iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** X **Month of publication:** October 2021

DOI: https://doi.org/10.22214/ijraset.2021.38438

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

Nutritional Evaluation and Biochemical Profiles of Microalgae as Potential Human Health Supplements

Kaaviyaa[1], Uma Kumari[2]
[1]*Sathyabama Institute of Science and Technology, Chennai- 600119, India*
[2] *Bioinformatics Scientist, Rapture Biotech, Noida-20130, India*

Abstract: ***Food supplements industries, an important place must be assigned to nutraceuticals containing microalgae, nowadays accounting for a large and rapidly expanding market. The marketed products are mainly based on production strains, i.e., Spirulina and Chlorella in the composite situation, since two of them are cyanobacteria and the second one is eukaryotic. In the marketed form and several utilizations, and peculiarities that need special attention and adequate studies. General report is about the current scientific knowledge on each microalga, in particular the nutritional value and properties in prevention and wellbeing. Second, original studies are presented concerning the quality control of marketed products. Quality control is act as key argument in nutraceuticals validation. Microalgae one of particular organisms that need specific approaches to check identity and validate properties of microalgae. The paper is dedicated to the need for specificity in uses and to considerations about the future of microalgae in food supplements in our daily needs. India is a country with heterogenic population having diverse food habits become a driving force in the shift towards a greater recognition between diet and health care in research the use of few natural unprocessed foods like blue-green algae "spirulina" which has a galaxy of nutrients as diet supplements. The purpose of the present review is to compile evidence regarding the health benefits of spirulina, amount of evidence on health benefits are its effect in preventing anaemia, blood sugar and obesity many health diseases.***
Keywords: ***Microalgae, Nutraceuticals, Omega fatty acids, Phycocyanin, Spirulina: Blue-Green Algae.***

I. INTRODUCTION

International organizations such as the FAO have set the goal of feeding everyone on the planet. However, we must examine two key factors, production and quality, to achieve this accomplishment against any Malthusian forecast. Aside from the never-ending issue of producing a sufficient amount of food, quality has lately become critical for preserving health and improving lifestyles, as shown by the worldwide obesity epidemic (James R 2012).Both of these elements might be regarded as important parts of the so-called nutritional environment. In light of linked issues such as health and societal costs, the nutritional environment is at the forefront of everyone's attention, from governments to ordinary people.

Rapid developments have recently influenced the culinary scene, resulting in the introduction of numerous new items. These products—nutraceuticals, botanicals, and others—had a significant impact on the market because of their hybrid character, which fell midway between common food and medical medications. (Science, 1999, Zeisel S.H. Regulation of "Nutraceuticals")

They are, in fact, regarded to be a part of the dietary supplement industry, despite the fact that the situation is always changing and new interpretations are being made (Kalra E.K 2003). As a consequence, we have a complicated, dynamic scenario that needs thorough analysis and knowledge on each of the various elements. Microalgae, which already accounts for a substantial and constantly increasing market Bishop, is a clear example of the current and future state of food, including dietary supplements (W.M., Zubeck H.M. 2012)In fact, the chemical composition of microalgae is a complex mixture of minerals, vitamins, and primary and secondary products, with a wide range of potential applications and uses for humans, ranging from nutritional properties to antioxidant and anti-aging properties, as well as preventative effects. In other words, microalgae constitute a nutraceutical case study.

II. CYANOBACTERIA IN NUTRACEUTICALS

Cyanobacteria are also known as blue-green algae and are traditionally associated with seaweed, in consideration of the trophic level, the environmental condition, and several other similarities. The evolutionary line leading to modern plants started from that model based on the chlorophyll work in autotrophic algae. Following the evolutionary pathways, we focused on advanced organisms, considering them a major source of food and medicinal drugs. It is now time to reverse this attitude. Again, the first signal of novelty comes from nutraceuticals. Microalgae are heavily used as raw materials in food supplements. The claim is to obtain both equilibrium in the diet and a specific activity, in accordance with the characters of the functional food.

