxidative activities of sulphated polysaccharide derived from algae have been determined by several researchers using various methods. The sulphated polysaccharides when isolated from marine alga exert radical scavenging activities in vitro and in vivo.

Preliminary studies have indicated that some antioxidants, particularly *β*-carotene, may be of benefit in the treatment of precancerous conditions such as oral leukoplakia, possibly a precursor of oral-cancer.

The antioxidant activities of different seaweed species show great variety. Brown algae normally possess better antioxidative activity than green and red algae due to its higher levels of total phlorotannin content (TPC). Some species of brown seaweeds have been reported by several researchers to exhibit superior antioxidant activity in vitro.

Some researchers investigated the antioxidative activities of phlorotannins derived from 25 common Japanese marine algae species. They reported that 50% ethanol extracts of the brown seaweed *Sargassum ringgoldianum* showed the highest radical scavenging activity. Antioxidant activities of 10 Icelandic seaweeds using various antioxidant assays were evaluated. The results showed high correlation between TPC of seaweed extracts and their scavenging capacity against DPPH (1,1-diphenyl-2-picryl hydrazil)

and peroxyl radicals, which indicated an important role of seaweed polyphenols as chain-breaking antioxidants.

Cytotoxic activity

The cytotoxic activities of organic solvent extracts of three brown algae species (*Sargassums wartzii*, *Cystoseira myrica*, *Colpomenia sinuosa*) were investigated. The results showed that extracts had some effects on different cancer cells. Two novel trihydroxylated diterpenes were isolated from the brown algae *Bifurcaria bifurcate*. Both compounds were tested in vitro for their cytotoxicity and proved to be active against the NSCLC-N6 cell line. Two novel cyclized meroditerpenoid satomarianones derived from the brown algae *Taonia atomaria* were found to exhibit significant cytotoxic activity against two lung cancer cell lines. The cytotoxic effects of nine halogenated monoterpenes isolated from the red algae *Plocamium cartilagineum* against different tumour cell lines were investigated. The results showed that some compounds had strong and interesting cytotoxic activities.

Antiviral activity

Several different compounds derived from algae show antiviral activities towards some viruses responsible for human infectious diseases. These substances include sulphated polysaccharides, fucoidan, sulfoglycolipids, carrageenans, sesquiterpene hydroquinones, etc.

Three dollabella diene derivatives from the brown algae *Dictyota pfaffi* showed strong anti-HSV-1 activity *in vitro* and one compound also inhibited the reverse transcriptase enzyme of HIV-1.

A new sulfolipid has been isolated from marine red algae, *Gigartina tenella*, as a potent inhibitor of eukaryotic DNA polymerases and HIV-reverse transcriptase type 1.

According to the findings of several researchers, sulphated polysaccharides from seaweeds *Aghardhiella tenera* and *Nothogenia fastigiata* show antiviral activities against human immunodeficiency virus, Herpes simplex virus, human cytomegalo virus and respiratory syncytial virus. Carrageenan isolated from the red seaweed *Gigartina skottsbergii* showed antiviral activity against herpes simplex virus types 1 and 2. Other researchers isolated three fractions of fucoidan from the brown seaweed *Leathesia difformis* and investigated their antiviral activities. They reported that these compounds showed selective antiviral activities against herpes simplex virus types 1 and 2 and human cytomegalo virus.

Anticoagulant activity

Some anticoagulant compounds have been found in algae. Fucoidin and compounds of laminarin are used as anticoagulant while carrageenin acts as blood coagulant. Fucoidans isolated from seaweed *Fucus evanescens* and *Laminaria cichorioides* kelp can inhibit thrombin and factor Xa of the blood coagulation system. Several investigators isolated an anticoagulant polysaccharide from the red algae *Lomentaria catenata* and assayed its anticoagulant activity using the methods of activated partial thromboplastin time, prothrombin time, and thrombin time. The results showed that the isolated compound may act on the intrinsic and/or common pathways of the blood coagulation system. The acidic polysaccharide

from the brown algae *Laminaria cichorioide* was isolated and tested the anticoagulant activity. The result showed that sulfated fucan from *L. cichorioides* is a promising anticoagulant polysaccharide and a possible alternative for an antithrombotic compound due to its preferential heparinco factor II-dependent activity.

Anti-inflammatory activity

Researchers evaluated anti-inflammatory activity of 3-O-beta-D glucopyranosyl-stigmasta-5, 25-dien which was isolated from the marine green algae, *Ulva lactuca.* A chlorophyll-related compound, pheophytin a, has been identified from an edible green algae, *Enteromorpha prolifera*. The anti-inflammatory effects of pheophytin a have been analysed using *in vitro* and *in vivo* experiments and the results suggest it has a potent anti-inflammatory activity. A new phlorotannin called phlorofucofuroeckol-B was isolated from the brown algae *Eisenia arborea*. The compound was found to have an inhibitory effect on histamine release from rat basophile leukemia (RBL)-2H3 cells.

Antibacterial and Antifungal activity

It is well known that the pathogenic microbes (for example *Pseudoalteromonas porphyrae*, *Pseudomonas elongate*, *Bacillus polymyxa, Deleya marina* in the oceanic ecosystem can devastate populations of sea weeds. Yet, these sessile organisms suffer remarkably low levels of microbial infection, despite lacking cell-based immune systems. Sea weeds might use targeted anti-microbial chemical defense strategies by eliciting secondary metabolites, which

are important in ecological interactions between marine macro organisms and microorganisms. Therefore, seaweeds could be a promising source of novel bio-active compounds that can help plant survival by offering protection against stress imposed by the environment.

Algae have recently received significant attention in the search for bioactive compounds to develop new drugs and health foods. Many compounds of marine algae show anti-bacterial activities such as polysaccharide, lyengaroside, polyhydroxylated fucophlorethol, bromophenols, guaiane sesquiterpene, lactone malyngolide, cycloeudesmol, polyphenolic compound, halogenated compound and quinone metabolite. Antibacterial activities of compounds derived from algae have also been extensively studied by several researchers.

The cell extracts and active constituents of various algae have been shown to have antibacterial activity in vitro against Gram-positive and Gram-negative bacteria. A wide range of results of in vitro anti-fungal activities of extracts of green algae, diatoms, and dinoflagellates have also been reported.

Recently, much attention has been paid to seaweeds as a source of bioactive compounds as they are able to produce a great variety of secondary metabolites characterized by a broad spectrum of biological activities with antibacterial and antifungal activities which acts as potential bioactive compounds of interest for pharmaceutical applications. Most of these bioactive substances isolated from marine algae are chemically classified as brominated, aromatics, nitrogen-heterocyclic, nitrosulphuric-heterocyclic, sterols, dibutanoids, proteins, peptides and sulphated polysaccharides.

Studies of the antibacterial activities of algae against pathogenic bacteria and fungi in humans have shown evidence of antimicrobial activity in *Ulva lactuca*, *Padina gymnospora*, *P*. *Sanctae-cruces*, *Sargassum wightii*, *Caulerpa sertularioides* and *Gracilaria edulis* against *Staphylococcus aureus, S. epidermidis, Bacillus subtilis, B. cereus, B. anhtracis*, *Lactobacillus acidophilus, Pseudomonas aeruginosa, E. coli., Proteus mirabilis, Salmonella typhi, Shigella flexneri, Vibrio alginoyticus, Candida albicans* and *Aspergillus niger*. An extract of the green algae *Caulepra prolifera* was reported to demonstrate significant activity against strains of marine bacteria.

Algae have been recognized as potential sources of the antibiotic substances. Antibiotic chlorellin is extracted from *Chlorella vulgaris* which inhibits the growth of certain bacteria. The growth of *Escherichia coli* (*E. coli*) is found to be reduced by *Nitzschia palea* (diatom). *Microcystis* reveals inhibitory action to *Staphylococcus, Closteridium*.

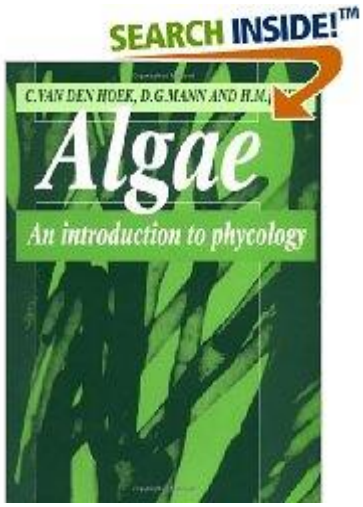
The antibacterial substances in algae are usually extracted by water or organic solvents such as methanol, ethanol, acetone, ethyl ether, diethyl ether, ethyl acetate, chloroform, dichloromethane, benzyne, hexane, chloroform: methanol (2:1), and chloroform: ethanol (1:1, 2:1). The antibacterial assays are usually done by paper disc diffusion assay, absorbance measurements and growth studies.

