**Spirulina use as a Source of Bioactive Compounds in the Food and Health Sector**

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**Abstract:**

The purpose of this review is to summarise the mechanisms of action of spiriluna, phytochemical, food safety, nanofiber scaffolds, PHB, highlight the potential effects of this alga on humans, and address current and potential future clinical applications, based primarily on in vivo studies and a few carefully designed in vitro studies, as well as the highest levels of evidence currently available in the literature. The objective of this study is to examine the antioxidant activity of new commercial products containing fresh spirulina and the factors influencing it. Antioxidant activity varies depending on the combination of elements in the meal, according to several studies. government organisations growing spirulina to reduce the cost of purchasing it from private businesses and supplying it as food to anganwadis and ashrams so that it can gradually eradicate the problem of malnutrition in India. The synergy coefficient was used to identify and express synergistic, antagonistic, and additive interactions between samples in order to gradually alleviate the issue of malnutrition in India and other nations.

**Key words:** Phytochemical, Food safety, Nanofiber scaffolds, PHB)

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**Introduction**

Spirulina are multicellular and filamentous blue-green microalgae belonging to two separate genera

*Spirulina* and *Arthrospira* and consists of about 15 species. Of these, *Arthrospira platensis* is the most

common and widely available spirulina and most of the published research and public health decision

refers to this specific species. Spirulina is natural food belongs to plantae kingdom which consists different phytochemicals .( Balakrishnan CP et al 2009). (Dawes, C. (1998). This all phytochemicals are biologically significant and plays a vital role in medicinal applications. Mainly laboratory experiments revealed phytochemicals from Spirulina and their use in cancer, tuberculosis, inflammation and many other blood related diseases . (Shyamala, V and N et al 2013).But each and every Spirulina is varying from each other in the production of these compounds. Somehow these production is depends on environmental conditions such as temperature, pH, nutrients, metal ions and other chemicals.( Wijesekara I et al 2011). The phytochemical research loom is measured effective in discovering novel bioactive compounds from Spirulina. There are two main methods for the analysis of phytochemical screening such as qualitative and quantitative analysis. The qualitative tests are used to identify the constituents. (Wijesekara et al 2011). Spirulina is marketed and consumed in several countries, including, U.S.A, Thailand, Taiwan, Vietnam, China, India and Cuba (Shanmugam M et al 2000.).

**Field of Application**

Asia has used spirulina for more than a millennium.It has been marketed as a food supplement due to the high-quality protein and additional beneficial components. (Ali and Saleh, 2012;) Borowitzka,2013,Priyadarshaniand,Rath,2012).Spirulina has recently gained popularity as a non-toxic, no carcinogenic natural blue colourant for use in food and cosmetics (Pandey et al., 2013)

In the US, the FDA has designated spirulina extract as a colour additive exempt from certification and authorised its use in ready-to eat cereals (apart from extruded cereals), frostings, ice cream and frozen desserts, dessert coatings and toppings, beverage mixes and powders, yoghurts, custards, puddings, cottage cheese, gelatin, and breadcrumbs..

 Spirulina is a suitable dye for dairy goods, ice cream, and sweets including chewing gum, coatings, chocolate, sugar embellishments, and candies. The shelf life of the finished goods is increased during processing and storage by low temperatures and light exclusion. The colourant is unsuitable for commercial use for watery food items with pH values below 4.5 and alcohol contents above 20%. (Newsome et al., 2014).

Additionally, spirulina is utilised as an antioxidant, thickening, and waterbinding agent, especially in face, skin, and hair care products, as well as a pigment in cosmetics including lip sticks, eyeliners, and eye shadows.(Priyadarshaniand Rath,2012). Numerous toxicological investigations have validated the safety of spirulina.Spirulina is currently one of the items on the US Food and Drug Administration's list of item classified as Generally Recognised as Safe (GRAS). (Tarantino LM.2003.) (Belay A. 2003.)

Spirulina biomass demonstrates antiallergenic, antibacterial, antifungal, antiinflammatory antioxidant, and immunomodulating effects in addition to stimulating vital biological processes. (Khan et al 2005) As a result, the biomass of Spirulina LEB 18 added to scaffolds promotes cell proliferation and tissue regeneration. . (Morais et al 2010. Qureshi MA et al 1995)

**Expected outcomes**

With the efforts of researchers and the government, the potential of Spirulina must be noticed and brought into use for solving various problems like malnutrition on national and international levels.