III. MICROALGAE USED IN FOOD SUPPLEMENT

Microalgae using now a days are mainly utilized to feed livestock and pets. However, human consumption is increasing, in particular in food supplements .Factors that influence vegetarian food intake should include knowledge of a balanced diet, vegetarian food variety, as well as the use of enriched food items and available food supplements, for their content microalgae one of the best candidates to supplement vegans' and vegetarians' diet.

Spirulina is a well-known genus of microalgae. Spirulina is a multicellular filamentous cyanobacterium. Reside in fresh water and contain bioactive components such as protein, vitamins, pigments, long-chain polyunsaturated fatty acids, sterols, and other chemicals that make those microalgae highly appealing from a health standpoint.

Spirulina got its name from the spiral form of its leaves. But Arthospira microalgae with a linear form have also been discovered. Spirulina microalgae are also known as blue-green algae-cyanobacteria, and two species, Arthospira Platensis and Arthospira Maxima are widely farmed. (Lidiane Maria de Andrade, 2018)

Spirulina is nutrient-dense algae. It includes phycocyanin, a strong plant-based protein. This has antioxidant, pain-relieving, anti-inflammatory, and brain-protective effects, according to research. Phycocyanin, the blue-green plant pigment that gives spirulina its color, has been shown to decrease inflammation in the body as well as inhibit tumor development and kill cancer cells. The immune-boosting protein is being researched to see if it may be used to treat cancer.

IV. NUTRITIONAL COMPOSITION OF SPIRULINA:

A. Proteins

Spirulina typically has a significant amount of protein, ranging from 55 to 70% by dry weight. Leucine, valine, isoleucine, tryptophan, methionine, phenylalanine, theanine, and lysine are among the essential amino acids found in spirulina. Spirulina contains two non-essential amino acids: aspartate and glutamate. Spirulina is a perfect protein because it includes all of the essential amino acids, unlike other plant-derived proteins. Its status as a complete protein supply derived from plants makes it an excellent dietary supplement for vegetarians. (Ruma Arora Soni, 2017)

B. Carotenoids and Vitamins

Vitamin B1, B2, B3, B6, B12, C, D, E, and other B vitamins are abundant in spirulina (up to 1320 mg/kg). Spirulina vitamins serve as raw materials and coenzymes for hemoglobin synthesis, as well as having anti-anemia, hematopoietic, and anti-oxidant effects. Carotenoids are a class of pigments found in nature. Spirulina contains up to 4000 mg/kg of carotenoids, with -carotene dominating. Carotenoids contain anti-oxidant, anti-aging, and anti-inflammatory properties, among other things. Carotenoids can quench singlet oxygen and scavenge radicals, resulting in the cessation of oxidation chain processes. Carotenoids are commonly used to treat cardiovascular disease (CVD). (PeiHanaJingjingLi, 2021)

C. Phenolic Compounds

Compounds that contain phenolics, which are spirulina's secondary metabolites, are chemicals that can benefit human health. (Gargouri,2016) discovered that spirulina polar extract included numerous phenolic components, particularly flavonoids, that had a significant link to anti-oxidation activity, including a high ability to scavenge DPPH radicals, a moderate overall antioxidant capacity, and a perceptible reducing power.

V. THERAPEUTIC AND NUTRACEUTICAL PROPERTIES OF SPIRULINA

A. Used to treat Acquired Immunodeficiency Syndrome

The antiviral activity of calcium spirulan (Ca-SP) derived from Spirulina has been demonstrated against a variety of viruses, including HIV-1, herpes simplex virus type I, and influenza virus. The effect of calcium ion chelation on sulfate groups is thought to be responsible for antiviral activity. (Ayehunie S, Belay A, Baba TW, Ruprecht R.M, 1998)

B. Used to treat Hypertension and Hyperlipidemia

Spirulina or its extracts have been shown to have a hypolipidemic impact in a variety of animal species, including the mouse, rat, hamster, and rabbit. Spirulina's cholesterol-lowering properties were originally discovered in albino rats (Devi MA, Venkataraman LV,1983) then in mice (Kato T, Takemoto K,1984). In mouse research, supplementing a high-fat, high-cholesterol diet with 16 percent Spirulina resulted in substantial reductions in total blood cholesterol, LDL, VLDL cholesterol, and phospholipids, while serum HDL cholesterol increased. Furthermore, Spirulina intake significantly decreased elevated hepatic lipids caused by a high fat and cholesterol diet. (RuitangDeng, Te-Jin Chow, 2010)