Algae: Protection against radiation and environmental pollutants

There is no family of foods more protective against radiation and environmental pollutants than marine algae. Scientific studies show that marine algae, such as kelp (Laminariales), contain sodium alginate, which has the ability to bind to radioactive strontium. Sodium Alginate provides a pure source of this excellent chelator known for its ability to bind to heavy metals, including radioactive particles and everyday environmental toxins. Research shows heavy metals, cigarette smoke and other toxins cause extensive damage to the liver, kidneys, lungs, heart and brain cells, and weaken immune defenses. Sodium alginate, an extract from brown algae, is known for its ability to bind to strontium, lead, mercury, cadmium, arsenic, barium and aluminum. These toxic materials deposit into kidneys, brain, liver, bones and marrow, and interfere with proper vitamin and mineral utilization. Sodium Alginate is indicated for all autoimmune disorders, including chronic fatigue syndrome, multiple sclerosis and fibromyalgia; and for attention deficient and hyperactivity disorder (ADHD), autism, gastrointestinal disorders and hypercholesterolemia. Sodium Alginate is essential for any heavy metal detoxification program, especially for barium, cadmium, lead, strontium and mercury, and for toxic environmental fumes.

Eating marine algae such as kelp will detox and protect from radiation. Kombu (*Saccharina japonica* or *Laminaria japonica*), a member of the kelp family (Laminariaceae), is one of the most radioprotective marine algae because it is high in fucoidan, a potent radioactive detoxifier. Bladderwrack (*Fucus Vesiculosus*), another type of marine algae, is also rich in fucoidan and can protect and

detox from radiation. Marine algae are also rich in iodine, which has a protective effect on the thyroid in the event of a nuclear disaster. They also bind to and detox heavy metals. The U.S. Atomic Energy Commission recommends that we consume two to three ounces (wet weight) of marine algae per week, or two tablespoons daily to protect from radiation toxicity. This should be increased fourfold during or after direct exposure to radiation.



In 1974 a report was published by I. Yamamoto *et. al.* in the Japanese Journal of Experimental Medicine, (44: 543-46). These scientists reported that several varieties of Kombu Mojaban (common sea vegetables eaten in Asia and traditionally used as a decoction for **cancer** in Chinese herbal medicine) were effective in the treatment of **tumors** in laboratory experiments. "In three of four samples tested, inhibition rates in mice with implanted sarcomas ranged from 89-95%." "The tumor underwent complete regression in half of the mice in each treated group." Similar experiments on mice with leukemia have also shown promising results."

Doctors are using Marine phytoplankton to reduce the side effects of chemotherapy and radiation: Research indicates marine phytoplankton can protect against some of the noxious side effects of chemotherapy and radiation.

Algae Extract Fights Ebola, HIV, SARS and HCV:

While researchers scramble to develop a vaccine or monoclonal antibody against the Ebola virus – and continue to develop chemo treatments to stem HIV and Hepatitis-C while fearing SARS – nature has already provided a natural treatment.

Research has shown that a healthy strong immune system can allow a person to not only avoid contracting the disease – but become resistant to it as well.

Hunting Natural Immunity For Ebola

After the two 1996 Ebola outbreaks in Gabon Africa, medical scientists determined that about Ebola causes death among about 70 percent of those who contracted the virus.

This question led researchers from Gabon's Franceville International Center of Medical Research to investigate. The questions ensued: Why don't the other 30 percent die? How do 30 percent of those infected recover?

Furthermore, medical researchers found many instances where there were close contacts of those who became infected who never were infected at all. Even though they were in contact with the infected patient while the patient was symptomatic.

Note: According to the available evidence, an infected patient with Ebola must be symptomatic in order to be contagious – with fever and other flu-like symptoms. A person must also have direct mucosal or blood contact in order to become infected with the virus. This means a transfer of saliva, urine, semen or blood from one person to another.

Thus, when the researchers investigated "close contact" individuals, they focused upon those who had this sort of exposure.

Ebola Antibodies

The research found that nearly half of those who were asymptomatic and seemingly immune developed antibodies (IgM and IgG) to the Ebola virus.

This means these individuals certainly were intimately exposed to the virus, but simply naturally developed the immunity tools - including those discussed below - that prevented the infection from replicating out of control.

Furthermore, the asymptomatic group exhibited greater anti-inflammatory responses in general. They were found to have higher levels of circulating cytokines and chemokines – which speed up the body's natural ability to break down the viral cells and stop their activity within the body.

They concluded:

"Asymptomatic individuals had a strong inflammatory response by high circulating concentrations of cytokines and chemokines."

Mannose-Binding Lectins Attack Ebola Virus

The particular mechanism with which the body naturally breaks down and prevents infection from lethal infections including Ebola, HIV, HCV and SARS has gradually emerged.

The mechanism is called mannose-binding lectins. Mannose-binding lectins are apparently produced in the human body via a DNA sequence, called the MBL2.

When this part of our genes is in order, the body will produce and release these mannose-binding lectins into the bloodstream. Mannose-binding lectins will then recognize and glom onto certain

carbohydrate molecules that cover and make up various microorganisms.

These include fungi, bacteria and even parasites, which utilize glycoprotein shells to protect themselves. But they also include viruses. Once the lectins attach to these shells, they will break apart the surface of the microbe and basically break them down, allowing the body's other immune cells to kill off the microbe and prevent it from replicating.

In fact, a healthy body that produces good levels of these mannose-binding lectins will be able to easily fight off colds and flus, as well as other microbial infections. Several animal studies have shown mannose-binding lectins heartily beat down coronaviruses and infectious bronchitis.

Research over the past five years has found that low levels of mannose-binding lectins increases the risk of respiratory infections, including syncytial virus infections, pneumonia and others.

For example, in a study of 121 children, RSV-infections were associated with low levels of mannose-binding lectins. Nearly 70 percent of RSV-infected children had low levels of mannose-binding lectins. But other infections – especially those related to bacterial infections – are not necessarily connected with mannose-binding lectin levels.

When it comes to virulent infections such as Ebola, Hepatitis C and HIV, however, these are different. These viruses come with glycoprotein shells that protect the virus from being broken down.

Furthermore, the glycoprotein shell of the Ebola virus produces glycoproteins that damage cells, allowing the virus to penetrate and replicate within the cell.

Mannose-binding lectins actually break down this shell and the glycoprotein matrix through a mechanism called the lectin pathway.

Humans that don't produce enough of these mannose-binding lectins are not only more susceptible because they don't have enough lectins, but they are typically also immunosuppressed with regard to the rest of their immune system.

One of the reason some humans don't produce enough mannose-binding lectins is because of a slight genetic mutation, where the MBL2 gene is switched off. The reason for this mutation/switch-off has yet to be fully understood. (Guess - something to do with our toxic environment and/or nutritional deficiency).

Mannose-Binding Lectins from Algae

This brings us to the fun part. Yes, humans aren't the only critters that produce mannose-binding lectins. Algae also produce these profusely, which allow the algae to protect themselves from invasion by viruses.

The most promising form of mannose-binding lectins is a component of the *Scytonema varium* called Scytovirin. The protein extract was isolated by researchers from the National Cancer Institute at Frederick, Maryland in 2003. The protein contains 95 amino acids, and was found to bind to HIV-1 viral shells.

A similar antiviral protein was found in *Nostoc ellipsosporum* – called Cyanovirin-N. Both of these antiviral proteins did similar things – they broke down the glycoprotein shells of HIV and HCV.

Yet another anti-viral extract was found from the New Zealand red alga species, *Griffithsia sp*. This protein is called Griffithsin, abbreviated with GRFT.

Over the next few years, Griffithsin was tested against HIV-1 with great success in laboratory studies, which included studies with mice. The epidemic-potential virus SARS was also tested against Griffithsin, also with great success.

Multiple studies illustrated these effects. Research from the Center for Cancer Research in Frederick, Maryland found that Griffithsin not only stopped HIV-1 virus replication, but stopped cellular intrusion of the virus.

