

## ARTHROSPIRA-FRIEND OF THE FUTURE-REVIEW

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### ABSTRACT

The investigation for natural items that have health advantages in general and that have the ability to treat human disease has piqued the curiosity of people all over the world. In this paper, we examine the most recent information available on Cyanobacteria, which are aquatic and photosynthetic organisms that are well-known for their pigment-rich colours. Because of their high protein content, they are widely used as dietary supplements in a variety of applications. A high concentration of proteins, lipo polysaccharides, and gamma-linolenic acid may be found in the algae. AP extracts, phycocyanin compounds, and the polysaccharide calcium spirulina (Ca-SP) have all been tested in a variety of animal models to determine their efficacy. In addition to the synthesis of phycocyanobilin and allophycocyanin, spirulina (Arthrospira) also exhibits antioxidant and antimicrobial (antibacterial, antifungal, and antiviral) properties through the creation of additional important chemicals. Additional anti-cancer efficacy was shown in oral cancer, melanoma and UV-induced non melanoma skin cancer models, as well as in human patients. This article is an attempt to compile all of the nutritional and therapeutic uses of Arthrospira in one convenient location.

**Keywords:** blue-green algae, arthrospira, spirulina, Cyanobacteria

### I.INTRODUCTION

Cyanobacteria are photosynthetic organisms that have existed for millions of years and may be found in a variety of aquatic settings. Their photosynthetic pigments give them a variety of hues, although they are typically considered to be blue-green in appearance [1]. To refer to them as algae, on the other hand, is a misnomer because they are true prokaryotes that exhibit many of the features of eubacteria. Cyanobacteria can be found as colonies or as single cells in the environment. They can also develop structures such as coccid or filamentous structures. The filamentous colonies have demonstrated the capacity to differentiate into three distinct cell types [2].

Arthrospira (formerly known as Spirulina) platensis (AP) is a photoautotrophic, planktonic, filamentous green-blue algae that has gained popularity as a medicinal treatment because of its healing properties [3]. Some of these chemicals have also been shown to have significant insecticidal activity [4].

## II. NUTRITIONAL VALUE

Arthrospira (Spirulina) is one of the most abundant sources of protein available. A protein-rich AP makes up 70% of the dry matter in the sample. A significant amount of gamma-linolenic acid (GLA) is found in this plant, which is generated by the alga by the direct desaturation of linoleic acid. AP also contains a significant amount of vitamin B complex, carotene, and ascorbic acid [5]. Similarly, dietary supplementation with Spirulina has been shown to reduce the prevalence of anaemia in women who are pregnant or breastfeeding. S. platensis supplementation in the diet of rats during the first half of pregnancy and lactation has been shown to improve iron storage more than the combination of casein and wheat gluten diets [6] resulting in greater iron storage than the combination of casein and wheat gluten diets.

## III. PHARMACOLOGICAL EFFECTS

### 3.1 Antioxidant Activity

As established by its action against the OH radical produced by the ascorbate/iron/H<sub>2</sub>O<sub>2</sub> system, the existence of two phycobiliproteins in Spirulina, phycocyanin and allophycocyanin, is attributed to the presence of two phycobiliproteins in Spirulina: phycocyanin and allophycocyanin [7]. It was discovered that the activity was related to the concentration of the phycobiliproteins and that it was mostly attributable to the presence of phycocyanin.

The hanging-drop vapour diffusion techniques used by Chinese researchers were successful in crystallising the selenium-containing phycocyanin from the selenium-rich solution. C - Phycocyanin was discovered by Indian researchers who devised a method for purifying it [8].

### 3.2 Renal Disorders

In a recent study, researchers looked at the potential of algae extracts to treat diabetic nephropathy in a mouse model [9]. The treatment of phycocyanin (300 mg/kg) orally for ten weeks provided protection against albuminuria and renal mesangial enlargement in the kidneys of mice.

The nephroprotective effect of *S. platen sis* extract was demonstrated in rats when they were exposed to sodium oxalate and developed hyperoxaluria. It was also shown that administration of *A. platen sis* to rats provided protection against HgCl<sub>2</sub>-induced testicular damage as well as degraded sperm quality [10]. With the help of one-step high-speed counter-current chromatography (HSCCC) with ethanol-ammonium sulphate, a major antioxidant was isolated: a - acidic polysaccharide, composed mostly of glucose with minor rhamnose and mannose and having a molecular weight of 12.33 kDa. The compound was found to have antioxidant properties [11].

### **3.3 Cardiovascular effects**

In a study of 68 individuals with ischemic heart disease (IHD) and atherogenic dyslipidemia, *A. platen sis* biomass preparations were found to have some beneficial effects on the progression of atherosclerotic processes [12].