C. Uses to treat Allergy, Rhinitis, and Immunomodulation

Spirulina has been shown to have anti-inflammatory effects via blocking the production of histamine by mast cells. Individuals with allergic rhinitis were fed daily either placebo or Spirulina for 12 weeks in a recent randomized, double-blind placebo-controlled study. The levels of cytokines (interleukin-4 (IL-4), interferon- (IFN-), and interleukin-2), which are crucial in controlling immunoglobulin (Ig) E-mediated allergy, were examined in peripheral blood mononuclear cells before and after Spirulina eating. The study found that a high dosage of Spirulina decreased IL-4 levels by 32%, showing the microalga's protective benefits against allergic rhinitis. Ishii et al investigated the effect of Spirulina on IgA levels in human saliva and found that it increases IgA synthesis, indicating that microalgae play an important role in mucosal immunity. (DiviJalajaKumari, B. Babitha, 2010)

Figure 1. Spirulina Product

Figure 2. Nutritional compositions

D. Used to Treat Diabetes

Spirulina is gaining popularity as a therapeutic food due to its high concentration of functional nutrients. Spirulina's hypoglycemic and hypolipidemic properties were investigated in this study. Twenty-five people with type 2 diabetes were randomly allocated to one of two groups: the study group or the control group. Spirulina supplementation for two months resulted in significant reductions in fasting and postprandial blood glucose levels. HbA(1c) levels were also found to be much lower, indicating superior long-term glucose control. Triglyceride levels were considerably reduced when it came to lipids. (Panam Parikh, 2001)

E. Used to heat Stokes

Supplementing broilers with spirulina (SP) in their drinking water improved their tolerance to prolonged heat stress. SP supplementation substantially impacted cardio-protective indices in broilers, such as atherogenic index, atherogenic coefficient, and cardiac risk ratio. At 15 g/L, spirulina reduced the propensity of erythrocytes to oxidize and lipid indices. In comparison to control broilers, spirulina at 20 g/L improved vaccinal immunity to NDV, decreased hepato-cellular damage and lowered mortality. (Gautham Kolluri,2021). Spirulina also contains beta-carotene, a substance that protects the cardiovascular system.

F. Used to Improve Eye Vision

Spirulina has a high concentration of zeaxantuin, a vitamin associated with eye health. As a result, spirulina might help prevent cataracts and age-related macular degeneration. More investigation is required. Spirulina's high beta-carotene content makes it ideal for developing and keeping excellent vision, as well as avoiding night blindness. Spirulina given to children at a dose of 1 grams per day has been demonstrated to prevent Vitamin A deficiency and enhance vision and cognitive performance (**Bolan YuJie Wang**., 2012).

G. Antioxidant Properties

The existence of two phycobiliproteins, phycocyanin and allophycocyanin, is attributed to Spirulina's antioxidant activity, as measured by its action against the OH radical produced by the ascorbate/iron/H2O2 system. The activity was shown to be proportional to the concentration of phycobiliproteins, with the phycocyanin content accounting for the majority of the activity (M. Samir and P. S. Amrit,2007). Oxygen stress was reduced by phycocyanin and phycocyanobilin from Spirulina as an antioxidant action, resulting in protection against diabetic nephropathy. (J. Zheng, T. Inoguchi,2013)