In 2010 Harvard researchers tested a recombinant version of Griffithsin – called rhMBL – against Ebola. Once again, they found the mannose-binding lectins were able to not only breakdown the viral shells of the Ebola, but when given to mice infected with Ebola, the mice became immune to the virus.

Yes, when the mice given the recombinant mannose-binding lectins were rechallenged with the Ebola virus, they were found to be immune to the Ebola virus.

Since that study other research has tested other animals with Griffithsin, with similar results.

Algae are Medical Solutions for Overweight, Obesity and Diabetes

Obesity and diabetes have become an epidemic globally. The Centers for Disease Control reported recently that one of three of our children born will develop diabetes.

An energy imbalance causes children and adults to be overweight. The body needs a certain amount of energy, which comes from the caloric energy in food to sustain basic life functions. Body weight tends to remain the same when the number of calories eaten

equals the number of calories the body uses or "burns." When people eat and drink more calories than they burn, the energy balance tips toward weight gain, overweight, and obesity.

Algae offer a set of solutions to moderate obesity, including satiety, fat and nutrient bioavailability. Satiation is the feeling of fullness during an eating episode that slows, and then stops the eater. Satiety starts after the end of eating and prevents further eating before the return of hunger. Enhancing satiation and satiety derived from food assists with weight control.

Algae offer a rich set of bioactive agents that facilitate efficient and healthful metabolic processes. The fibrous components of algae add bulk to the digestive tract reducing hunger, transit time, and intestinal pathologies. The fibrous bulk in algae foods delivers compounds that create a feeling of satiation.

Studies have revealed that the fibrous bulk reduces hunger pains by creating a feeling of satiety, which aids in avoiding weight gain and obesity. Avoiding hunger pains reduces the urge to find another bite to eat.

Research at the University of Copenhagen found dietary fiber from brown algae boosts satiety and promotes weight loss and weight maintenance. The researchers demonstrated that healthy subjects who took alginates and were allowed to eat as much as they wanted felt less hungry and ate less than the subjects not drinking fiber drinks with alginates. The 80 subjects who completed the study achieved a far larger weight loss with alginate treatment than those drinking a similar drink without alginates. Subjects in the seaweed fiber drink group lost 1.7 kg more body fat than those in the placebo group. The weight loss occurs because the alginates form a gel in the

stomach, which strengthens the gastrointestinal satiety signals to the brain. The gel takes up space in the stomach and gives an artificial feeling of fullness. When subjects feel full, they eat less than usual.

Macro or microalgal biomass contains high levels of dietary fiber and/or digestible crude protein and/or low saturation triglyceride oil. Homogenization methods to liberate free oil and fiber enhance the feeling of satiety in a human, thereby reducing caloric intake.

Algae polysaccharides also demonstrate anti-atherosclerotic functions, reducing blood cholesterol concentrations and cardiovascular disease risk. These soluble polysaccharides may act as prebiotics, stimulating growth of beneficial bacteria in the colon.

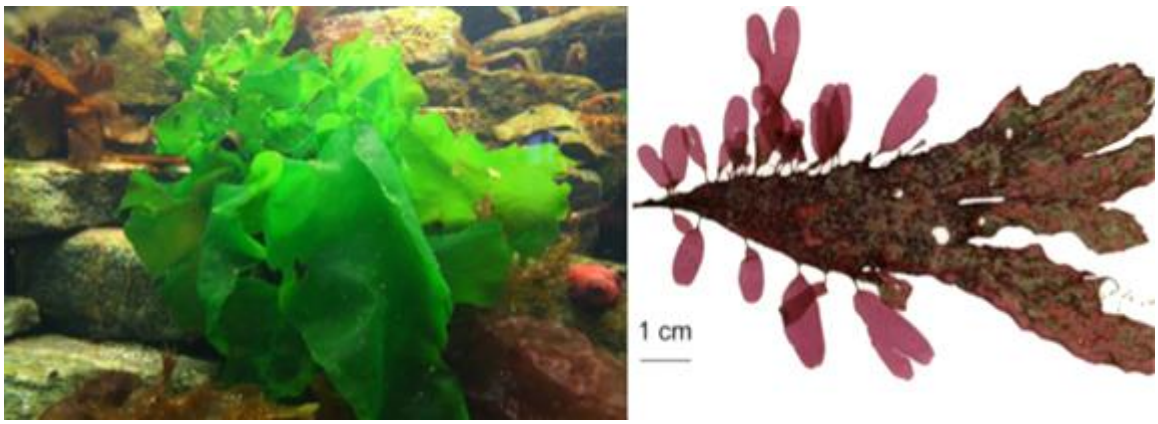
The soluble dietary fibers in algae provide value for avoiding obesity and diabetes. The total fiber content of several algae species, (~6 g/100g), is greater than that of fruits and vegetables promoted today for their fiber content: prunes (2.4 g), cabbage (2.9 g), apples (2.0 g), and brown rice (3.8 g).

Research shows that the fibers attenuate the blood glucose response after a meal. In long-term studies, algae fibers improved control of diabetes. Sodium alginate induces significantly lower postprandial rises in blood glucose, serum insulin and plasma C-peptides. The diminished glucose response, after the addition of sodium alginate in the diet, may lead to the delayed gastric emptying rate, induced by the fiber.

The effect of soluble fiber on the blood glucose response seems related to its ability to increase the viscosity of a meal. Viscous fibers slow the gastric emptying rate of a meal in subjects with and without diabetes. Alginate fiber offers a source of viscous dietary fiber in

algae-based foods. The main constituents of alginates are uronic acids (mannuronic and guluronic acids), which give the alginate characteristics similar to pectin (galacturonic acid).

Other research has investigated algae's ability to moderate hypoglycemic effects through enhancement of glucose uptake in the liver and in soleus muscles. Improved insulin sensitivity after algae treatment could be also due to lower serum non-esterified fatty acid levels. Insulin sensitivity tends to blunt elevated non-esterified fatty acids in diabetes. Phenolic-rich extracts from four edible marine macroalgae—*Ulva, Ascophyllum, Alaria*, and *Palmaria*—were found to offer biological components that inhibit replication of cultured colon cancer cells. These studies confirmed that phenolic extracts inhibit digestive enzymes and achieve anti-diabetic effects.



Ulva (Sea Lettuce) and *Palmaria*

Several studies have shown algae's ability to decrease lipids, lower blood sugar and improve diabetic symptoms. Research confirms that algae reduce triglycerides and low-density proteins in blood cholesterol, which helps regulate lipids, and offers other health benefits.

Most algae offer low-fat proteins that often have nutrient profiles superior to land-based plants, dairy or meat. The next generation of food processing will incorporate more low fat, nutrient rich algal components throughout the food system to improve health and reduce obesity.

Algae offer global nutrient deficiency solutions

The four most prevalent deficiency diseases globally are: malnutrition, nutritional anemia (iron and B12 deficiency), xerophthalmia (vitamin A deficiency), and endemic goiter (iodine deficiency). One tablespoon of algae a day can relieve these and other nutrient deficiencies, including vitamin B, C, D, E and K.

Algae synthesize all essential vitamins, which make algae a popular food for its many consumers. One hundred times more animals eat algae than any other food probably because each cell is a treasure trove of essential nutrients, vitamins, antioxidants and minerals.

Algae absorb a wealth of mineral elements that concentrate about one third of their dry biomass. The mineral macronutrients include sodium, calcium, magnesium, potassium, chlorine, sulfur and phosphorus, while the micronutrients include iodine, iron, zinc, copper, selenium, molybdenum, fluoride, manganese, boron, nickel and cobalt. Algae typically offer three to five times more minerals per bite than terrestrial foods. In addition, algae produce dozens of therapeutic compounds such as omega-3 fatty acids that are not found in land plants or animals.

Mineral availability

Mineral availability from land plants, particularly legumes and grain, is often compromised by phytic acid, which binds the minerals rendering them unavailable for absorption into the blood stream. In one investigation, phytic acid was undetectable in four species of marine algae, and iron absorption was 3.5 fold greater for marine algae compared to rice. Algae iron is easily absorbed by the human body because its blue pigment, phycocyanin, forms soluble complexes with iron and other minerals during digestion, making iron more bioavailable. Hence, unlike iron derived from land plants, the bioavailability of algal iron is comparable to that of heme iron in meats.

