

MEDICINAL USES OF SPIRULINA PLATENSIS

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ABSTRACT

Spirulina is a free-drifting filamentous smaller scale green growth developing insoluble water bodies. With its high healthy benefit, it has been expended as nourishment for quite a long time in different parts of the world. It is presently generally utilized as a nutraceutical nourishment supplement around the world. *Spirulina platensis* has picked up prominence as the nourishment of the universe. Different inquiries have demonstrated it to be a strong wellspring of the supplement. Spirulina in particular, proteins, sugars, lipids, nutrients, minerals, nucleic acids, cancer prevention agents, colors and catalysts. Spirulina function as a therapeutic plant with various kinds of sicknesses for instance, against irritation, hostile to oxidation, antitumor, immunological improvement.

KEYWORDS: Spirulina, Health benefit, Therapeutic plant, Supplement.

INTRODUCTION

Spirulina is free-drifting filamentous miniaturized scale blue green growth which is primarily found in soluble water bodies. Spirulina is the minuscule microalgae (cyanobacteria) and their cell structure is a straight forward prokaryote (1). Spirulina the plant can perform photosynthesis in light of the fact that can change over sun based vitality to substance vitality by means of photosynthesis. It's exceptionally famous to everywhere throughout the world that normally develops in high-salt soluble water supplies in subtropical and tropical territories including America, Mexico, Asian and Central Africa for utilization for the person, since it contains variations of nourishing and helpful viewpoints (2-3). Its name derives from the spiral or helical nature of its filaments (Belay, 2002).

The biochemical arrangement of *Spirulina platensis* are of protein, fundamental unsaturated fats, nutrients, minerals, photosynthesis colors like chlorophyll a, xanthophylls, betacarotene, myxoxanthophyll, echinenone, canthaxanthin, 3- hydroxycchinenone, diatoxanthin, beta-cryptoxanthin, oscillaxanthin, in addition to the allophycocyanin, phycobiliproteins and c-phycocyanin. (Cheng- Wu, 1994) (4).

Spirulina platensis are wealthy in protein, between 55-70 % by dry weight. It is a complete protein, containing all basic amino acids, however with decreased measures of Cysteine, lysine and, when appeared differently in relation to standard proteins, for example, that from eggs, meat, or milk; it is, in any case, better than all

standard plant protein, for example, that from vegetables (5). *Spirulina* has a high measure of polyunsaturated unsaturated fats, 1.5 to 2.0 percent of 5 to 6 percent absolute lipid. Specifically Spirulina is rich in γ -linolenic corrosive (36 percent of complete PUFAs), and furthermore gives γ -linolenic corrosive (ALA), linoleic corrosive (LA, 36 percent of all out), stearidonic corrosive (SDA), docosahexaenoic corrosive (DHA), ecosapentaenoic corrosive (EPA) and arachidonic corrosive (AA). Spirulina contains nutrient B2(riboflavin), B1(thiamine), B3(nicotinamide), B9(folic corrosive), B12(cyanocobalamin), B6(Pyridoxine), nutrient D, nutrient E and C (6-8).

A blue green growth *Spirulina platensis* has been utilized as a wellspring of nourishment supplement since it has high protein content esteem and nutritive incentive too. It has been likewise exhibited a few gainful wellbeing impacts because of their capacity to go about as scroungers for receptive oxygen species. It is utilized as protein supplement and furthermore thinks about the particular impacts resistant framework (9-10).

Spirulina has numerous medical advantages just as remedial significance, for example, insurance of the liver and kidneys, improvement of blood quality and anticipation of frailty, benefits for diabetes, decrease in circulatory strain, expulsion of substantial metals from the body, radioprotection, avoidance of liver and renal harmfulness, cancer prevention agent activity, safe security help in unfavourably susceptible responses. The high chlorophyll content flushes out poisons from

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the blood, going about as a characteristic detox. It additionally helps your insusceptible framework. [11]

There are some Medicinal uses of *Spirulina platensis*:

1. In Malnutrition: *Spirulina platensis* gives a few huge and amazing medical advantages to malnourished kids, particularly the individuals who are under five years of age.[12] The protein constituents of *Arthrospira platensis* and its Vitamin-B complex give a significant nourishing advancement in grown-ups and youngsters' eating regimen, since it supplies the attractive characteristics of beta carotene that can defeat eye issue or eye sicknesses brought about by inadequacy of nutrient A and propose to dietary prerequisite of β carotene which can help or counteract the eye infections of kids.[13] It is the main nourishment source fusing huge measures of fundamental amino acids, gamma-linoleic-acid (GLA) and basic unsaturated fats, which helps to decide the whole hormonal framework. *Spirulina platensis* assumes an incredible job in treating individuals who are experienced kwashiorkor. Kwashiorkor is the ailment brought about by a protein-lacking eating routine in newborn children and youngsters. *Spirulina* protein is significantly more proficient and successful than some other protein sources like drain and milk powder. These *Spirulina* benefits considered as solid nourishment and diet with high dietary and therapeutic worth (14).

2. *Spirulina* role in Antiviral activity: *Spirulina* has strong antiviral activity due to presence of antibacterial and antimycotic substances that are isolated from *Spirulina platensis* through the therapeutic researches on it. These outcomes show fantastic in vitro restraint of HIV-1 infection both in human Lymphocyte lines and in human monocytes(15). The therapeutic evidence of the extract is reported to be over 100 and concentrations as low as 5-10 $\mu\text{g/ml}$ evidently reduce the production of virus in any system and hence prove to be highly antiviral in activity. Ingestion of *Spirulina* adds to the utilitarian safeguarding of the intestinal epithelium which acts as a first line of mucosal obstruction against diseases. Restraint of humoral insusceptible reaction, cell interceded insusceptible reaction (postponed type excessive touchiness) and TNF-alpha was seen in a portion subordinate way in mice. *Spirulina* has likewise been found to secure against roughage fever.

The benefit of utilizing herbs and algal items with demonstrated antiviral properties in battling certain infections is that they can be utilized—through immunomodulation—in any event, when the contamination is set u (16).

3. *Spirulina* role in Antidiabetic activity: Water dissolvable division of *Spirulina* was found reasonable in bringing down the serum glucose level at fasting while the water covered glucose level at glucose stacking. In a human clinical study with 15 diabetics, a huge diminishing in the fasting glucose level of patients was seen following 21 days of 2 g/day *Spirulina* supplementation.[17] Cholesterol bringing down impacts and consequences for diabetes, cardiovascular malady, and stays most significant hazard factors by supplemented with the 4.2 g on day 1 of *Spirulina* to 15 male volunteers and what's more, in spite of the fact that there was no huge increment in high-thickness lipoprotein (HDL) levels, they watched a huge decrease of high-thickness lipoprotein (LDL) cholesterol following two months of treatment. The atherogenic impact additionally declined essentially in the above gathering demonstrating *Spirulina* to be up-and-come liable for this impact (18).

In a later report regulated *Spirulina* supplements in ischemic coronary illness patients and discovered a huge decrease in blood cholesterol, triglycerides what's more, LDL cholesterol and an expansion in HDL cholesterol. In a clinical report, found a noteworthy decrease in LDL: HDL proportion in 15 diabetic patients who were given *Spirulina*. Be that as it may, this examination was little and better investigations are required before *Spirulina* can be suggested in diabetes (19).

Antidiabetic impact was likewise observed by enhancing *Spirulina* 2g/day portions for 2 months on the levels of blood glucose, lipid profile and glycosylated haemoglobin. The bringing down of fasting and postprandial blood glucose levels and in the HbA1c level showed the antidiabetic property of *Spirulina* (20).

The impact of *Spirulina* at a portion of 15 mg/kg body weight yielded a more significant level of noteworthiness than the dosages of 5 and 10 mg per kg of body weight. The action of hexokinase in the liver diminished extraordinarily, while the action of glucose-6-phosphatase expanded essentially in diabetic control (21).

4. *Spirulina* Role in Anti-inflammatory effect: Late research uncovers that free bilirubin works physiologically as a powerful inhibitor of NADPH oxidase action. The chromophore phycocyanobilin (PCB), found in blue green growth and cyanobacteria, for example, *Spirulina*, additionally has been seen as a powerful inhibitor of this chemical intricate, likely in light of the fact that in mammalian cells it is quickly diminished to phycocyanorubin, a nearby homolog of bilirubin. Orally regulated *Spirulina* or phycocyanin (the *Spirulina* holoprotein that contains PCB) can apply a wide scope of mitigating impacts. Until PCB

enriched *Spirulina* separates or artificially created PCB are financially accessible, the most attainable and most economical approach to direct PCB is by ingestion of entire *Spirulina* (McCarty, 2007)

Spirulina contains a few dynamic fixings, prominently phycocyanin and β -carotene that have powerful cell reinforcement and mitigating exercises. As calming exercises, phycocyanin restrains proinflammatory cytokine development, for example, $\text{TNF}\alpha$, smothers cyclooxygenase-2 (COX-2) articulation and diminishes prostaglandin E(2) creation. Furthermore, phycocyanin has been accounted for to smother the enactment of nuclear factor- κB (NF- κB) through avoiding debasement of cytosolic I κB - α and adjust the mitogen-initiated protein kinase (MAPK) actuation pathways, including the extracellular-signal-managed kinase (ERK1/2), p38, c-Jun N-terminal kinase (JNK), pathways (22).

Another element of *Spirulina*, β -carotene, has been accounted for to have cancer prevention agents and mitigating exercises. In concentrate to look at β -carotene, nutrient E, and nitric oxide as film cell reinforcements, it was discovered that β -carotene secured against singlet oxygen-interceded lipid per oxidation. (Helliwell, 2011). Studies likewise indicated that β -carotene hindered the creation of prostaglandin E (2) and nitric oxide, and stifled the statement of iNOS, $\text{TNF}-\alpha$, and IL-1 β and COX-2. Such concealment of provocative arbiters by β -carotene is likely to come about because of its restraint of NF- κB enactment through blocking atomic translocation of NF- κB p65 subunit (23).

Oxidative stress and inflammation both add to the pathogenesis of cardiovascular illnesses, including atherosclerosis, heart hypertrophy, cardiovascular breakdown, and hypertension. Overproduction of responsive oxygen species (ROS) showing that oxidative pressure has been seen in those cardiovascular sickness conditions. ROS likewise adds to vascular brokenness and renovating through oxidative harms in endothelial cells. Moreover, proof shows that LDL oxidation is fundamental for atherogenesis. Then again; the microenvironment present inside the atherosclerotic injury is proinflammatory. Notwithstanding being a confusion of lipid digestion, atherosclerosis is currently perceived as an incessant incendiary illness. Amassing proof shows that extreme aggravation inside the blood vessel divider is a hazard factor for cardiovascular sicknesses and can advance atherogenesis. Specialists with cancer prevention agent or potentially calming movement may demonstrate to be useful in battling cardiovascular maladies (24).

5. ANTI-CANCER EFFECT

Numerous scientists see phycocyanin as really powerful cell reinforcement, calming and hostile to malignancy properties colour found distinctly in *Spirulina* and different types of blue green growth. It has been contended that the consolidated cancer prevention agent and resistant regulation attributes of *Spirulina* may have a potential component of tumour demolition and henceforth assume a job in disease anticipation. The impacts of *Spirulina* on oral carcinogenesis, specifically leukoplakia indicated tumour relapse after topical application or on the other hand enteral admission of *Spirulina* separate. Jalaja et al., 2011 concentrated the impact of *Spirulina* on chemoprevention of disease in tobacco chewers in Kerala, India (25). It was discovered supplementation with *Spirulina* at 1 g/day for 1 year brought about complete relapse. On the off chance that *Spirulina* demonstrates to have such impact, it can without much of a stretch be fused in the day by day diet as a helpful operator. It was demonstrated that boiling water concentrate of *S. platensis* encouraged improved antitumor action of common eucutioner (NK) cells in rodents. As of late, complex polysaccharides from *Spirulina* have realized concealment of glioma cell development by down regulating angiogenesis by means of halfway guideline of interleukin-17 generation. High generation of tumor corruption factor- (TNF-), in macrophages, was recorded in the nearness of acidic polysaccharides from *A. platensis*. Li et al. have demonstrated that with expanded phycocyanin focus, articulation of CD59 proteins in HeLa cells was advanced while Fas protein that initiates apoptosis was expanded with a chaperon decrease in the augmentation of HeLa cells. These discoveries are a proof for the multidimensional uses of phycocyanin substance of *S. platensis*. [26,27] It isn't astonishing that couple of human investigations exist to date as disease anticipation preliminaries with lower malignancy occurrence as an endpoint have strategic issues, rendering them basically difficult to lead for most malignancies. The examination directed by Mathew et al. on a partner of 77 patients begins from past preliminaries on hamsters that indicated tumour relapse after topical application or enteral admission of *Spirulina* extract (28).

