PRODUCTION AND EVALUATION OF IMMUNITY BOOSTER POWDER FROM SPIRULINA

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ABSTRACT

Our planet faces dwindling resources, prompting shifts in human life across economy, nutrition, sports, and family dynamics. This has spurred a quest for alternative resources. Scientists are exploring alternative supplements for animals, targeting growth, immunity, reproduction, and metabolism. Spirulina platensis emerges as a nutritional component beneficial to human and animal health. Recent studies focus on its growth and immunomodulation properties. Researchers now prioritize understanding the nutritional specifics of S. platensis, a rich source of protein, essential amino acids, fatty acids, and antioxidants. Investigations delve into its effects on growth, immunity, antioxidant activity, antitoxicological properties, anticancerogenic potential, and metabolic health, suggesting its potential as a superfood for future generations. The chapter offers a comprehensive review of S. platensis, covering historical background, literature, qualitative findings, and microscopic characteristics

Keywords : Super food, *spirulina platensis*, microalgae , Phycocyanin , GLA , IFN , Zarrouk's Media .

INTRODUCTION

Spirulina is a microscopic filamentous aquatic cyanobacterium (genus Spirulina, especially *Spirulina platensis* synonym *Arthrospira platensis*) that is sometimes cultivated for use as food especially as a dietary supplement. Spirulina is among the world's most popular supplements. It is loaded with various nutrients and antioxidants that may benefit your body and brain.

Spirulina is commonly found in aquatic ecosystems like lakes, ponds and tanks. It is one of the nature's first photosynthetic organisms capable of converting light directly for complex metabolic processes. Spirulina was first isolated form Lak of Texcoco by the azetecs in sixteenth century. The algae Spirulina was eaten in Mexico under the names "Tecuitlatl". Spirulina grows optimally in pH range of 9-11 and there is least chance of contamination of other microbes.

Spirulina or Arthrospira is a blue-green alga that became famous after it was successfully used by NASA as a dietary supplement for astronauts on space missions. It has the ability to modulate immune functions and exhibits anti-inflammatory properties by inhibiting the release of histamine by mast cells.

Scientific Classification:

Phylum: *Cynobacteria*
Class: *Cynophyceae*
Family: *Microcoleaceae*
Order: *Oscillatoriiales*
Genus: *Athrospira*
Species: *Arthrospiraplantensis*

Spirulina consist of three species:
1. *Spirulina Platensis*
2. *Spirulina Maxima*
3. *Spirulina Fusiformis*

From those *Spirulina Platensis* & *Spirulina Maxima* are most used.

Why Spirulina is known as Superfood?

Spirulina called a superfood because of its nutrient profile is more potent than any other food, plant, grain or herb (Fathima and Salma, 2001; Dillon, 2014). These nutrients make Spirulina a whole food alternative to isolated vitamin supplements. The United Nations world at food conference declared that Spirulina as the best food for the future, and its popularity is increasing nowadays among the wide population (Pulz & Gross, 2004). Spirulina is one of nature's nearperfect foods. It helps to boost our immune system, and is a good immediate energy source. It is a natural detoxifier as it helps detoxification of toxins and impurities present in our body. Due to the several health benefits, Spirulina is gaining more and more interest, especially in the sector of food supplements, where it is either used as a powder, or consumed in the form of capsules or tablets.

Pharmacological actions of Spirulina:

Anti-inflammatory and immunomodulatory effect
Spirulina comprises a pigment known as phycocyanobilin, which is a powerful inhibitor of an enzyme that is necessary for causing an inflammation. Spirulina enhances immunity by producing a huge amount of antibodies, interferon gamma, and cytosine

Effect on diabetes and obesity
Spirulina fraction was discovered to be efficient in reducing the amount of serum glucose at fasting, while water-insoluble fraction suppressed glucose levels at glucose load and also reduced cholesterol, triglycerides, LDL cholesterol in blood and thus act as anti-hyperlipidemic agent in clinical pathways that could be protective against atherosclerosis and euglycemia.

As Nutraceuticals and cosmetics
Spirulina whitening face masks, which are protein-rich cosmetics, thus enhances the beauty by removing dead skins, and reduces wrinkles and thus exhibiting anti-aging property as well as in skin toning, healing of dark circles, skin purification and promote hair growth by dandruff treatment.

Anti-anemic effect
Spirulina supplementation may be of great potential importance during pregnancy and lactation as it includes all the hematopoietic nutrients that will eventually benefit both mother and fetus.

Spirulina in biofuel production
Spirulina platensis is a precious candidate for biodiesel production because of its elevated growth rate of 2.23g/Ld, adequate lipid content, desiring an easy and cheap crop medium and generating other precious by-products that would reduce the global price bio-diesel production.

Spirulina as therapeutic agent
Apart from being a health food, Spirulina has invaluable medical applications. Dietary supplementation of this organism showed protective effect towards food allergy. Spirulina has two types of water-soluble polysaccharides that are calcium spirulan and Immunila. These polysaccharides show inhibitory effects against some viruses like HIV and they help in activating the immune system during cancer chemotherapy. Spirulina extracts prevents the formation of tumors and shows hypocholesterolemic and anti-diabetic properties.

Spirulina and Chronic Fatigue:

Spirulina has been promoted as "the food of the future" with "exceptional constituents" that contribute to high energy levels. A few of these constituents such as polysaccharides (Rhamnose and Glycogen) and essential fat (GLA) are absorbed easily by human cells and help in energy release. Spirulina increases healthy lactobacillus in the intestine, enabling the production of Vitamin B6 that also helps in energy release.

Allergy, Rhinitis, and Immunomodulation:

It has been well documented that Spirulina exhibits anti-inflammatory properties by inhibiting the release of histamine from mast cells. . IFN-γ production and Natural Killer (NK) cell damage were increased after administration of the microalga extracts to male volunteers.

MATERIAL AND METHODOLOGY

- **Material:**
  - **Chemical and ingredients:**
    1. Spirulina mother culture
    2. Chemical for Zorrouk's media
  - **Apparatus:**
    Beaker, measuring cylinder, stirrer, etc.
  - **Instrument:**
    Aeration pump

- **Spirulina mother culture:**

  Spirulina mother culture (live species Arthrospira platensis) is provided and can be used for starting Spirulina cultivation.

- **Chemicals for Zorrouk's media:**
  - Sodium bicarbonate
  - Dipotassium hydrogen phosphate
  - Sodium nitrate
  - Potassium sulphate
  - Sodium chloride
  - Magnesium sulfate
  - Calcium chloride
  - Ferrous sulfate
  - EDTA

- **Aeration pump:**

  An aerator, or air pump, pushes air and oxygen into your septic system. The additional oxygen increases natural bacterial activity within the system, that then provides additional treatment for nutrients in the effluent.

  The main roles of aerator pumps include, generating and maintaining effective air-water contact and maintaining a certain concentration of dissolved oxygen in the water in the case of continuous consumption of oxygen by biological oxidation.

- **Methods:**

Steps in cultivation of spirulina:

A) Steps in cultivation of spirulina

1. Take 800 ml of water in a beaker .
2. Add 40 ml spirulina starter culture into a beaker .
3. Prepare nutrition media (Zarrouk'sMedia).
4. Add nutrition medium in beaker(Add nutrition media after 7 days time interval).
5. Keep it in sunlight and stir up 4 - 5 times in a day(Never keep it in direct sunlight).
6. Growth in spirulina seen when it turns from light green to dark green incolor.
7. Harvest spirulina when culture turns dark green and have thick consistency usually it takes 15 to 30 days .

B: Formation of Powder

To produce spirulina powder from wet biomass of spirulina, you can follow these steps:

1. Harvesting: Harvest the spirulina biomass by filtering or centrifuging the culture to separate the biomass from the growth media.

2. Washing: Wash the harvested biomass with clean water to remove any impurities or contaminants.

3. Drying: There are several methods to dry the spirulina biomass. Here are two commonly used methods:

a. Sun-drying: Spread the spirulina biomass in a thin layer on clean, food-grade trays or screens. Place them in a well-ventilated area under direct sunlight. Stir the biomass occasionally to ensure even drying.

4. Milling: Once the spirulina biomass is completely dry, use a grinder or mill to reduce it into a fine powder. This will make it easier to incorporate into various recipes or supplements.

5. Sieving: Pass the powdered spirulina through a fine mesh sieve to remove any larger particles or lumps, resulting in a more uniform powder.

6. Packaging: Store the spirulina powder in airtight containers to protect it from moisture and light.

EVALUTION

❖ **Methods of Evaluation of Spirulina Powder:**

1. Organoleptic properties:

The organoleptic properties such as color, odor, taste, pH and appearance of spirulina powder was studied.

2. Angle of repose:

Angle of repose is the maximum possible angle between the surface of pile of powder and horizontal plane. It is determined b formula as given below:

$\theta = \tan^{-1}(2h/d)$

In this formula:

- θ represents the angle of repose.
- h represents the height of heap.
- d represents the distance.

3. Bulk density:

In materials science, bulk density, also called apparent density, is a material property defined as the mass of the many particles of the material divided by the bulk volume. Bulk volume is defined as the total volume the particles occupy, including particle's own volume, inter-particle void volume, and the particles' internal pore volume.

$$\rho b = M/V$$

In this formula:

- ρb represents the bulk density.
- M represents the weight of powder.
- V represents the volume of powder.

4. Tapped density:

The tapped density is an increased bulk density attained after mechanically tapping a container containing the powder sample. The tapped density is obtained by mechanically tapping a graduated measuring cylinder or vessel containing the powder sample.

$$\rho t = M/Vt$$

In this formula:

- ρtrepresents the tapped density.
- M represents the weight of powder.
- Vt represents the minimumvolume occupied after tapping.

5. Moisturecontent:

Water content or moisture content is the quantity of water contained in a material, such as soil (called soil moisture), rock, ceramics, crops, or wood. Water content is used in a wide range of scientific and technical areas, and is expressed as a ratio, which can range from 0 (completely dry) to the value of the materials' porosity at saturation. It can be given on a volumetric or mass (gravimetric) basis.

$$mc = (w\text{-}d /w)\times 100$$

In this formula:

- *mc*represents the moisture content.
- w represents the wet weight.
- d represents theweight after drying.

6. Ash value:

The residue left behind following incineration represents the ash content of the drug, comprising inorganic salts such as carbohydrates, phosphates, and silicates of sodium, potassium, calcium, and magnesium. This residue is commonly referred to as ash content.

Ash value is the criteria to judge the identity or purity of crude drug. The food sample is weighted before and after ashing to determined the concentration of ash present.

The ash content can be expressed on either dry or wet basis.

$$\% \text{ ash(dry basis)} = (M_{ash} / M_{wet}) \times 100$$

$$\% \text{ ash(wet basis)} = (M_{wet} / M_{ash}) \times 100$$

In this formula:

- M_{ash}represents the mass of the ash residue obtained after the sample has been incinerated.
- M_{wet} represents the mass of the sample before incineration.

7. pH value:

pH of the water is determined to investigate the possibility of any side effect. Spirulina powder is 6.93 ± 0.09 represent that color of spirulina pulse mixture is brownish green and texture is amorphous. As the spirulina considered as alkaline food so it was determined to keep the pH as close to alkaline as possible.

8. Test for protein:

- **Biuret test**: Given sample food + Aqueous copper sulfate → Bluish violet colouration confirms the presence of proteins
- **Millions test**: Given sample food + Mercuric sulfate in the presence of sodium nitrite and sulfuric acid → white ppt confirms the presence of proteins

9. Test for Carbohydrates:

- **Molisch's test**: Given sample food + Molisch's reagent → Purple or violet ring confirms the presence of carbohydrate.
- **Iodine test:** Given sample food + Iodine solution → Blue color solution confirms the presence of starch.

RESULT AND DISSCUSSION

The result of evaluation parameters of the obtained powder is shown in the table given below.

1.Organoleptic Evaluation

Table No. 1.Organoleptic properties

Sr.no	prameters	Observation
1.	Colour	Green
2.	Odour	Fishy and Spices Smell ,Pungent
3.	Taste	Bitter
4.	pH Value	6.81
5.	Appearance	Fine smooth powder

2. Results Of Micrometric Properties:

Table No. 2: Results of micrometric properties

Sr.No	Evalution Parameter	Values
1	Moisture content	8%
2	Ash Value	13.5%
3	pH Value	6.81
4	Bulk Density	0.6 gm/ml
5	Tapped Density	0.8 gm/ml
6	Angle of Repose	30^0

3. Test For Proteins:

Table No. 3: Test for proteins

Sr No	Test	Procedure	Observation
1	Biuret Test	sample + sodium hydroxide + aqueous copper sulphate	Bluish violet color is observed
2	Millions Test	sample + 2-3 drops of millions reagent + shake	White ppt is observed

4. Test For Carbohydrates:

Table No. 4: Test for carbohydrates

Sr. No.	Test	Procedure	Observation
1.	Molisch's Test	2ml sample + 2-3 drops of molisch's reagent + conc. H_2SO_4	Violet ring is observed
2.	Iodine Test	sample + 2-3 drops of iodine solution	Blue color is observed

CONCLUSION

Spirulina, a potent natural supplement with minimal side effects, is hailed as a potential 'wonder food' due to its nutraceutical and pharmaceutical properties. While its production is thriving in countries like the USA and China, India could greatly benefit from its expanded cultivation, particularly in coastal and alkaline regions facing agricultural challenges. This expansion could empower youths through Spirulina-based agri-entrepreneurship, offering lucrative returns with low capital investment and job opportunities. Beyond human consumption, Spirulina's recent adoption as an animal feed supplement promises enhanced productivity, contributing to sustainable food security. Furthermore, Spirulina emerges as a cost-effective alternative to fish meal and a biofortification agent. Optimizing cultivation methods and promoting its use in organic farming as a biofertilizer are essential for maximizing Spirulina's protein content and its potential as a biostimulant for crop growth and yield.

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