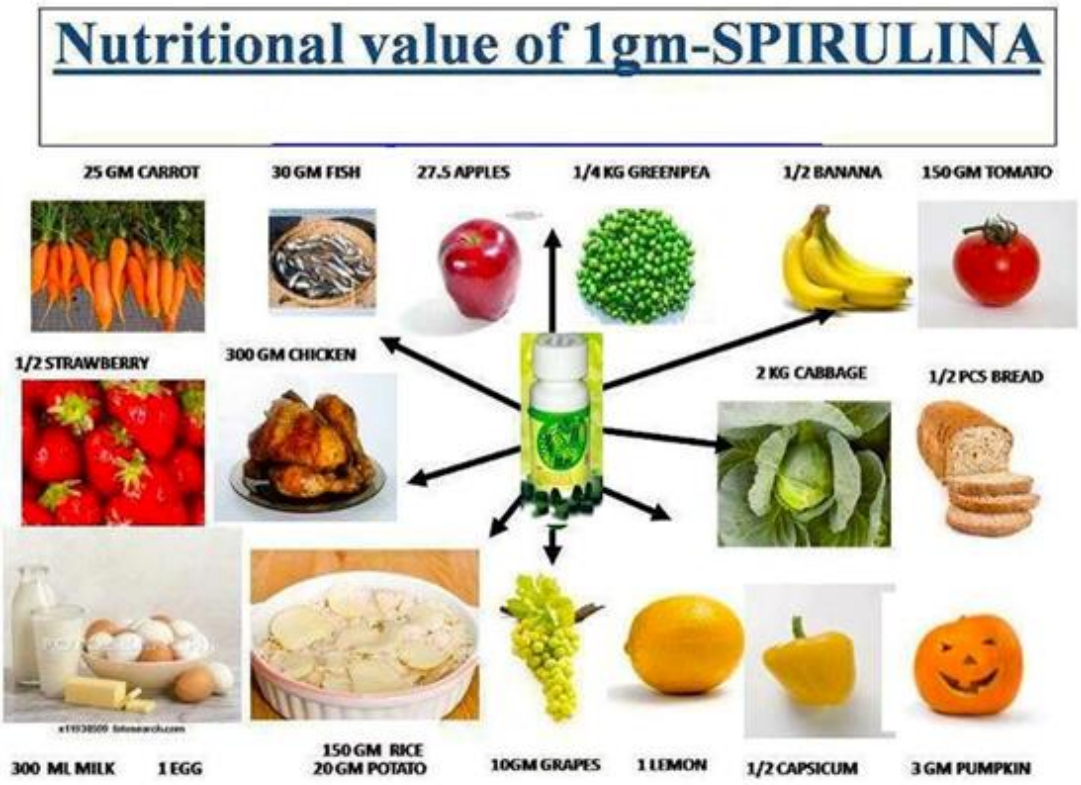
Algae are rich in iodine and selenium, critical trace elements that are highly variable in food supplies by geographic region. These minerals have caused serious endemic deficiency disorders throughout history. Algae concentrate these trace minerals and only small amounts of algae (1 tablespoon) provide sufficient levels of these nutrients when introduced into the diet. Some indigenous societies gain access to these minerals, vitamins and nutrients even from non-digestible algae and seaweed by chewing algae in a cud like chewing gum.

Algae's rich set of nutrients, antioxidants, enzymes and extracts, boost the immune system and enhance the body's ability to grow new blood cells. Algae are rich in phytonutrients and functional nutrients that activate digestive and immune systems. Algae compounds accelerate production of the humoral system (antibodies and cytokines), allowing it to better protect against invading germs.

Algal components also activate the cellular immune system including T-cells, macrophages, B-cells and anti-cancer natural killer cells.

Malnutrition

The World Health Organization, (WHO) cites malnutrition as the gravest single threat to the world's public health. Malnutrition may occur from insufficient usable protein or deficiencies in specific essential nutrients. Algae can provide a reliable protein source with three times more protein per unit of weight than rice and twice the protein of meat. Unlike herbivore meat, algae offer all nine of the essential amino acids and nearly all the essential nutrients.



Anemia

Humans have fought anemia from iron and B vitamin deficiencies for millennia because this blood disorder still plagues mankind today. Anemia is the most common blood problem and

creates a decrease in the normal number of red blood cells or less than the normal quantity of hemoglobin in the blood. Iron and B vitamins are essential for strong red blood cells and a healthy immune system. Since human cells depend on oxygen for survival, varying degrees of anemia can have severe medical consequences. Anemia causes weakness, fatigue, general malaise and brain dysfunction. Anemic children have trouble concentrating and learning. Severe anemia can cause loss of breath and cardiac arrest.

Anemia typically occurs from insufficient dietary iron. The WHO reports that iron deficiency currently affects the health and vitality of 3.5 billion people around the world. Algae are a demonstrated source of bioavailable iron, and the introduction of algae into a low iron diet increases iron absorption 3-6 fold.

B vitamin deficiency (B9, also known as folic acid or B12) is the leading cause of macrocytic anemia worldwide. In addition to the symptoms noted above, macrocytic anemia impairs female reproductive function and embryo/fetal viability. Folic acid concentrations in algae are comparable to many common fruits and vegetables. Unlike terrestrial plants, algae hold a unique place in the plant world as an adequate and reliable source of B12. Algae or algae foods buffer against anemia and the devastating impact this condition has on mental function, reproduction and physical vitality.

Vitamin A deficiency

Nearly half the children in the world today are vitamin A deficient, which causes blindness. The WHO estimates 13.8 million children to have some degree of visual loss related to vitamin A deficiency. Approximately 500,000 children in the developing world

go blind each year from insufficient vitamin A. Night blindness and color blindness are markers of vitamin A deficiency.

Land plants contain little pre-formed vitamin A and few people in developing countries can meet their nutritional requirement through the conversion of ingested beta-carotene to retinol. The bioconversion of beta-carotene to retinol is highly variable based on the plant's food matrix. Foods with complex matrices (fruits and vegetables including spinach and carrots) have poor conversion rates (15:1 to 27:1) compared to foods with simple food matrices. Algae have possibly the highest conversion rates for all foods (4.5:1), presumably due to its simple cell structure.

A diet of land-based plants in developing countries can lead to widespread vitamin A deficiency, which is catastrophic for human development. Algae consumption provides immediate relief from vitamin A deficiency symptoms, including the reversal of blindness in some situations. The Kanenbu tribe in Chad avoids vitamin A deficiency using a strategy they have used for centuries by adding about 10 grams of locally harvested algae to their meals each day. Various algal varieties provide ten times the beta-carotene (a provitamin A carotenoid) per pound than modern carrots. Vitamin A deficiency is often accompanied by zinc deficiency, which amplifies the health impacts. The same algae supplement provides sufficient daily zinc for adults and children.

Iodine deficiency

Over 2 billion people have insufficient iodine intake, making iodine deficiency the single largest preventable cause of mental retardation. Even moderate iodine deficiency, especially in pregnant women and infants, lowers intelligence by 10 to 15 I.Q. points. The

most visible and severe effects include disabling goiters, cretinism and dwarfism. About 16% of the world's people today have at least mild goiter, a swollen thyroid gland in the neck. The high iodine content in algae contributes to the low rates of goiter observed in countries where people frequently eat algae.

Algae in cosmetics

The applications of algae in cosmetic products have recently received more attention in the treatment of skin problems, such as aging, tanning and pigment disorders. There are also potential uses in the areas of anti-aging, skin-whitening, and pigmentation reduction products. While algae species have already been used in some cosmetic formulations, such as moisturizing and thickening agents, algae remain largely untapped as an asset in this industry due to an apparent lack of utility as a primary active ingredient.

Algae were discovered for the use in cosmetics because of its characteristics as true multi-talents for skin care. Algae promote blood circulation, provide the skin with moisture and regulate the sebaceous gland function. They activate the cell renewal and the metabolism, increase the skin's resistance, have an anti-inflammatory effect and drain the tissues.

Algae rehydrating the skin, tones it, prevent premature aging and the effect on prevention of skin cancer caused by solar radiation.

The antimicrobial substance obtained from algae can be used as soaps, lotions, shampoos, creams, etc.., applied to unbroken skin as a cleaning agent. It is assumed that the possible role of antimicrobial substances contained in this preparation to alleviate the symptoms of

adult acne, which are often accompanied by bacterial infection clogged pores.