### **3.4 Hepatoprotectivity**

AP extracts have been shown to reduce liver damage caused by liver toxins such as dibutyl nitrosamine precursors; carbon tetrachloride induced hepatotoxicity, lead acetate and deltamethrin, as well as medicines such as acetaminophen or cisplatin, among others [13]. Using a *Spirulina* hexane extract, a remarkable 89.7% elimination of arsenic from rat liver tissue was accomplished, which is a superior result than that obtained with either an alcohol or a dichloromethane extract. Another recent discovery was that an aqueous extract of *S. platen sis* exhibited suppressive efficacy against cyclophosphamide-induced lipid peroxidation in goat liver homogenates, which was attributed to its free radical scavenging activity [14].

### **3.5 Neuroprotection**

*Arthrospira* supplementation has also been shown to have radio protective properties. As proven by its free radical scavenging activity against gamma-irradiation-induced oxidative stress and tissue damage in rats, it has anti-oxidant properties as well. *S. Platen sis* is also known to have neuroprotective properties [15].

### **3.6 Antiviral activity**

#### *A) HIV infections*

Human T - cell lines, peripheral blood mononuclear cells (PBMC), and Langerhans cells were all suppressed in their HIV - 1 replication by an aqueous extract of AP including lipo polysaccharides as well as a fraction depleted of polysaccharides and tannins (LC). The

extract's 50 percent inhibitory concentration (IC<sub>50</sub>) for PBMC development varied between 0.8 and 3.1 mg/ml, depending on the concentration used [16].

#### *B) Anti-enteroviral effects*

In vitro, allophycocyanin from AP was found to be effective in neutralising the cytotoxic effects of enterovirus 71 in both human rhabdomyosarcoma cells and African green monkey kidney cells, with an IC<sub>50</sub> of about 0.045-0.012 mM in both cell types. Apoptosis produced by enterovirus 71 was decreased as a result of the use of allophycocyanin, which slowed the production of viral RNA in infected cells [17].

#### *C) Herpes infection*

The potential of aqueous extracts of AP and pure calcium spirulina (Ca-SP) in the treatment of human herpes simplex virus 1 (HHV1) and 8 (HHV8) infections was explored in this study. In the case of Ca-SP, it is a sulphated polysaccharide consisting primarily of rhamnose that has the capability of chelating calcium. In vitro, Ca-SP suppressed HHV1 infection of Vero cells with an inhibitory concentration (IC<sub>50</sub>) of 0.04 g/mL and HaCaT cells with an inhibitory concentration (IC<sub>50</sub>) of 0.07 g/mL. The AP extract was shown to be less effective [18].

#### *D) Cytomegalovirus (CMV)*

Spirulan-like molecules isolated from the polysaccharide fractions of *A. Platensis* were shown to have substantial antiviral activity against a variety of viruses, including the human cytomegalovirus and HIV-I [19].

### **3.7 Antibacterial Activity**

Spirulina is not without antimicrobial action, as previously stated. 0.1 percent Spirulina was found to improve the bacterial clearance abilities of 3-week-old chicks injected with either *Escherichia coli* or *Staphylococcus aureus* suspensions, as demonstrated by an increase in the activities of different phagocytotic cells in the chickens, including heterophils, thrombocytes, macrophages, and monocytes [20]. Animal models with MRSA colonisation were reduced by 3 - 4 log units when compared to controls, according to the findings

. Pure C-phycoerythrin from *S. Platensis* significantly reduced the growth of microorganisms that were resistant to antibiotics, including *E. coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* [21].

### **3.8 Antifungal activity**

Recently, it has been discovered that Spirulina possesses antifungal properties. The butanol extract of *Spirulina* sp. exhibited antifungal activity against *Candida glabrata* to the tune of 13 mm. On Balb/C mice that had been infected with candidiasis, the immune

stimulatory activity of *S. Platen sis* extract was investigated. TNF- and interferon-gamma (IFN-) production was increased in this experiment when mice were given extract for 4 days prior to intravenous infection with *Candida albicans* [22].

In a similar vein, *S. Platen sis* biomass was employed to keep the counts of starter organisms in acidophilus-bifidus-thermo philus (ABT) milks at appropriate levels during the whole storage period . This is an exciting new possibility for the development and preservation of beneficial dairy meals.

### **3.9 Anti-inflammatory activity**

Apoptosis in macrophages is induced by the cyclooxygenase-2 (COX-2) enzyme, which is increased during inflammation. C-phycoyanin is a specific inhibitor of COX-2 that is raised during inflammation [23]. The anti-inflammatory and anti-hyperalgesic properties of C - phycoyanin were studied in a carrageen an-induced thermal hyperalgesic animal model, as well as in humans. Nitric oxide (NO) and prostaglandin E2 overproduction were reduced by C - phycoyanin, which did so through inhibition of inducible NO synthase and COX-2 enzymes. Additionally, there was a reduction in the production of TNF-alfa and the infiltration of neutrophilic granulocytes into the tissue [24].