Spirulina proves to be an excellent source of micro nutrients like iron iodine, vitamin a foliate zinc, vitamin B1 vitamin B2 and vitamin B3 as all these micronutrients happen to be very effective in recovery from malnutrition. Eradication of malnutrition in Maharashtra gradually with the help of Spirulina supplements manufactured by the government.

* Use of Spirulina reminants or expired supplements as a natural fertilizer to crops and other agricultural produce.
* Use of cheaper spiral in a based supplements produced by government for people suffering from anemia diabetes cholesterol and blood pressure related issues as it aids them very well.
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* Approximately 3000 tons dry weight is currently produced annually in the United States, Thailand, India, Taiwan, China, Pakistan, and Burma (Raja et al., 2007)

**Scope approach**

The Spirulina Market is expected to reach $1.1 billion by 2030, at a CAGR of 9.4% from 2023 to 2030, while in terms of volume, the market is expected to reach 102,381.3 tons by 2030, at a CAGR of 8% from 2023 to 2030

**Use of spirulina food industry**

Spirulina are multicellular and filamentous blue-green algae that has gained considerable popularity in the health food industry and increasingly as a protein and vitamin supplement to aquaculture diets.

Earthrise farm was the first spirulina farm in North America, established in 1976, and today is the largest spirulina farm in the world. With over 40 years of experience and a 108-acre site, Earthrise has continued to produce high quality and safe spirulina for consumers around the world. (WWW.Earthrise)

 **Benefits to the society**

 Like other blue-green algae, spirulina is susceptible to contamination from poisonous compounds known as microcystins. Additionally, it can take up heavy metals from the water in which it is grown. For these reasons, it's crucial to purchase spirulina from a reputable company.

Spirulina may strengthen the immune system, assist in preventing allergic reactions, and have antiviral and anticancer characteristics, according to test tube and animal research. However, there is no evidence that Spirulina offers these or any other advantages to humans. More study is required.

Nanofiber scaffolds offer tissue engineering potential by replicating extracellular matrix structure and function. Electrospun scaffolds have high surface area, porosity, nutrient diffusion, and promote angiogenesis/vascularization during regeneration. (Ramier J,2014)

**Nanofiber** scaffolds can be replaced with Spirulina biopolymers, which are biodegradable and compatible with cells and tissues. Spirulina biomass can be added to polymer solutions without extreme temperatures or pH, allowing internal components like proteins, fatty acids, and biopolymers to stimulate cells or tissues.

**Polyh**ydroxyalkanoates (PHAs), including polyhydroxybutyrate (PHB), can be extracted from microorganisms like Spirulina and used as a toxic biocompatible scaffold for human tissue and organ culture. PHB degrades into a harmless compound, indicating its biocompatibility with cultured cells and tissues. Spirulina biopolymer nanofiber scaffolds have lower rejection risks and advantageous bioactive compounds.. (Sudesh K,et al 2000”and Jau M et al 2005)

**Future scope**

Commercial and mass cultivation: In the early 1960s, Japan began a large-scale culture production programme for the microalgae chlorella and spirulina. More than 22 nations currently engage in extensive commercial spirulina cultivation.

**Conclusion**

Already, spirulina is a well acknowledged and well-liked nutritional supplement. The requirement for studies to support its health advantages is minimal. This is supported by information on its nutritional worth, which makes spirulina a superior option when creating diets and addressing malnutrition.

Preclinical research employing animal models is still being done to assess the bioactive potential of spirulina. However, these research appear to support the existence of Spirulina's potent antioxidant, anticancer, and antiviral activities as well as its ability to prevent diabetes, obesity, and allergic inflammation. Additionally, it has excellent hypoglycaemic, hypocholesterolaemia, and immunomodulatory potential.

The potential of spirulina as a therapeutic food is drawing more attention due to consistent results on its bioactivities. The use of nutraceuticals in the treatment of hypercholesterolemia, hyperglycaemia, cardiovascular disease, and cancer should be quite beneficial.

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