Marine Algae is one of the most studied ingredients used in cosmetics, proven with supreme antioxidants powers, inflammatory and moisturizing properties. One of its varieties is Phaeophyceae, Brown algae, is rich in polyphenols and fucoidans, essential components to effectively perform anti-oxidant and anti-ageing actions by:

- Preventing damages to amino-acids within the skin and protect the cell's membrane.
- Combat damage caused by free radicals which accelerate the ageing process by attacking healthy cells and damaging collagen.

Extract of brown algae will also help the formation of collagen and elastin due to its high concentration of omega-6 and omega-3 fatty acids, leading to strengthening and tightening of our skin texture.

Red Marine Algae

How Red Marine Algae (RMA) can help you:

- RMA can assist the body's immune response to viruses. This can help to reduce the number of outbreaks and the severity of your outbreaks.
- RMA can reduce the formation of herpes virus colonies, also helping to reduce the number and severity of your outbreaks.
- RMA can be useful for weight-loss and lowering cholesterol, helping improve your overall health.
- RMA, a sea vegetable, has 10 to 20 times the amount of minerals than plants that grow on land, helping to maintain the proper alkaline balance in the body.

Red Marine Algae and Herpes - Alternate relief for Herpes?

Historically, there has been no long term relief for chronic sufferers of herpes simplex infections, let alone a cure. Herpes sufferers are seemingly at the mercy of this viral menace. Despite failure at the eradication of the herpes virus, success in the short term by temporarily suppressing its proliferation has yielded positive results. One such agent, acyclovir, a nucleoside analogue, has been regarded as the drug of choice by the medical community.

However, as with most drugs, there are side effects. Are there no alternatives?

There are as many known factors which contribute to a chronic case of herpes, while other factors remain a mystery. Finding ways to stop or curb some of the known factors which predispose one to herpes activity can be helpful. Chronic herpes sufferers are well accustomed to the recommended restrictions in diet and lifestyle. Yet, even healthy individuals who seemingly do everything right to lead a herpes-free life cannot escape this relentless virus. So, what's next?

Treatment with acyclovir relieves symptoms, reduces the amount of infectious virus released from the sores and speeds healing. The treatment does not prevent subsequent attacks or diminish their frequency or severity. The effect of acyclovir in a herpes virus infection is to inhibit the synthesis of viral DNA. Prophylactic courses of oral acyclovir can have a modest impact on recurrent infections, but the cost of the drug and its potential toxicity over the long term do not justify such regimens in most cases. In the majority of cases for genital herpes, general recurrency patterns returned within 8 to 25 days after stopping long term use.

Laboratory studies suggest prolonged administration of acyclovir as a prophylactic or its prescription for trivial infections might favor the appearance of virus strains that are both drug-resistant and pathogenic. This concern over the advent of drug resistant pathogens, has recently come to pass. The NIH reported that a new strain of genital herpes (HSV-II) has evolved upon which acyclovir had no effect.

Western medicine, armed with its infinite technological powers, can still help us. Many potent botanical agents have been investigated but never made it through the arduous process of drug approval. Difficulties in understanding the intricate process under which particular botanical agents interact within the human body has kept many useful medicines from ever reaching the people who most urgently need them. In addition, many botanical agents can only work in their whole plant form. They work on multiple levels and act synergistically within the body.

Although the actions of these botanical agents in whole plants (commonly described as herbs or medicinal plants) are difficult to trace and report scientifically, a close monitoring of clinical results by trained practitioners can be useful and show efficacy. Certainly, using our powers of observation to determine whether a particular treatment works better than no treatment, or better than some other treatment for a patient whose health status and history is well documented can be significant.

One such casualty of the drug approval process is a red marine algae in the family of Dumontiaceae. Research on antiviral carbohydrates from marine red algae indicate a high potential for low-cost, broad spectrum antiviral agents. Further research in the family of Dumontiaceae produced two patents where clinical efficacy for herpes I and II was clearly shown. The treatment was effective for treating subjects (e.g. human patients) both prior to and subsequent to herpes infection. It was used topically to alleviate symptoms associated with herpes infections or preferably systemic, by oral administration, to eradicate the virus and thereby prevent symptom recurrence. No side effects or toxicity were noted. This treatment,

which now must be considered alternative, suggests a breakthrough in the discovery of natural immunomodulatory and antiviral agents.

Recent research and gathering of anecdotal evidence on the health benefits and antiherpetic action of the red marine algae, Dumontiaceae, has yielded much promise. Its use as a topical has been further documented and thought superior to acyclovir. It was shown to be clinically effective against herpes zoster infections as well. Anecdotal reports from patients suffering from Epstein Barr (another herpes virus) and Candida have shown marked improvement in a short period of time through oral administration (systemic).

General health benefits show red marine algae useful in weight-loss programs and for lowering cholesterol and fat in the blood. It contains soothing, mucilaginous gels such as algin, carregeenan, and agar, which specifically rejuvenate the lungs and gastrointestinal tract. Once thought of as a liability that blocked assimilation, the tough cell wall in Dumontiaceae has been found to be invaluable. It binds with heavy metal, pesticides, and carcinogens, and carries these toxins safely out of the body. Contained within the cell walls are polysaccharides, which are a complex of simple sugars. These long chained complex sugars stimulate interferon production as well as other anti-tumor and immune- enhancing activity (improving activity of T- and B-cells). Other compounds in the cell wall are related to those found in friendly bacteria which fortify and strengthen our immune systems to fight against invading organisms and toxins.

Although the effects of long term use of an alternative treatment such as the red marine algae, Dumontiaceae, has not been

clinically substantiated, edible seaweeds have been consumed for thousands of years and are considered safe, nutritious, and beneficial. The added dimension that science has uncovered surrounding its antiviral and immunomodulatory potential; opens up a whole new source of food that could serve to palliate or even hopefully cure virally caused diseases. Since most life derived from the sea, the novel idea that the ocean lies untapped as perhaps our greatest medicinal resource is entirely possible and may be critical to our human survival.

Red Marine Algae Herpes Remedy to Stop Outbreaks

Red marine algae are abundant sea algae, with more than 4,000 species of it in the sea. Specific types of red marine algae have been shown to have strong immunity boosting and antiviral properties, and it is especially known for being effective for virus sufferers. In fact, it has been used for years in traditional Chinese medicine. Today, it is available in pill/supplement form as well as topical ointment forms.

Why use Red Marine Algae for Herpes?

Red Algae is commonly used to prevent and treat the symptoms of herpes (HSV-1& HSV-2). Here are its health properties:

Antiviral Properties: Some types of red marine algae have been shown in lab studies to have antiviral properties. What this means is that the red algae can suppress the herpes virus and prevent outbreaks. Generally speaking, an antiviral substance can reduce a patient's "viral load," or amount of the virus in the body at a given time.

Immunity Booster: Red Marine Algae is also known for being an immune system booster. When your immune system is strong, you are less likely to experience a herpes outbreak. Know why stress makes you susceptible to an outbreak? Because stress weakens your immune system! So it's always good to do whatever you can to keep your immune system running on all cylinders at all times, and health supplements are one way to do that.

How is it used?

Red algae is usually taken orally in capsule form to prevent or stop herpes outbreaks from HSV-1 and HSV-2. As for red marine algae dosage, a person can typically take 1000mg per day to suppress the herpes simplex viruses, whereas to stop an ongoing outbreak they might up their dose to as much as 2500mg per day.

Nutritional benefits of red marine algae:

Some notable nutritional benefits of red marine algae include provision of essential minerals like calcium, magnesium to meet the standards of recommended daily dosage. Moreover, research data also indicates that red marine algae serves as anti-oxidant to kill/ neutralize reactive oxygen species that is preventive against heart diseases and also minimize the risk of stroke in elderly patients.

Calcium:

Calcium is required for healthy bones, teeth and other parts of the body. Red marine algae contain sufficient amounts of Calcium that is enough to cover almost 13% of recommended daily intake (per cup of red marine algae). Excessive consumption of Calcium is not recommended and moderate consumption of algae does not interfere with the normal calcium homeostasis of the body.

Magnesium:

Magnesium is one of the most important minerals that is richly concentrated in red marine algae and one serving of algae serves to furnish 55% of the daily requirements of the body. Most importantly, magnesium is responsible for calcium homeostasis for the maintenance of healthy bones.

