

# REVIEW ON FORMULATION, DEVELOPMENT OF SPIRULINA CHOCOLATES AS IMMUNITY BOOSTERS.

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## ABSTRACT

*Spirulina*, linking bacteria and plants is primitive, has a simple structure but a complex composition. It has been a common dietary substance around the world from ancient times. Although dietary usage and supplementation continues to be popular, there was for a long time no strong scientific evidence of spirulina's nutritive and health benefits. *Spirulina* is a blue-green algae. There are three predominant species in India namely *Spirulina platensis*, *Spirulina fusiformis* and *Spirulina maxima*. *Spirulina* is the first photosynthesizing prokaryotes, called cyanobacteria or blue-green algae, which is used as a source of potential food supplement and pharmaceutical values. Therefore it is used as a food supplement and has antioxidant and anti-inflammation activities, free radical-scavenging activity, peroxidation effects and metalloprotein role. *Spirulina* is very rich in protein, omega 3 and omega 6 oils, vitamin and mineral and its incorporation into chocolates will enrich their nutritional values. Our *Spirulina* Chocolates were prepared by simple incorporation method by addition of 1gm *Spirulina* by dissolving in 10 ml NaCl as a solubility enhancer as well as to mask the taste and smell. This chocolate form is easier for every individual to chew and absorb. The chocolates were assessed for organoleptic properties, pH, blooming test, and hardness. This significant study revealed the efficacy of *Spirulina* Chocolate Formulation and it would definitely have wide scope in the future as an immunity booster.

**Keywords:** *Spirulina*; Immunity booster, Chocolate, *Athrospira plantensis* dietary supplement, immunomodulation.

## 1. INTRODUCTION:

Human nutritional and dietary requirement understanding and an optimal provision of the same are of primary importance. Changing lifestyles, dynamic restructuring of micro and macro niches, and unavailability of nutrition sources contribute to an increasing incidence of malnourishment and other health risks. As the source for most nutritional requirements is the diet, it is necessary to look into the aspect of supplements that will boost the health status of individuals [1]. *Spirulina* was heavily exploited and became a commercially important filamentous cyanobacterium due to its inherent ability to accumulate wealth of natural resources such as proteins, minerals, PUFAs and a few vitamins. Hence, several methods are attempted to cultivate both at laboratory, mass and industrial scales [2,3,4].

### 1.1 Taxonomy of *spirulina plantensis* :

The genus *Spirulina* was established by Turpin for *Spirulina oscillarioides* in 1827 [5]. It belongs to the kingdom Monera and division Cyanophyta which is a genus of the phylum Cyanobacteria ("Cyano" from the Greek meaning blue). Nowadays, there are more than 39 species of *Spirulina* in which *S. platensis*, *S. fusiformis* and *S. maxima* are the most investigated because of their high nutritional and pharmacological values. *S. plantensis* species is the most commonly available and widely used in different fields specially food industry and medicine [6].

<b>Domain:</b>	<b>Bacteria</b>
Phylum:	Cyanobacteria
Class:	Cyanophyceae
Order:	Oscillatoriales
Family:	Microcoleaceae
Genus:	Arthrospira

**Table No 1 : Domain and bacteria**

Spirulina, like many other plant-based super foods, is absolutely safe for kids and adults to eat. As food, spirulina represents a complete vegetarian protein source. When it is sourced safely and administered correctly, it can be a fantastic supplement for adults as well as children [7].

### 1.2 Nutritional supplementation:

One health problem that is of great concern, especially in developing countries, is malnutrition. Severe forms of malnutrition are expressed as protein energy malnutrition defects such as kwashiorkor, marasmus and marasmic kwashiorkor. Apart from protein deficiencies, affected children usually do not have a complete balanced diet which includes the micronutrients such as vitamins and minerals that are essential for normal growth and development. The consequences of malnutrition represent a global problem, which affects morbidity as well as mortality. Increased tissue production of prostaglandin E2 as a result of high intake of linoleic acid in a polyunsaturated fatty acid deficient diet, causes inhibition of the proliferation and cytokine production of Th1 cells, the mediators of cellular immunity[8].

Spirulina is rich in proteins, carbohydrates, polyunsaturated fatty acids, sterols and some more vital elements such as calcium, iron, zinc, magnesium, manganese and selenium. It is a natural source of vitamin B12, vitamin E, ascorbic acid, tocopherols and a whole spectrum of natural mixed carotene and xanthophylls phytopigments. Spirulina as a supplement serves to provide these nutrition requirements and seems to be a 'wonder food'. Ith diabetic rat models concluded that Spirulina maxima was effective in correcting the abnormal carbohydrate and lipid metabolisms caused by excess fructose within the body[9].

### 1.3 Vitamins

**1.3.1 Vitamin E:** Children need plenty of vitamin E for proper growth, and this need begins before a child is even born, according to a 2006 article published in the "American Journal of Clinical Nutrition." Vitamin E also plays a role in gene expression and helps children convert the foods they eat into energy, according to the National Institutes of Health. Spirulina contains vitamin E that helps to supply the RDA for a child.

