REVIEW ON CULTIVATION OF SPIRULINA PLATENSIS AND ITS BIOCHEMICAL COMPOSITION

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ABSTRACT

Spirulina it is used as human Food as an important source of protein and is collected from natural water, dried and eaten. It has gained Considerable popularity in the human health food industry and in many countries of Asia it is used as Protein supplement and as human health food. Spirulina has been used as a complementary dietary Ingredient of feed for poultry and increasingly as a protein and vitamin supplement. Spirulina appears to have considerable potential for development, for Nutritional enhancement, livelihood development and environmental mitigation. Spirulina platensis, a multicellular, photosynthetic prokaryote (algae) contains a high amount of proteins, vitamins as e.g. soybeans.

A photosynthesizing microorganism culture, like Spirulina platensis, can be an alternative source of protein for human food and feed purposes, with the possibility of obtaining other products like pigments (carotenoids, phycocyanin and chlorophyll), vitamins and lipids. The biomass obtained can be introduced directly in the diet and it can also be used in cases of malnutrition. The influence of inoculum age in S. platensis cultivation in mini-tanks and low cost medium using seawater was developed for the cultivation of an economically important cyanobacterium Spirulina (Arthrospira) platensis. After the determination of the best inoculum age, a study of the influence of inoculum concentration in mini-tanks cultivation was performed. The versatile utilization of the alga can be explained on the one hand with the nutrient levels and on the other hand with recognized effects as anti-viral, anti-bacterial, anti-oxidant, anti-diabetic, anti-cancer and anti-inflammatory substance.

Keywords : *Spirulina platensis, Single cell protein, cyanobacteria, Biomass and Phycocyanin.*

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1. INTRODUCTION

Blue-green algae (cyanobacteria) are among the most primitive life forms on Earth. Their cellular structure is a simple prokaryote. They share features with plants, as they have the ability to perform photosynthesis. They share features with primitive bacteria because they lack a plant cell wall. Edible blue-green algae, including Nostoc, Spirulina, and Aphanizomenon species have been used for food for thousands of years.[1]

The use of Spirulina pigments as colorants has been explored by the pharmaceutical and food industries. The phycocyanin, a blue pigment, is used as food colorant in Japan.[6]

Cyanobacteria, especially Spirulina, have been used for human feed in countries of Asia and Africa, due to their high protein content. Spirulina cultivation is widespread in aquaculture applications due particularly to the use of their pigments as feed for tropical fish.[2] A significant number of other algal species are used in wastewater treatment and agriculture.[3]

The first experimental plant for S. platensis production was developed during the 60’s in the Institut Francaise du Petrole. Nowadays, Japan and United States of America have industrial scale production and more than 40 kinds of products are available on the market.[7],[8]

Temperature is one of the major factors controlling the multiplication of Spirulina species. The optimum temperature for Spirulina growth lies in the range of 30 ^{0}C to 35 °C favourable conditions of temperature and light exposure time, for algal cultivation throughout the year. Heating is required in winter in temperate climates to maintain temperatures above 30 °C, thus greatly increasing operational costs. In winter, Spirulina does not grow significantly in open tanks.[4],[5] The primary objective of this review is therefore to assess and evaluate the existing knowledge on the culture, production and use of spirulina for both human consumption and animal feeds.

1.1 Spirulina Platensis

Spirulina sp. has been used as food for centuries by different populations and only rediscovered in recent years. Once classified as the ―blue-green algae'', it does not strictly speaking belong to the algae, even though for convenience it continues to be referred to in that way. It grows naturally in the alkaline waters of lakes in warm regions. Its impressive protein content and its rapid growth in entirely mineral environments have attracted the attention of both researchers and industrialists alike.

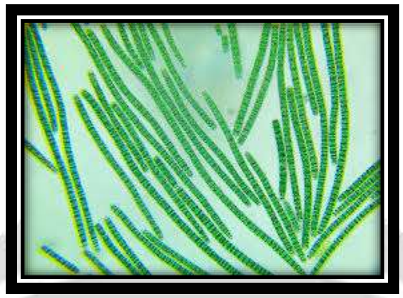

Fig -1: Spirulina platensis

Spirulina are unicellular and filamentous bluegreen algae that has gained considerable popularity in the health food industry and increasingly as a protein and vitamin supplement to aquaculture diets. Spirulina has been used as a complementary dietary ingredient of feed for fish, shrimp and poultry. Among the various species of Spirulina, the blue green alga Spirulina platensis has drawn more attention because it shows an high nutritional content characterized by a 70% protein content and by the presence of minerals, vitamins, amino acids, essential fatty acids etc.[9]

1.2 Biochemical Composition

The biochemical composition of Spirulina as follows:

1.2.1 Proteins - Spirulina has high quality protein content (55–70 percent of the dry weight), which is more than other commonly used plant sources such as dry soybeans (35 percent), peanuts (25 percent) or grains (8–10%).

1.2.2 Essential fatty acids - Spirulina has a high amount of polyunsaturated fatty acids. The important fatty acids like linoleic acid and linolenic acid are also present: up to 1.0 g/100 g of dry biomass of spirulina.