H. Anticancer Effects

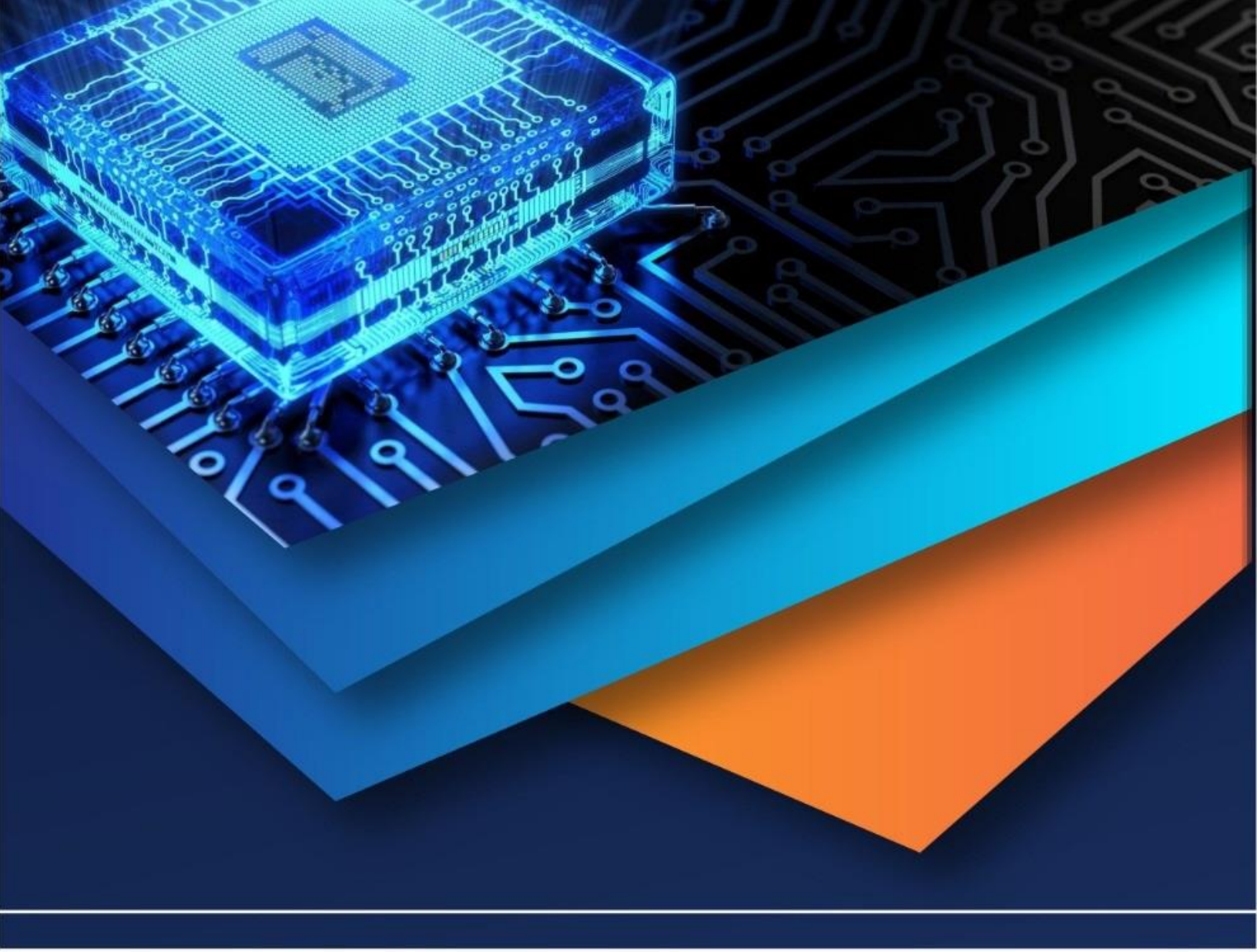
Because of its hypocholesterolemic characteristics, Spirulina platensis is utilized as a dietary supplement. Tetra pyrrolic compounds, which are connected to the bilirubin molecule and act as an antioxidant and antiproliferative agent, are also abundant."Using an experimental model of pancreatic cancer, we evaluated the putative anticancer effects of S. platensis and S. platensis-derived tetrapyrroles. Experimental therapies substantially reduced the growth of human pancreatic cancer cell lines in vitro in a dose-dependent manner (from 0.16 g•L-1 [S. platensis], 60 M [PCB], and 125 M [chlorophyllin], p0.05) when compared to untreated cells