**1.3.2 Vitamin C (Ascorbic Acid):** It contains vitamin C, also known as ascorbic acid, this is one of the most essential elements of any diet, and is particularly beneficial to the immune system, in helping to prevent colds and flu which the children are quite prone to. •

**1.3.3 Vitamins A (Beta Carotene):** Children require 3 to 6 mg of beta-carotene (the equivalent of 5,000 to 10,000 Units of vitamin A activity) per day. Spirulina contains beta carotene, that is pure vitamin A, this antioxidant aids vision in dim light [10]. Spirulina platensis is a blue-green microalga classified as single-celled cyanobacteria with spiral body shape [11]. Spirulina has good protein, essential fatty acids, vitamins, minerals, chlorophyll, and phycocyanin used as a functional food. Spirulina is often referred to as a nutraceutical ingredient because it has phytonutrients (phycocyanin, carotene, and xanthophylls), gamma-linolenic acid (GLA) galacto-lipids, sulfo-lipids, chlorophyll and minerals [12]. Besides, phycocyanin, phycocyanobilin, and allophycocyanin compounds in Spirulina biomass are known to function as effective anticancer, antibacterial, antifungal, and antiviral agents [13]. High content of phycocyanin pigment shows antioxidant characteristic, which functions as an inflammatory, inhibits tumor necrosis and protects nerve cells [14]. Besides, spirulina also contains high carotenoids, especially  $\beta$ -carotene [15].

## 2 MATERIALS AND METHODS

### 2.1 Materials

Spirulina powder was obtained from local vendor, Milk powder, Caster sugar, Cocoa powder were purchased from local market and 10% NaCl Solution prepared at Laboratory.

### 2.2 Methods Preparation of Chocolate:

All the ingredients were weighed accurately. Evaluation of Spirulina powder and all dry contents were done by color, odor, taste, extractive value and Ash Value. Solubility of Spirulina was checked in different concentrations of NaCl as solubility enhancer with little warm condition and prepared Spirulina solution. Chocolates were prepared by mixing all the ingredients in required quantity along with Spirulina solution and was made into a dough. By using appropriate mould, dough transferred into designed mould. test were kept in refrigerator for better hardness [16, 17].

## 3 EVALUATION PARAMETERS

### 3.1 Determination of ash

Place about 3 g of the ground material, accurately weighed, or the quantity specified in the monograph, in a suitable tarred dish (for example, of silica or platinum), previously ignited, cooled and weighed. Incinerate the material by gradually increasing the heat, not exceeding 450 °C, until free from carbon; cool, and weigh. If a carbon-free ash cannot be obtained in this way, exhaust the charred mass with hot water, collect the residue on an ash less filter-paper, incinerate the residue and filter-paper, add the filtrate, evaporate to dryness, and ignite at a temperature not exceeding 450 °C. Calculate the content in mg of ash per g of air dried material [13–18]

### 3.2 Loss on drying

Procedure set forth here determines the amount of volatile matter (i.e., water drying off from the drug). For substances appearing to contain water as the only volatile constituent, the procedure given below, is appropriately used. Place about 10 g of drug (without preliminary drying) after accurately weighing (accurately weighed to within 0.01 g) it in a tarred evaporating dish. For example, for underground or unpowered drug, prepare about 10 g of the sample by cutting shredding so that the parts are about 3 mm in thickness. Seeds and fruits, smaller than 3 mm should be cracked. Avoid the use of high speed mills in preparing the samples, and exercise care that no appreciable amount of moisture is lost during preparation and that the portion taken is representative of the official sample. After placing the above said amount of the drug in the tarred evaporating dish dry at 105° for 5 hours, and weigh. Continue the drying and weighing at one hour interval until difference between two successive weighing corresponds to not more than 0.25 per cent. Constant weight is reached when two consecutive weighing after drying for 30 minutes and cooling for 30 minutes in a desiccator, show not more than 0.01 g difference.

### 3.3 Tests for alkaloids :

**3.3.1 Dragendorff's test:** By adding 1 mL of Dragendorff's reagent to 2 mL of extract, an orange red precipitate was formed, indicating the presence of alkaloids.

**3.3.2 Mayer's test:** Few drops of Mayer's reagent were added to 1 mL of extract. A yellowish or white precipitate was formed, indicating the presence of alkaloids.

**3.3.3 Hager's test:** Two milliliters of extract were treated with few drops of Hager's reagent. A yellow precipitate was formed, indicating the presence of alkaloids[19-27].

### CONCLUSION :

The phytochemical analysis is very much important to evaluate the possible medicinal utilities of a plant and also to determine the active principles responsible for the known biological activities exhibited by the plants. Further, it provides the base for targeted isolation of compounds and to perform more precise investigations. The chocolate formulation provides a palatable means for delivering medicaments through oral delivery. Each chocolate contains 1gm dose of Spirulina which can be consumed 3 times a day as the standard dose of Spirulina is 1 – 8 gm. per day.

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