1.2.3 Vitamins - Spirulina contains vitamin B1 (thiamine), B2 (riboflavin), B3 (nicotinamide), B6 (pyridoxine), B9 (folic acid), B12 (cyanocobalamin), vitamin C, vitamin D and vitamin E

1.2.4 Minerals - Spirulina is a rich source of potassium, and also contains calcium, chromium, copper, iron, magnesium, manganese, phosphorus, selenium, sodium and zinc.

1.2.5 Photosynthetic pigments - Spirulina contains many pigments including chlorophyll a, xanthophyll, beta-carotene, echinenone, myxoxanthophyll, zeaxanthin, canthaxanthin, diatoxanthin, 3-hydroxyechinenone, betacryptoxanthin, oscillaxanthin, plus the phycobiliproteins c-phycocyanin and allophycocyanin. [10]

1.2.6 Amino acids - Spirulina protein has a balanced composition of amino acids, with concentrations of methionine, tryptophan and other amino acids almost similar to those of casein although this depends upon the culture media used.

1.2.7 Chelating of toxic minerals (neutralization of toxic minerals) - Spirulina has a unique quality to detoxify (neutralize) or to chelate toxic minerals. [11],[12]

Spirulina can be used to detoxify arsenic from water and food. It also may be used to chelatize or detoxify the poisonous effect of heavy metals (minerals) from water, food and environment. Beijing University has extracted bioactive molecules from spirulina which could neutralize or detoxify the toxic and poisonous effect of heavy metals, and which showed anti-tumor activity.[13],[14]

2 CULTIVATION AND PRODUCTION OF SPIRULINA

Fig -2: Cultivation of Spirulina

Fig -3: Spirulina Powder

2.1 Natural Production

Cultivation process consists of harvesting during day and night and the algal biomass doubles in three to four days. After filtration, the algal biomass is spray-dried after homogenization and pasteurization.

Cultivation process consists of harvesting during day and night and the algal biomass doubles in three to four days. After filtration, the algal biomass is spray-dried after homogenization and pasteurization.[15]

Spirulina is harvested on parallel inclined filters, washed with fresh water, dewatered and pressed again. This paste is extruded into noodle-like filaments which are dried in the sun on transparent plastic sheets.

2.2 Growth Factors

Spirulina production plants for mass cultivation are to be done in areas with suitable climatic conditions, particularly with the sunshine throughout the year. It is difficult to have an ideal growth due to different environmental factors like solar radiation, rain, wind, temperature fluctuation, etc.

2.2.1 Nutrient Medium

Spirulina required high nutrient inputs and salt concentrations compared to Scenedesmus and Chlorella. This might be the reason for Spirulina was naturally grown in salt lakes exclusively[16]. The difficult media currently in use in various centers of production were small alternations of the medium first developed by Zarrouk's for Spirulina culture. Spirulina required a medium of high alkalinity and a steady supply of bicarbonates ions[17].

2.2.2 Carbon source

Ogawa and Terui[18] reported that Spirulina did not grow in organic compounds as the sole carbon source. To increase the productions of cyanobacteria, during mass culture, the minimal medium without sodium chloride fertilized with extracts of different organic manures were used. The dry matter production of Spirulina platensis was increased by 5 to 30 percent[19].

The effect of increased atmospheric CO_2 on photosynthesis and growth of Spirulina. The increase of CO_2 did not cause any change in maximum growth rate while it decreased maximum biomass yield as it affected the pigment content of the algae[20].

2.2.3 Temperature

Temperature in the range of 30-35°C even if the outside temperature as 38°C was most ideally suited for getting maximum yield of Spirulina. Temperature above 35°C leads to bleaching of cultures. Partial shading provided a culture temperature of about 30°C even if the outside temperature was 38°C[21]

The maximum specific growth rate of 0.141 was found at 32 ^{0}C for Spirulina platensis. Maximum biomass production of 2.4 g l-1 and chlorophyll a production of 16.6 mg l-1 were observed at 320 C for Spirulina platensis[22].

Temperature was the most important factor and that the greatest amount of gamma-linolenic acid (GLA) was obtained at 30 ^{0}C, the fatty acid profile of the Spirulina cultivated showing that (in order of abundance) palmitic, linolenic and linoleic acids were most prevalent[23].

2.2.4 Water quality

The characteristics of water quality contributed in the algal mass production. It had dual influence, firstly by affecting the solubility of nutrients added in the medium and also selective accumulation of certain heavy metals by algae during the growth phase[24].

2.2.5 Light

Spirulina required light intensities during its growth phase. Spirulina platensis is an important source of pharmaceuticals and nutraceuticals such as glinolenic acid (GLnA**).** The dry weight of Spirulina platensis was 0.85g/500ml while protein content and Chlorophyll a were 64.3% and 9.8mg/gm respectively[25].

2.2.6 pH

The pH had a direct effect on the physiological properties of algae and the availability of nutrient. pH determined the solubility of carbon source and minerals in the culture directly or indirectly. Spirulina grow well at pH values between 9 and 11. The optimal pH of the Spirulina nutrient medium was shifted from 8.4 to 9.5 during the mass cultivation, due to the consumption of bicarbonate and sodium ions. [26].

3. CONCLUSION

From this review we have come on the conclusion that the Spirulina Platensis contains multiple chemical constituents and the cultivation is depend on environmental and other factors.

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