VI. CONCLUSION

As algae use in food supplements can be particularly useful to support some diets. Some aspects need to be considered and research should play a central role. Microalgae are more or less used at the same level of utilization in nutraceuticals. Using dried spirulina used in food supplements contains about (51%–71%) protein, due to composition rich in all essential amino acids, with reduced amounts of methionine, cysteine, and lysine when compared to meat, eggs, and milk, although superior to typical plant protein, such as that from legumes(Heidarpour A., Fourouzandeh-Shahraki A, 2011) An interesting fact concerns vitamin B12. Most edible cyanobacteria, like spirulina, do not naturally contain vitamin B12, but it contain pseudovitamin B12, which is inactive in humans that's why the American Dietetic Association and the Dieticians of Canada, in their position paper on vegetarian diets add as food. The spirulina cannot be counted on as a reliable source of active vitamin B12 However, companies that grow and market spirulina have claimed it to be a significant source of the vitamin on the basis of alternative, unpublished assays, although their claims are not accepted by independent scientific organizations India is a country with heterogenic population having spirulina has potential for being a 'wonder food supplement'. As the culture conditions of the spirulina that is being utilized. Blue-green algae harvested in uncontrolled culture way in that way it may be contaminated with heavy metals that can lead to liver damage, diarrhea, and vomiting. One approach is to grow spirulina in an 'organic' way and various spirulina fortified foods are required to create nutritional awareness and increase the acceptance level in the developing countries like India where there are lot of deficiency disorders in the population. As a potential exists for spirulina used as a food supplement, in therapeutic management of various disorders. Microalgal biomasses are being widely cultivated for use in commercial formulations of functional foods and nutraceuticals. Microalgae include a variety of beneficial chemicals, including omega-3 fatty acids, vitamins, and pigment-protein complexes, as well as anticancer, antioxidative, cytotoxic, and anti-obesity properties. Microalgae's function in delivering health benefits and nutrition will continue to develop as research and investment in the field grows in many areas of the world, and these microscopic biofactories may bring about revolutionary improvements in nutraceuticals in the future.

