Volume : 5 | Issue : 1 | JANUARY 2016 • ISSN No 2277 - 8179

Research Paper

Scientific Cultivation and Quality Control System for Futuristic Super Food - SPIRULINA

Science

KEYWORDS : Spirulina, Super Food, Scientific Cultivation, Nutrition Value, Proteins, Algae

Manish Karandikar Researcher – Jigyasa Research And Development Society, Nagpur, INDIA

Neha Kawadkar Researcher – Jigyasa Research And Development Society, Nagpur, INDIA

Shruti Wandre Researcher – Jigyasa Research And Development Society, Nagpur, INDIA

ABSTRACT

In today's hectic lifestyle, it has become extremely important to keep our self energetic throughout extended working hours of each day. The urban lifestyle forces us to consume the packed / processed food which is insufficient to supply necessary nutrition for the body. Hence health supplements are becoming integral part of our daily food consumption. This is the urban dimension of super food requirement. There is another side to it, the rural dimension, which is more serious.

The socio cultural divide is making rural person poorer. Hence purchasing quality food is becoming distant dream for him. In such case super food can be the best solution to satisfy the need of rural sector or even to eradicate malnutrition from the surface of earth.

The other dimension of food requirement is from viewpoint of future technology – space science, space colonies etc. and the last dimension to nutritious food is fighting diseases like cancer to obesity. Well, it is amazing that for all such problems there is one possible solution – SPIRULINA.

When we say that spirulina can be the super food for tomorrow, it needs very scientific method of cultivating it. The report, prepared by the United Nations, the World Bank and the World Resources Institute, shows that humans have become a major force of nature, largely because of the success of science-based technologies in extracting the earth's resources without proper concern for the environmental consequences. Science, though, has a crucial role to play in helping us avoid the impending catastrophe that is partly of its own making. Perhaps nowhere is this better demonstrated than in the need for science in developing sustainable agricultural / ecological systems.

There is also the need of maintaining the quality standards for all type of food. This paper provides an overview of the system being developed by researchers of Jigyasa Research and Development Society, which is very much necessary to produce the super food – SPIRULINA - in scientifically controlled conditions.

INTRODUCTION

When it comes to maintaining health, protein is the king of nutrients. Numerous studies show that it can boost metabolism (calories out) and reduce appetite (calories in).A high protein diet can increase the amount of calories you burn by 80 to 100 calories per day, because protein requires energy to be metabolized. There is also a study showing that eating 30% of calories as protein made people automatically eat 441 fewer calories per day and lose 11 pounds in 12 weeks, just by adding protein to their diet. If you keep protein high, then you should automatically tilt the energy balance equation in your favor and make it easier to lose weight and maintain health over the long term.

SPIRULINA offers the solution for easy access to portentous diet. But the quality of spirulina is very much important to achieve all given advantages. Hence we at Jigyasa Research and Development Society are proposing a complete scientific atomized spirulina cultivation process and quality check mechanism through this paper.

LITERATURE SURVEY

Whenever any new system is to be developed, it is necessary to carry out the feasibility study of the system. Following key elements made our vision very clear about the technical system for scientific cultivation system of SPIRULINA. Some of the key elements which initiated the research in this area are given below.

- Spirulina is most ideal food for mankind – announced in 1974 by United Nations world Food Conference.
- World Health Organization has described SPIRULINA as -Mankind's best health product.
- UNISCO – SPIRULINA is most ideal food for tomorrow.
- US Department of Agriculture – SPIRULINA is food of future
- NASA and European Space Agency – one of the primary food-that can be cultivated in long term space missions in space.
- In 2005 an open letter is published by UN to all governments –"There is a need for development of technology needed to produce spirulina."

Considering such a futuristic vision of all leading agencies worldwide, there is no need to ask for another proof than to start working on the said requirement.

Still, from research point of view it is necessary to gather important and vital information about the botanical characteristics and other technical details. The key feature that ate of importance regarding the blue green algae SPIRULINA are:

- Spirulina is a major oxygen producer of planet.
- The filaments of algae are very small. Every filament is 1.3 to 1 mm in length.
- The cells capture energy of sun and utilize the energy in watery environment.
- By reaction of photosynthesis cells produce proteins, carbohydrates, sugar fatty acids and all important minerals our body need.
- Every small cell contains all the strength to produce natures vital forces.
- It is major product to fight global malnutrition
- Sea algae still produces 95 % of earths oxygen
- This algae does not multiply sexually but simply breaks or splits in parts
- SPIRULINA is free floating, filament, cylindrical, multi cellular, hair like structures. Generally open left hand spiral or helix.
- Name spirulina is derived from spiral structure
- All the secrets of universe including DNA are available in spiral form
- SPIRULINA thrives on alkaline water bodies. Needs temperature of 25 to 40 degree with 45 as max limit.
- On temperature below 20 deg spirulina dies.
- SPIRULINA needs sodium carbonated water. It needs high Ph value, between 9 and 11.
- Spirulina performs in sunshine

- Stronger sunshine and agitated water are physical needs for optimum growth
- In perfect scientific conditions, spirulina can double its weight every 24 hours
- It is produced in large outdoor ponds
- Best quality is produced with geothermal water
- If water contains polluted agents or heavy metals they are easily absorbed by spirulina which makes it unhygienic for human consumption

All the above points are used as guidelines to develop the proposed system. The proposed system, is designed to ensure the perfect physical and chemical conditions in conducive environment. Once the proposed technical system is implemented, we will get best quality product.

The second part of proposed system is for quality check. The quality check is important as the SPIRULINA can play a vital role in health science.

- Very high in proteins. (70 % of biomass)
- Proteins in SPIRULINA are digested to 95 % (highest among all values).
- It does not have thick cellulosic walls which makes digestions of proteins difficult in other cases.
- Its B12 contents are 12 times higher than carrot
- It contains all vital minerals in proper proportions
- Contains 58 times more iron than spinach
- Space colonies require sustainable supply of fresh food and method to recycle wastage.
- Spirulina has capacity to turn west into purified water
- NASA is developing Controlled Ecological Life Support System. (CELSS). Its purpose is to supply nutrition food , oxygen to astronauts and at same time produce oxygen and clear water for survival
- There is similar European program called as MELISSN being developed by European Space Agency (Micro Ecological Life Support System)
- The proteins are biologically complete. Excess amount of proteins in spirulina goes out of body as it is water soluble. But animal protein gets deposited as fats.
- It has energy boosting properties, and contains over 100 nutrients.
- It is not medicine but dried naturally balanced vegetable.
- Spirulina is rich in GLA, GLA has potential anti cancer agents .
- GLA can provide solution for arthritis, eczema and premenstrual syndrome.
- It has anti ageing properties. For older people it can make digestion simpler
- Diseases like osteoporosis can be prevented by spirulina
- Provides energy and anti oxidant protection
- Providing all 8 essential amino acids
- SPIRULINA has weight and Cholesterol reduction effect.

THE PROPOSED SYSTEM

The complete SPIRULINA – A Super food -- Cultivation and Quality Testing System is broadly divided in 2 parts.

- The Pre Production Support System
- The Post Production Quality Check System.

The Pre Production Support System.

This is complete software controlled atomized PH and temperature monitoring and control system.

Spirulina can live in a wide range of compositions of water; the following is a convenient analysis:

Anions Carbonate	2800 mg/l
Bicarbonate	720
Nitrate	614
Phosphate	80
Sulfate	350
Chloride	3030
Cations Sodium	4380
Potassium	642
Magnesium	10
Calcium	10
Iron	0.8
Total dissolved solids	12847
Density @ 20°C	1010 g/l
Alkalinity	0.105 N (moles strong base/liter)
pH @ 20°C	10.4

In addition, the solution contains traces of all micronutrients necessary to support plant life.
Such solution can be obtained by dissolving various combinations of chemicals;
here is one example convenient for many typical waters :

Fertilizer	g/l
Sodium carbonate (soda ash)	5
Sodium chloride, crude	5
Potassium nitrate	2
Sodium bicarbonate	1
Potassium sulfate, crystallized	1
Urea	0.02
Monoammonium Phosphate, crystallized	0.1
Magnesium sulfate, crystallized, (7 H2O)	0.2
Lime	0.02
Ferrous sulfate	0.005

The software being developed by Jigyasa Research and Development Society aims at maintaining the above parameters from centralized control room.

- The system continuously monitors the PH level of each SPIRULINA cultivation tank.
- If PH level of any cultivation tank is outside the permissible limits then the system immediately suggests the chemicals to be added to concerned tank with all technical parameters regarding quantity, water to chemical ratio and various brands which can be mixed to get desired PH.
- The system administrator can check and verify the suggestions given by system and approve it.
- Once approved, operator can open the flow valves connected between tank and mixer unit from control room using software developed by us .
- The chemical from mixer flows down the pipeline to specified cultivation tank and maintain the PH of cultivation tank.
- The control system also monitors temperature and flow rate of water of every cultivation tank periodically and maintains complete log of data with time stamp.

The complete operation can be implemented and tested in 2 phases.

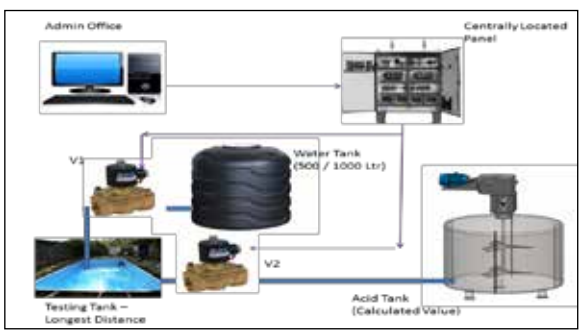
Phase 1.

- Computer program is operated from admin building for single tank.
- Testing is done for the tank having maximum distance between tank and panel.
- Flush time (T1) then ACID flow time (T2) and then again flush time (T3) will be input to software system which is installed and operated from admin office.

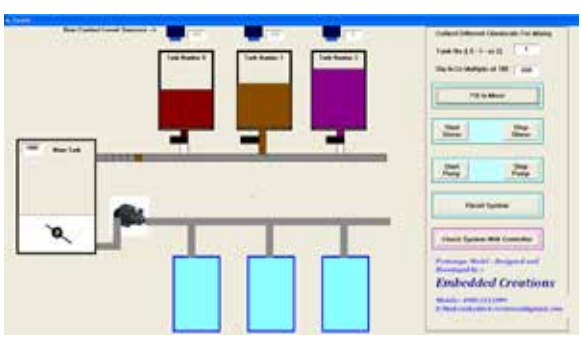
- The timing cycle will be transferred to centrally located panel.
- The panel will execute T1-T2-T3 timing cycle for "flush-acid-flush" operation.
- All formulas are tested for various simulated conditions and time calculation of acid flow is configured for selected single tank for test purpose.

Phase 2: Once the test is OK for single tank (Phase 1)

- The panel will be loaded with valve control system for all tanks.
- Necessary decode circuits,driver circuit and Fault protection system will be installed for all tanks.
- Emergency signals and changeover between manual and auto mode will be tested and implemented.



1. All calculations involving volumetric analysis of chemicals are performed on PC installed in admin building
2. The system performs time calculations for on time and off time of water flow and acid flow.
3. All data is transferred to centrally installed controller panel. This transfer is using standard LAN connection.
4. The controller receives on off schedule for selected tank and controls on off activity of valves to control flow of water or acid so that proper pH is maintained.



The Post Production Quality Check System.

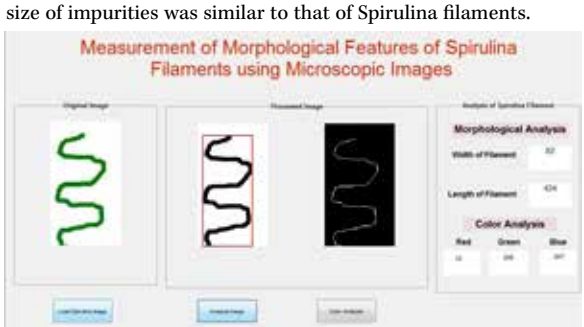
Once we are ready with the product – SPIRULINA – we need to check quality of the product. We, at Jigyasa Research and Development Society, are developing quality monitoring software. This software measures vital parameters from image of SPIRULINA filament and develops a report on quality of the product.

The image processing algorithm are being designed to find vital parameters like

1. Length
2. Degree of Spiralisation
3. Width of filament
4. Diameter of helix
5. Green / Blue color ratio
6. Presence of any contamination/foreign bodies

The rapid, objective and accurate measurement of the morphological features of Spirulina filaments is very important to improve the algal production and reduce the losses due to environment changes. In this study, morphological features of Spirulina filaments are rapidly and accurately measured using image processing algorithms based on microscopy images.

The software is being developed to optimize the algorithms to distinguish between Spirulina filaments and impurities. Only the area of objects was used for separating Spirulina filament from impurities in this study, and this would be a problem when the size of impurities was similar to that of Spirulina filaments.



REFERENCE

1. Research Paper Elsevier Journal - 6 March 2012 Rapid measurement of morphological features of Spirulina microalgae filaments using microscopy and image processing algorithms By : Di Wua,Songjing Wangb, Kangsheng Liu, Xinjie Yu, Yong He, Zhiping Wanga 2. Grow your own SPIRULINA By Jean-Paul Jourdan 3. Publications Jörg Ullmann (Diplom-Biologe), Dr. Martin Ecke (Diplom-Chemiker) Algae: Chlorella, AFA, Spirulina