Iron:

Red marine algae is traditionally a plant but it is a great source of animal nutrition to those who don't consume animal proteins for religious reasons or personal preferences. Iron is another essential component of algae and serves to satisfy 180% of the daily requirement of Iron (a cup full of dried marine algae). Individuals who are severely anemic can use dried marine algae to replenish iron stores and improve hemoglobin levels

Essential amino-acids:

There are approximately 20 amino-acids that human body cannot produce and therefore these amino-acids should be obtained from diet. If you are a pure-vegan, you may have a hard-time in getting all the essential amino-acids from vegan diet alone, but thanks to red marine algae that contains all essential proteins and amino-acids in correct proportion. One ounce of dried red marine algae can supply up to 16 grams of high quality amino-acids, which approximately suffice 35 to 40% of recommended daily protein requirements. Along with essential amino-acids, red marine algae also contain sufficient amounts of fats and carbohydrates and omega-

3 fatty acids that are required for healthy heart functioning and circulatory health.

Iodine:

Iodine is one of the most essential minerals that is responsible for the synthesis of thyroid hormone for maintenance of normal metabolic activities. Iodine deficiency can occur in a number of situations (after thyroid surgery, radiation therapy of chest, low dietary intake, soil deficient in iodine and a number of other issues).

***Gigartina* (Red Marine Algae)**

Support for Skin, Hair, Nails, and Immunity

Gigartina is a type of Red Marine Algae (RMA) that has been found effective for skin ailments such as psoriasis, eczema, and herpes.

Gigartina is a type of ocean-growing algae, commonly known as sea vegetables, that could be one of the most important new therapeutic foods. Sea vegetables contain ten to twenty times the minerals of land plants, as well as an abundance of vitamins and other elements necessary for proper metabolism. They have been sought for thousands of years for their ability to prolong life, prevent disease, and enhance life.

While sea vegetables have been a common part of the diets of many healthy cultures to prevent aging and prolong life, scientific research has only recently reinforced the nutritional and medicinal importance of sea vegetables.

In the mid-seventies and early eighties, scientists identified some thirty species of Red Marine Algae (RMA) which enhanced the immune system's regulatory response and were shown to be antiviral. The most promising part of this discovery was that these species had an antiviral effect against a wide variety of pathogens.

Current research on Red Marine Algae has shown that promising results in the control and reduction of both the *Candida albicans* yeast (a fungus) and the *Herpes simplex* virus. Clinical trials have shown that these sulfated polysaccharides can suppress HIV, herpes, and influenza viruses, and patients have reported a lessening or even a halting of their growth within the body. Researchers believe that Red Marine Algae may serve as a gateway to resist many other types of bacterial, fungal, and viral pathogens.

Gigartina papillata growing wild.

The *Gigartina* genus of Red Marine Algae is rich in sulfated polysaccharides, or sulfur-containing complex sugars that have been found to improve the body's immune response. *Gigartina* also contains **carrageenan**, which is extracted from sea vegetables for use as a jelling agent in dairy products, and this carrageenan component seems to help direct the beneficial immune-enhancing effects of *Gigartina* toward the skin.

Brown Seaweed:

Brown Seaweed Healing Properties

Latin Name: ***Fucus vesiculosis***

Common Name: **Bladderwrack**

Bladderwrack (*Fucus vesiculosus*) is a common brown shoreline seaweed that has tough straplike fronds containing air bladders that give buoyancy. This grows on the northern coast of the Pacific and Atlantic oceans and also in North and Baltic Sea. A brown seaweed that grows alongside the *Fucus vesiculosus* is *Ascophyllum nodosum*. Thus this name is sometimes used for *Fucus vesiculosus*. Along with other types of seaweed, these seaweeds are often included in kelp preparations.

Seaweed is used as a herbal medicine and Vietnamese are also known to use it as food. They consume it in different forms like vegetable, vegetable soup, raw salad, pickle with vinegar or sauce and sweetened jellies.

Bladderwrack (*Fucus vesiculosis*) Benefits

Bladderwrack is a form of kelp that has been used medicinally for centuries. The main use of the herb has been for the stimulation of the thyroid gland as a treatment for obesity and cellulite. The high iodine content of the herb stimulates thyroid function which boosts metabolism.

It has a reputation in the relief of rheumatism and rheumatoid arthritis and may be used both internally and as an external application for inflamed joints. The main phytotherapeutic use of

Fucus is during debility and convalescence, and also to remineralise the body.

Fucus also appears to assist in the problem of lipid balance associated with obesity, and where obesity is associated with thyroid dysfunction, this herb may help to reduce excess weight.

Bladderwrack is rich in iodine, calcium, magnesium, potassium, sodium, sulfur, silicon and iron and high in some B-complex vitamins. It contains moderate amounts of phosphorus, selenium, manganese and zinc and small amounts of vitamins A, C, E and G. It also contains anti-sterility vitamin S as well as vitamin K. It is rich in algin and mannitol, carotene and zeaxantin with traces of bromine.

BladderWrack (*Fucus vesiculosis*) Medicinal Properties

1. Based on various unclear scientific evidences seaweed is used for these medical ailments. However it is not thoroughly being tested for its safety and effectiveness and more scientific researches in this field are needed.

2. Bladderwrack may have antifungal and antibacterial properties and also anticoagulant and antioxidant properties in fucans and fucoidans that are components of bladderwrack.

3. A number of brown algae which also includes bladderwrack may help to curb the formation of the cells responsible for cancer in the body and may also be helpful in lowering blood sugar levels.

4. Due to the variable content of iodine in bladderwrack, it is used in the treatment of thyroid disorders such as goiter.

5. Many products are available in the market with bladderwrack and other seaweeds and these are marketed for losing weight.

6. Traditionally based on scientific theories bladderwrack is also used for arthritis, edema, eczema, psoriasis, atherosclerosis, enlarged glands, hair loss, heart burn, stomach upset, ulcer, high cholesterol, laxative, malnutrition, herpes simplex virus, lymphoma, menstrual irregularities, rheumatism, soar throat and painful or swollen testes. However the safety and effectiveness of bladderwrack is not tested in humans for these conditions.

Skin Care

Bladderwrack powder is filled with minerals that help nourish and cleanse the skin of toxins that cause dryness, wrinkles and excess fluid retention, states From Nature With Love. The powder, which may be purchased from most natural food or health stores, may be added to bath water, soaps, wraps and to facial scrubs and salts for detoxification of the skin.

Thyroid Stimulation

Because bladderwrack contains iodine, it provides a variety of benefits for thyroid health. As a thyroid stimulating property, bladderwrack may also regulate thyroid function and metabolism, according to Herb Wisdom. Some individuals take bladderwrack to help treat cellulite as well as obesity, as the herb is known to increase metabolism.

Spirulina

Spirulina is a type of blue-green algae that is rich in protein, vitamins, minerals, and carotenoids, antioxidants that can help protect cells from damage. It contains nutrients, including B complex vitamins,

beta-carotene, vitamin E, manganese, zinc, copper, iron, selenium, and gamma linolenic acid (an essential fatty acid).

Test tube and animal studies suggest *spirulina* may boost the immune system, help protect against allergic reactions, and have antiviral and anticancer properties.

Immune Support

A number of animal and test tube studies suggest that *spirulina* increases production of antibodies, infection-fighting proteins, and other cells that improve immunity and help ward off infection and chronic illnesses such as cancer.

Protein Supplement

Amino acids make up 62% of *spirulina*. Because it is a rich source of protein and other nutrients, *spirulina* has been used as a nutritional supplement. Other sources of protein, such as nuts, legumes, whole grains, and meat, provide protein in smaller servings.

Allergic Reactions

Animal and test tube studies suggest that *spirulina* may protect against allergic reactions by stopping the release of histamines, substances that contribute to allergy symptoms, such as a runny nose, watery eyes, hives, and soft-tissue swelling.

Antibiotic-related Illnesses

Although antibiotics destroy unwanted organisms in the body, they may also kill beneficial bacteria called probiotics, such as *Lactobacillus acidophilus*. This can cause diarrhea. In test tubes, *spirulina* has boosted the growth of *L. acidophilus* and other probiotics.

Infection

Test tube studies suggest that *spirulina* has activity against herpes, influenza, and HIV.

Oral Cancer

In one placebo-controlled study, taking *spirulina* seemed to reduce a precancerous lesion known as leukoplasia in people who chewed tobacco. Lesions were more likely to go away in the *spirulina* group than in the placebo group.

Liver Disorders

Preliminary evidence suggests that *spirulina* may help protect against liver damage and cirrhosis (liver failure) in people with chronic hepatitis.

Available Forms

Spirulina is available in pill or powder form, or as flakes. Most of the *spirulina* consumed in the United States is grown in a laboratory. There are many different *spirulina* species, only some of which are identified on labels of commercially available products. *Spirulina maxima* (cultivated in Mexico) and *Spirulina platensis* (cultivated in California) are the most popular.

***Spirulina* composition**

The composition of this alga includes more than 100 nutritive substances, which makes it an extraordinary source of matters indispensable for many physiological processes in human organism. This precious, 100% natural product – alga, due to its complex composition represents a peak in the food chain. *Spirulina* is a rich source of vitamins, minerals, proteins, and its composition includes essential amino acids, indispensable for our organism, and can be taken in only with food, i.e. our organism does not store them but

they must be obtained from food. Particularly important is amino acid phenil alanine which blocks the effect of the centre for appetite. *Spirulina* is used in dietetics, cosmetics and as an addition to everyday intake of food. *Spirulina* is recommended to persons exposed to everyday stress, to the extensive psychophysical strain; in two words, it provides energy for an active life.

- It is recommended for a better concentration and memory
- To athletes for increased endurance and concentration
- For healthy skin, hair, nails
- To convalescents, to encourage the immunity
- During fasting periods, dieting and with irregular and incorrect nutrition
- It is a natural purifier and helps eliminate toxins from the body
- It is recommended to people who intake increased quantities of synthetic drugs

***Spirulina* is the richest natural source of :**

- Beta carotene: 25 times more than in carots
- Iron: 28 times more than in beef liver
- Vitamin B-12: 4 times more than in beef liver
- Vitamin E: 3 times more than in wheat germs
- Calcium: 5 times more than in unprocessed milk
- Amino acids: complete profile of amino acids
- Proteins: 3 times more than in fish, chicken or red meat
- Antioxidants: contains the whole spectre of natural antioxidants

Helps in prevention of illnesses such as: a stomach ulcer, arthritis, allergies, obesity, hypertension, helps with digestion disorders, and feeding disorders. It is an ideal addition to nutrition.

Utilization of the iron contained in *spirulina* is by 60% higher in human organism, in comparison with other pharmaceutical iron preparations. Also, it contains vitamin E, zinc and selenium, which are important antioxidants of minerals, it is especially rich in calcium, magnesium, phosphor, potassium and iodine.

Use:

Spirulina tablets can be used by persons of all ages. Grown ups: 3-6 tablets a day, children up to 7 years of age: 1-2 tablets, from 7-14 years of age: 2-3 tablets a day. It can be taken during pregnancy, it is recommended also during menstrual period and menopause .

Spirulina can be used also as a facial mask by crushing 2- 3 tablets and mixing them with a small amount of water if the skin is oily or with a bit of yogurt or sour cream if the skin is dry. The mask is to be left to dry for 15 minutes, and than it should be removed with lukewarm water.

Spirulina can be used also as an addition to food by adding 1 - 2 crushed tablets to yogurt, pasta, bread or simply can be used as a spice in cooked meals at the end of thermic treatment.

***Spirulina* (dietary supplement)**

Spirulina is a cyanobacterium that can be consumed by humans and other animals. There are two species, *Arthrospira platensis* and *Arthrospira maxima*.

Arthrospira is cultivated worldwide; used as a dietary supplement as well as a whole food; and is also available in tablet, flake and powder form. It is also used as a feed supplement in the aquaculture, aquarium and poultry industries.

Spirulina tablets

Nutrient and vitamin content

Protein

Dried *spirulina* contains about 60% (51–71%) protein. It is a complete protein containing all essential amino acids, though with reduced amounts of methionine, cysteine and lysine when compared to the proteins of meat, eggs and milk. It is, however, superior to typical plant protein, such as that from legumes.

Other nutrients

Spirulina's lipid content is about 7% by weight, and is rich in gamma-linolenic acid (GLA), and also provides alpha-linolenic acid (ALA), linoleic acid (LA), stearidonic acid (SDA), eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and arachidonic acid (AA).

Spirulina contains vitamins B_1 (thiamine), B_2 (riboflavin), B_3 (nicotinamide), B_6(pyridoxine), B_9 (folic acid), vitamin C, vitamin A, and vitamin E. It is also a source of potassium, calcium, chromium, copper, iron, magnesium, manganese, phosphorus, selenium, sodium, and zinc.

Spirulina contains many pigments which may be beneficial and bioavailable, including beta-carotene, zeaxanthin, chlorophyll-a,

xanthophyll, echinenone, myxoxanthophyll, canthaxanthin, diatoxanthin, 3'-hydroxyechinenone, beta-cryptoxanthin, and oscillaxanthin, plus the phycobiliproteins (phycocyanin and phycoerytherin).

***Spirulina*（dried）**	
Nutritional value per 100 g (3.5 oz)	
Energy	1,213 kJ (290 kcal)
Carbohydrates	23.9 g
Sugars	3.1 g
Dietary fiber	3.6 g
Fat	7.72 g
Saturated	2.65 g
Monounsaturated	0.675 g
Polyunsaturated	2.08 g
Protein	57.47 g
Tryptophan	0.929 g
Threonine	2.97 g
Isoleucine	3.209 g
Leucine	4.947 g
Lysine	3.025 g
Methionine	1.149 g

Cystine	0.662 g
Phenylalanine	2.777 g
Tyrosine	2.584 g
Valine	3.512 g
Arginine	4.147 g
Histidine	1.085 g
Alanine	4.515 g
Aspartic acid	5.793 g
Glutamic acid	8.386 g
Glycine	3.099 g
Proline	2.382 g
Serine	2.998 g
Vitamins	
Vitamin A equiv. beta-carotene lutein zeaxanthin	(4%) 29 µg (3%) 342 µg 0 µg
Thiamine (B1)	(207%) 2.38 mg
Riboflavin (B2)	(306%) 3.67 mg

Niacin (B3)	(85%) 12.82 mg
Pantothenic acid (B5)	(70%) 3.48 mg
Vitamin B6	(28%) 0.364 mg
Folate (B9)	(24%) 94 µg
Vitamin B12	(0%) 0 µg
Choline	(13%) 66 mg
Vitamin C	(12%) 10.1 mg
Vitamin D	(0%) 0 IU
Vitamin E	(33%) 5 mg
Vitamin K	(24%) 25.5 µg
Trace metals	
Calcium	(12%) 120 mg
Iron	(219%) 28.5 mg

Magnesium	(55%) 195 mg
Manganese	(90%) 1.9 mg
Phosphorus	(17%) 118 mg
Potassium	(29%) 1363 mg
Sodium	(70%) 1048 mg
Zinc	(21%) 2 mg
Other constituents	
Water	4.68 g

Spirulina a popular nutritional supplement with good reason. *Spirulina* is a rich source of essential nutrients, vitamins, minerals, and essential fatty acids, including GLA. *Spirulina* contains 65% to 71% amino acids, more than beef which only contains 22%. *Spirulina* is of the few plant sources of B12, with a teaspoon full supplying twice the RDA of B12. *Spirulina* also provides high concentrations of chelated minerals, and complex plant sugars, trace elements, and enzymes that are in an easy to assimilate form. In fact *spirulina* is such a complete food source it is often used to supplement the diet during cleansing fasts, and by those who may not have access to enough fresh vegetables.

Commercial products extracted from algae and their cell walls:

a) Alginates (Alginic acid): derived from cellulose free middle lamella and primary wall of the members of phaeophyceae like *Macrocystic, Laminaria, Ascophyllum*, *Lessonia* etc. Alginic acid content varies with the location, seasones, temperature and parts of the plants. Its content approximately 30-40% in brown algae on dry weight. It is similar to cellulose and pectic acids in composition consisting of a long unbranched chain of β-d-mannuronic acid joined by 1:4 glycosidic linkages. The soluble calcium salt of alganic acid is algin.

As algin has remarkable water absorbing capacity it is used in many industries where there is the requirement of thickening, suspending, emulsifying, gel-forming, and stabilizing. Sodium salt of algainic acid is used in textile industry as they form excellent polishing and dressing material. Alginates are used also in food industry for filing creams, thickening soup, sauces, in cosmetics industry as dispensing agents in ointments, creams tooth pastes, shampoos, in paint industry for suspension of pigments, stabilization of emulsion; in pharmaceutical industry as emulsifyers and as filters in the manufacture of tablets, pills. Aginats are also used as gel in the freezing of fish, antibiotics and in the treatment of shocks.

b) Agar (Agar-agar): This is dried gel-like non-nitrogenous, gelatinous extract obtained from many red algae. This is one the best known algal products and used as a solidifying agent in the preparation of microbiological culture media. Dried agar is insoluble in cold water but soluble in hot water. The important algae used for the extraction of agar are *Gelidium, Gracilaria, Pterocladia, Gigartina,*

Chondrus. Gelling property varies with the species but it will set at from 35to 52 ^{0}c. The major component of agar is agarose. Uroinc acid, pyruvic acid, polysaccharides like agarose and agaropectin are also present in agar-agar.

Besides most important use of agar in the preparation of culture media. It has also been used in food industry, cosmetics, leather, textile industry, pharmaceuticals, dental impression mold and meat packing, for clotting of blood and as emulsifyers, laxatives.

c) Carrageenan (Carrageenin): it is carbohydrate mucilage named after Irish village Carrageenin which is extracted from red alga *Chondrus crispus* and to a lesser extent from *Gigartina*. The compound is a cell wall polysaccharide complex of D-galactose-3, 6-anhydro-D-galactoseand monoesterified sulphuric acid. These compounds are used like alginates in food, textile, leather, and industry, pharmaceutical and brewing industries. This gelatinous carbohydrate is variously used with pudding, consumed with milk, fruit and ice-cream. It is used as clearing agent in beer preparation.

d) Iodine and other compounds: Members of brown algae such as *Laminaria digitata* and *Fucus* spp.are known for the extraction of iodine. The maximum percentage of iodine (1.23%) has been obtained in Laminarias of Britsh Coasts. Seaweed are also known for the presence of macronutrients useful for human consumption like iron, manganese, zinc, copper etc. bromine , formic acid , acetone, acetic acid are also extracted from seaweeds. Seaweed ash is also used as source of salt and soda.

Examples for algal products:

Purple Algae Tea

Purple algae tea is a dietary product obtained by a mixture of dried sea algae *Fucus vesiculosus, Ulva lactusa, Palmaria palmata*. It is an exceptional dietary product, rich in minerals necessary for regular operation of physiological processes in the body. As such, this product is a precious food supplement, since it provides the body with necessary energy, contributes to strengthening and detoxication of the body.

It is particularly recommended to those that are on slimming diets or whose nutrition is inappropriate, so that the product may provide the necessary level of minerals in the body. It is particularly recommended in cases of exposure to extreme physical strain, exhaustion, obesity, for relief of problems resulting from poor peripheral circulation such as cellulite, relieves the occurrence of painful swollen legs, and it improves your complexion.

Wonder Glove

In many years of clinical trials and experience Wonder glove proved its high efficiency as an agent for skin cleaning and care, since in its application the basic phases of a cosmetic treatment are joined: skin cleaning, massage and peeling and skin preparation for further cosmetic treatment. It has been confirmed that the wonder glove is absolutely safe and that it can be recommended for the cleaning and care even in persons with the most sensitive skin.

Its purpose is the cleaning of facial skin, in particular the area around the eyes, and the whole face and neck. It is used for make-up removal, including the waterproof mascara. The secret of the glove lies in its specific weaving like a rose bud which in the form of a

brush enters every skin pore and remove from it dirt and make-up, and also by means of the glove remove the dead cells so that it achieves a mild face peeling. It's simple to use - it is enough just to wet it with warm water, and such wet glove is ready to use. The glove is easy to maintain, it only needs washing with soap and water after use and dry it and put it back in the box. Properly used and maintained glove can be effective for a year. Wonder glove is recommended both to persons with problem and sensitive skin and to persons with healthy and normal skin regardless of the gender and age. It is necessary every day when you are on a trip, at work, on the beach, for make up removal, and is especially popular for the removal of professional make-up.

Anti-cellulite Gel

Based on algae, ivy, caffeine and lecithin it is an excellent means for the treatment of cellulite and local thinning in selected areas of the body.

Active ingredients of the gel are beneficial for degradation of fatty deposits in the subcutaneous connective tissue; they improve exchange of mater and promote microcirculation on the treated areas. Beside, the extract of the sea algae vitalizes and regenerates the skin and the mineral content in it.

Body Care

Sunscreen factor +15

Sunscreen factor +15 is the latest formulation of a moisturizing cream which will give you a beautiful natural bronze complexion and body skin when sun-bathing in a solarium or in open air, at the same time protecting your skin from harmful effects of UV

rays. Sunscreen factor +15 is a special moisturizing cream made on basis of algae and beta-carotene. Using this cream prevents burns and skin redness. It is particularly recommended for sun-bathing in a solarium, as due to a high percentage of B-carotene it stimulates production of melanin and gives you a natural bronze complexion.

Copper Comlexion Cream

Over the last years the cosmetic industry has done a lot on the development of components which may lead to browning of the skin without exposure to the sun. Preparations have been developed which enable artificial skin browning owing to the substances which colour its surface. This is the safest and the simplest way to get a suntan and is recommended to anyone who would not or must not expose to natural sun radiation, or use solariums.

Oily Perles

These moisturizing bathing pearls release a relieving mixture of oils with a subtle fragrance, making a regular bathing an efficient and beneficial body treatment. With a visible improvement on skin firmness and flexibility, they reduce striae, leaving the skin tender and soft and fragrant. They are rich in vitamin E, so that after the bath no additional body care is necessary.

Salt for Face and Body Care

Salt for Face and Body Care with algae extract is another product fitting into the slogan of Božen company BEAUTY AND HEALTH COME FROM THE OCEAN. Peeling salt is of different grain sizes, different colours with an addition of natural ethereal oils, always with an algae extract. Larger grain salt is very good for baths with which we refresh, deodorize and disinfect the skin of our tired feet, particularly in summer period, due to excessive sweating. For better refreshment of our feet, hot baths are recommended with an addition of salts for better circulation.

Baths

A palette of multi-coloured transparent, mother-of-pearl bath preparations enriched with sea algae extracts and vitamin E, for everyday cleaning and care of all types of face and body skin. These bath preparations are made of speciall selected matters which thorougly remove skin impurities, not causing irritation and drying of the skin.

Shampoo Four in One

A beautiful hair is one of the greatest gifts of nature. To preserve its healthy look we should regularly take care of it, using the right shampoos and conditioners. The advantage of this product is that it contains both a shampoo and a conditioner. Instead of 4 packs, in this shampoo based on algae extract you will find a shampoo for your face, hair, body and an exceptional hair conditioner.

Body Milk

In present way of life and polluted environment, skin of the whole body is exposed to damaging effects, therefore you must care for your skin every day. Only in that way you will have a fresh and healthy skin. This Body Milk is exceptionally beneficial and fragrant emulsion for body care. In addition to algae and sea extracts it contains vitamin E, and thus is convenient for the care and regeneration of normal, oily, and first of all dry skin.

Shower Gel

Taking shower is often regarded just as a part of daily body care. But it can be much more - an experience of joy, a wonderful way to relax before going to sleep or a way to raise the spirit.

In the comfortable environment of your home you can enjoy the benefits of this shower gel enriched with algae and sea extracts, which give your skin a silky look, softness and fragrance.

Body Scrub

A regular body care is equally important as a regular care of the face, therefore it is never too late or too early to start taking care of your body. Regular attention and use of adequate preparations will help your body to keep a youthful looks. In body care, Body Scrub has a very important place as it is quick in removing

dead cells from skin surface. Using this preparation you will refresh your skin and prepare it for other body care preparations.

CONCLUSION

The marine algae are taxonomically diverse, largely productive, biologically active, and chemically unique offering a great scope for discovery of new anticancer drugs. The marine floras belonging to polyphenols and sulphated polysaccharides are rich in medicinally chemical potent predominantly. Since algae also represent an important source of vitamins, minerals, antioxidants and natural colorants, the incorporation of the whole biomass in food and feed could be used to provide the colour, increment nutritional value, and improve texture or resistance to oxidation. While a mixture of different species or combinations with other food opens up many possibilities, their use in feed can also compensate the usage of other foods which are in first position. The cultivation of algae population with so many medicinal benefits need to promoted and improved using modern techniques.