### **3.10 Antipyretic activity**

The antipyretic effect of AP was established in rats that had been exposed to Brewer's Yeast induced pyrexia. It had been demonstrated that it has anti-inflammatory properties when used to treat rat paw oedema produced by prostaglandin E2 injection [25]. The effectiveness of AP extract was shown to be dose-dependent in both animals. According to the findings of an earlier human feeding research done in this respect, a *Spirulina*-based dietary supplement was found to be beneficial in lowering the levels of interleukin (IL) 4.

### **3.11 Rhinitis**

Powders of *S. Platen sis* have been shown to prevent anaphylactic reactions in rats produced by antidinitrophenolIgE-mediated histamine release or by TNF-induced TNF-production. *Spirulina* has also been shown to be helpful in the treatment of allergic rhinitis [26].

### **3.12 Antiarthritic activity**

Several mechanisms, including free radical scavenging, suppression of arachidonic acid metabolism, and inhibition of TNF- in the mice, may be responsible for this anti arthritic effect [27].

### **3.13 Anticancer activity**

A) *Squamous Cell Carcinoma (SCC)*

It was discovered that AP extracts may have anti-cancer properties when they were used to treat dimethylbenz(a)anthracene-induced Squamous cell carcinomas (SCC) of the hamster buccal pouch, which served as a model for oral SCC. AP extracts were supplemented into the diet for 14 weeks in this trial and for 32 weeks in a long-term investigation. The results showed that AP extracts reduced epithelial dysplasia. In the latter research, AOP extracts were also found to be effective in slowing the development of SCC [28].

#### *B) Lung cancer*

We investigated the potential of Ca-SP extracted from AP by employing an in vitro invasion model of cancer cells through a reconstructed basement membrane (Matrigel)/fibronectin-coated filters in order to determine its efficacy. Cancer cells B16-BL6, Colon 26 M3.1 carcinoma cells, and HT- 1080 fibro sarcoma cells were all severely reduced in their ability to invade by Ca-SP. Additionally, Ca - SP reduced tumour cell migration on laminin, but failed to do so on fibronectin. As a result, B16-BL6 melanoma cells were unable to adhere to Matrigel or laminin, but they were able to adhere to fibronectin, indicating that this impact was associated with decreased adhesion. The co-injection of B16-BL6 cells with Ca - SP substantially decreased the incidence of experimental lung metastasis. Multiple intravenous injections of 100 µg of Ca - SP were given to a B16-BL6 spontaneous lung metastasis model, and the tumours lung colonisation was reduced [29].

#### *C) Melanoma*

Non-melanoma skin cancer is caused by prolonged exposure to ultraviolet (UV) light, both naturally and artificially. Irradiation of the skin with UVB light (280 - 320nm) results in the production of 8-hydroxy-7,8-dihydroguanine (8-oxoG), which is a reactive oxygen species produced by UVB radiation. These findings provide proof that the phycocyanin content of *S. Platensis* can be used in a variety of different applications [30].

### **3.14 Wound healing**

The researchers utilised an aqueous AP crude extract at a concentration of 1.125 percent in a skin cream to conduct their study, and the results were promising. In HS2 keratinocyte cell cultures, the formulation promoted wound healing more effectively.

### **3.15 Immunomodulatory**

Immunomodulatory effects of AP whole cells and lipopolysaccharides extracted from these cells were seen in rabbits, resulting in the generation of macro- and micro globulin antibodies in these animals.

#### IV CONCLUSION

The nutritional and therapeutic characteristics of metabolites produced from the cyano bacteria *Spirulina* (*Arthrospira*) sp. have been hypothesised to be responsible in the preceding article, and these hypotheses have been supported. The increasing popularity of alternative medicine means that these organisms represent very viable prospective sources of bioactive chemicals that might be imported for commercial usage. To summarise, AP is a source of varied, partially recognised, and purified compounds that have potential health benefits and activities in the prevention or treatment of a variety of human pathologies, including infections, environmental issues, chronic wounds, and cancer, among others. Consequently, more research, breeding programmes, isolation and purifying efforts should be conducted on these organisms in order to enable for the harvesting of their rich contents for therapeutic and commercial applications. A few numbers of human trials have been undertaken despite the significant benefits in fundamental research and disease models in both the lab and in the field of medicine. It is necessary to perform greater standardisation of natural products, as well as randomised controlled research in human disease, before any conclusive conclusions can be reached. It is important to remember that natural chemicals have the ability to act as antimicrobial agents notwithstanding their limitations.

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