Many studies had displayed that *S. platensis* is a significant source of phycocyanin (PC) and furthermore a decent contender for Selenium (Se) advancement. It has been accounted for that Se-PC can repress tumour cell expansion and can execute tumours by prompting apoptosis. PC PDT has been recently

appeared to incite apoptosis both in vivo (Zhou et al.1996;Li et al. 2016) and in vitro (Choi et al. 2004; Usuda et al. 2003). In any case, up to thispoint, the component of the Se-PC-PDT has not been very much characterized. Especially, thesystem fundamental the co-impact of PC and Se with or without light treatment on liver malignant growth cells stays obscure (29).

In vitro examination, study demonstrated that the HepG2 cell continuance ratedropped to 38% when the centralization of Se-PC came to 100 µg/ml, which contained 0.2 mg/gselenium, while the endurance pace of HL7702 arrived at 80%, suggesting that there was a substitute effect of Se-PC PDT treatment in common cells than in harmful development cells, and Se-PC is relied upon to be a protected and successful photosensitizer. We likewise found that the cell endurance rates rose to around 80% for the HepG2 cells upon 100 µg/ml Se- PC PDT treatment in addition to treatment with the caspase inhibitor Z-VAD-FMK, which proposed that caspase-subordinate apoptosis is associated with the Se-PC PDT process. This outcome was consistency with the limitation of over 75% of the Se-PC in the mitochondria of the cells, speaking to a large portion of the photosensitizer collection, and in this manner, apoptosis is the principle type of cell demise in Se-PC PDT treatment. Strikingly, we found that around 25% of Se-PC was situated in lysosomes, and the cells in both the Se-PC and Se-PC PDT treatment bunches appeared higher rates of apoptotic cores than the PC PDT bunch as indicated by the acridine orange recoloring investigation. In the xenograft tumour explore, the tumour volume was all the more especially diminished in both Se-PC and Se-PC PDT bunches than in the PC PDT gathering, and there were more processed vacuoles in the cytoplasm of the Se- PC PDT bunch than in the PC PDT gathering. These outcomes recommend that free radicals may additionally harm lysosome layers, causing cell autophagy and instigating caspasedependent apoptosis. At the point when tumor tissues were treated with higher convergence of Se-PC, ROS were created after illumination and activated cell demise with various pathways including cell autophagy, apoptosis and putrefaction. At the same time, in ordinary tissues, the degradative PC peptide provided supplement substance through blood flow framework and the light additionally advanced catalyst combination of SOD, particularly, the separated Se or Se-cys-amino-corrosive build-up involved in GSH-Px combination. The two upgraded body cancer prevention agent framework to guard tumour development.Taking everything into account, Se-PC PDT showed more grounded anticancer action in examination with PC PDT. The instrument of Se-PC PDT against liver tumours includes hematocyte harm hindrance and

mitochondria-interceded apoptosis went with autophagy hindrance throughout beginning period of tumor advancement. Because of its cell reinforcement and against proliferative exercises, Se-PC is proposed as a perfect nutrient based photosensitizer with potential applications in malignant growth treatment(30).

Different focuses (200, 400, 600, 800, 1000 µg/mL) of methanol concentrates of *S. platensis*, *A. oryzae* and *C. marchica* were examined against EAC in vitro. The outcomes showed that *S. platensis*, *A. oryzae* and *C. marchica* repressed EAC expansion. The *S. platensis* demonstrated more anti-proliferative impacts against EAC than *A. oryzae* and *C. marchica*, separately. The most extreme level of EAC restraint was 89%, 69%, and 61%, separately, with 1000 µg/mL *S. platensis*, announced that cyanobacteria have given gainful physiological impacts on human wellbeing, such as antitumor activity, immune modulating bioactivity and antimutagen capacity. Mirada et al. reported that some types of cancer were inhibited by algal extracts. Abu Zaid indicated that water extraction of *S. platensis* had hostile to proliferative properties in human colon carcinoma cells and hepatocellular carcinoma cells.

The investigation portrays the absence of antitumor action of *Spirulina* in EAC tumour-bearing mice model. *Spirulina* controlled all the while with fluorouracil didn't improve the antitumor action of the later yet rather brought about expanded portion subordinate mortality. Considering the present outcomes, the system of spirulina-inducedmortality is not well understood. Although *Spirulina* has been appeared to have anticancer impacts in different models, the present study shows that it probably won't be a reasonable restorative elective for ordinary chemotherapeutic specialists in all settings, for example, EAC tumour-bearing mice model. Also, *Spirulina* may be not sheltered, especially when directed with different medications, for example, fluorouracil. Therefore we suggest that *Spirulina*, or even other characteristic items, ought to be utilized warily and that potential associations with other co administered medications ought to be checked cautiously (31).

6. Antioxidant Effect

A study demonstrated that supplementation of *Spirulina* with a day by day portion of 8g for about a month essentially delayed an opportunity to weariness, decreased TBARS prompted by extract, and expanded the plasma glutathione, and protein carbonyls, catalase, and aggregate cancer prevention agent limit levels. C-phycocyanin (C-PC) is one of the major phycobilins of *Spirulina* with cancer prevention agent and radical rummaging properties. C-PC, a particular cyclooxygenase-2 inhibitor, initiates cell death in lipo

polysaccharide invigorated RAW 264.7 macrophages. It is additionally known to show mitigating also, anticancer properties [30]. Phycocyanin can rummage free radicals, including alkoxyl, hydroxyl and peroxy radicals. It additionally diminishes nitrite generation, stifles inducible nitric oxide synthase (iNOS) articulation, and hinders liver microsomal lipid peroxidation (31).

Supplementation of *Spirulina* in the eating regimen at the portions a lot higher than any foreseen human utilization didn't cause any indications of embryotoxic impacts. *Spirulina* had no discernible antagonistic impacts on regenerative execution, incipient organism and embryo advancement and development. Admission of diet containing *Spirulina* fundamentally expanded litter measure though birth loads of puppies were practically identical to those from different gatherings (32).

Spirulina platensis extract contains a mixture of proteins and carotenoid which have a synergistic effect on wound healing, skin cell proliferation, and tissue regeneration. In vitro cytotoxicity furthermore, twisted mending impacts of *S. platensis* removes were examined so as to assess the potential use in pharmaceutical and also in biomedical region. In vitro cell culture thinks about illustrated that *Spirulina* separates with 0.05% and 0.1%, focus appeared a noteworthy impact on L929 fibroblast cell line multiplication. As fibroblast cells are mesenchymal cells empowering tissue upkeep also, assist by discharging extracellular grid, they are dependable for aggravation and scar arrangement during wound mending. Accordingly, twisted recuperating action on HS2 cell lines L929 cell lines was dictated by in vitro scratch examine. Results indicated that cell expansion what's more, relocation were expanded by fuse of unrefined removes. Skin cream joined with 1.125% *S. platensis* extricate shown most noteworthy proliferative impact on skin cells and upheld by immunohistochemical measure outcomes. In light of discoveries, *Spirulina* fuse into biomaterials of skin will be a promising added substance for further applications in biomedical region, especially as wound healing (33).

CONCLUSION

Spirulina shows strong invulnerable animating impacts, shows antiviral movement against an assortment of hurtful infections. It appears guarantee as a malignant growth precaution operator and in the treatment of tumours. *Spirulina* appears far extending cardiovascular advantages counting improvement of blood lipid profiles, aversion of atherosclerosis, and control of hypertension. Notwithstanding high levels of provitamin A, dried smaller scale green growth can give different supplements including proteins, minerals, nutrients, and cancer prevention agents. World creation

of consumable green growth and green growth items to be utilized as dietary enhancements, nourishment added substances, practical nourishments, and medications has arrived at a huge number of tons every year after research which has demonstrated its significance.

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