REFERENCES

[1] Benkouider C. The world's emerging markets. Funct. Foods Nutraceuticals. 2005;44:8–11.
[2] Bishop W.M., Zubeck H.M. Evaluation of microalgae for use as nutraceuticals and nutritional supplements. J. Nutr. Food Sci. 2012;2:147. doi: 10.4172/2155-9600.1000147.
[3] Bolan YuJie ,Wang Paolo M. SuterRobert, M. Russell spirulina is an effective dietary source of zeaxanthin to humansDOI:10.1017/S0007114511005885
[4] Christaki E., Florou-Paneri P., Bonos E. Microalgae: A novel ingredient in nutrition. Int. J. Food Sci. Nutr. 2011;62:794–799. doi: 10.3109/09637486.2011.58006.
[5] Devi MA, Venkataraman LV. Hypocholesterolemic effect of blue-green algae Spirulina platensis in albino rats. Ann Nutr Reports Int 1983;**28**:519–530.
[6] Eskin N.A.M., Tamir S. Dictionary of Nutraceuticals and Functional Foods. CRC Press; Boca Raton, FL, USA: 215.
[7] Eckel R.H., Grundy S.M., Zimmet P.Z. The metabolic syndrome. Lancet. 2005;365:1415–1428. doi: 10.1016/S0140-6736(05)66378-7.
[8] El Schaimy E. Functional foods and nutraceuticals—Modern approach. World Appl. Sci. J. 2012;20:691–708.
[9] Heidarpour A., Fourouzandeh-Shahraki A.-D., Eghbalsaied S. Effects of Spirulina platensis on performance, digestibility and serum biochemical parameters of Holstein calves. Afr. J. Agric. Res. 2011;6:5061–5065.
[10] Hardy G. Nutraceuticals and functional foods: Introduction and meaning. Nutrition. 2000;16:688–689. doi: 10.1016/S0899-9007(00)00332
[11] James R. Obesity, Prevention and Treatment. Book News, Inc.; Portland, OR, USA: 2012.
[12] J. Zheng, T. Inoguchi, S. Sasaki et al., "Phycocyanin and phycocyanobilin from Spirulina platensis protect against diabetic nephropathy by inhibiting oxidative stress," American Journal of Physiology, vol. 304, no. 2, pp. R110–R120, 2013.
[13] Kalra E.K. Nutraceutical–definition and introduction. AAPS PharmSci. 2003;5:E25. doi: 10.1208/ps050325.
[14] Kato T, Takemoto K, Katayama H, Kuwabara Y. Effects of Spirulina (Spirulina platensis) on dietary hypercholesterolemia in rats. J Jap SocNutr Food Sci 1984;**37**:323–332.
[15] **Lidiane Maria de Andrade** University of São PauloCristiano José De Andrade,Meriellen Dias,Claudio A. O. Nascimento,Maria Anita Mendes.https://www.researchgate.net/publication/322888591Chlorella and Spirulina Microalgae as Sources of Functional Foods, Nutraceuticals, and Food Supplements; an Overview
[16] Nicoletti M. Nutraceuticals and botanicals: Overview and perspectives. Int. J. Food Sci. Nutr. 2012;63:2–6. doi: 10.3109/09637486.2011.62
[17] Nicoletti M. Nutraceuticals and botanicals appeal for new analytical solutions. J. Chromatogr. Sep. Tech. 2012;3:e103. doi: 10.4172/2157-7064.1000e103
[18] Ogden C.L., Carroll M.D., Kit B.K., Flegal K.M. Prevalence of childhood and adult obesity in the United States, 2011–2012. JAMA. 2014;311:806–814. doi: 10.1001/jama.2014.732
[19] Panam Parikh[1], Uliyar Mani, Uma Iyer.Role of Spirulina in the Control of Glycemia and Lipidemia in Type 2 Diabetes MellitusPMID: **12639401**DOI: 10.1089/10966200152744463
[20] PeiHan[a]JingjingLi[a]HuiqiZhong[a]JiawenXie[a]PeidongZhang[a]QianLu[a]JunLi[a]PeilunXu[a]PaulChen[c]LijianLeng[b]WenguangZhou[a]. Anti-oxidation properties and therapeutic potentials of spirulinahttps://doi.org/10.1016/j.algal.2021.102240
[21] Rajasekaran A., Sivagnanam G., Xavier R. Nutraceuticals as therapeutic agents: A review. Res. J. Pharm. Technol. 2008;1:328–340.
[22] Ruma AroraSoni[a] K.Sudhakar[ac] R.S.Rana[b] . Spirulina – From growth to nutritional product: A reviewhttps://doi.org/10.1016/j.tifs.2017.09.010
[23] Ruitang Deng,Te-Jin Chow,Hypolipidemic, Antioxidant, and Antiinflammatory Activities of Microalgae Spirulina **https://doi.org/10.1111/j.1755-5922.2010.00200.x**
[24] Renata Koníčková[1], Kateřina Vaňková[1], Jana Vaníková[1], Kateřina Váňová[1], Lucie Muchová[1], Iva Subhanová[1], Marie Zadinová[2], Jaroslav Zelenka[3], Aleš Dvořák[1], Michal Kolář[4], Hynek Strnad[4], Silvie Rimpelová[5], Tomáš Ruml[5], Ronald J Wong[6], Libor Vítek .**Anti-cancer effects** of **blue-green alga Spirulina platensis**, a **natural source** of **bilirubin-like tetrapyrrolic compounds** https://doi.org/10.1016/S1665-2681(19)30891-9
[25] SANCO . Directorate General European Commission the Use of Substances with Nutritional Effect Other than Vitamins and Minerals in Food Supplements. SANCO; Brussel, Belgium: 2007. Study undertaken for European Advisory Services (EAS)
[26] Tramroy P. Microalgae Market Outlook Report Website. CBDM.T—Market and Business Intelligence. 2011. [(accessed on 24 August 2011)].
[27] Manel Gargouri[1], Christian Magné , Abdelfattah El Feki[3], Hyperglycemia, oxidative stress, liver damage and dysfunction in alloxan-induced diabetic rat are prevented by Spirulina supplementation, Nutr. Res. 36 (2016) 1255–1268, https://doi.org/10.1016/j. nutres.2016.09.011M. Samir and P. S. Amrit, "A review of pharmacology and phytochemicals from Indian medicinal plants," The Internet Journal of Alternative Medicine, vol. 5, no. 1, pp. 1–6, 2007.
[28] Zeisel S.H. Regulation of "nutraceuticals" Science. 1999;285:1853–1855. doi: 10.1126/science.285.5435.1853



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY