GOVERNMENT DEGREE COLLEGE GAMBHIRAOPET

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GOVERNMENT DEGREE COLLEGE GAMBHIRAOPET PIN:505304 Dist:Rajanna Sircilla

# SPIRULINA SUSTAINABLE SUPER FOOD-AS FEED IN AQUACULTURE

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## GOVERNMENT DEGREE COLLEGE GAMBHIRAOPET

## CONTENT

# TITLE OF THE PROJECT

# SPIRULINA SUSTAINABLE SUPER FOOD-AS FEED IN AQUACULTURE

# CERTIFICATE

GOVERNMENT DEGREE COLLEGE GAMBHIRAOPET PIN:505304 Dist:Rajanna Sircilla

This is to certify that the dissertation entitled submittedSPIRULINA SUSTAINABLE SUPER FOOD-AS FEED IN AQUACULTURE to Satavahana University for the partial fulfillment of the requirements for the award of Degree of **Bachelor of Science** under the guidance of K.V.BIXAMAIAH, at **Government Degree CollegeGambhiraopet RajannaSircilla**, and the contents of the dissertation do not form the basis for the award of any other degree or diploma of the candidate from this or any other University elsewhere.

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## ABSTRACT

Spirulina is a microscopic filamentous aquatic cyanobacteria which form tangled massin warm alkaline lakes. It was discovered to overcome the killing problem over the world malnutrition and food crisis. In recent trends this single celled super food hadincorporated into the aquaculture as feed to the culturing fishes. As it has a good value of protein, better digestibility of protein and fat absorption this Spirulina had formulatedinto aqua diets. Spirulina flakes are being used in shrimp hatcheries for better growthand survival. It also used in milth fry and yearlings culturing, ornamental fisheries forgood pigmentation and into prawn industry for great commercial significance. This superfood also enhances the fish performance, increases RBC and blood profile, improves pigmentation, stress tolerance capacity, immune -competence and reproduction performance. Not only in aquaculture it is also a super cool food with high nutritive profile for human beings too as it eradicates malnutrition, reduces risk of cancer, anti-aging, anti-rickets, boosts immune system it acts as medicine to cure many diseases except liver failure .Hence due to these scientific values observed in this single celled algae this used as food in aquaculture as supplementary feed to obtain great yield with better quality andquantity.

SPIRULINA IS THE BEST FOOD FOR TOMORROW... AN ANSWER TO THEWORLD HUNGER AND MALLNUTRITION.

# INTRODUCTION OF SPIRULINA

According to recent and present census we are facing the problem of malnutrition and food crisis throughout the world due to many reasons. Hence, we can the daily requirement of nutrition by the intake of this super food Spirulina. The scientist named Dr.Darwin – who was analgal scientist. He discovered the spiral-shaped algae and designated it as Spirulina. It is a sea weed which is a blue-green algalbiomass, discovered in 16th century and hasbeen used as a daily food source. As Spirulina is considered as a powerful dietary supplement due to its high nutritional value. It is used by National aeronautics and Space administration and European space agency as a food supplement during space missions. Spirulina- it is defined as microscopic filamentous aquatic cyanobacterium which forms tangled mass in warm alkaline lakes. The word Spirulina is derived from Latin word and got this name due to its coil shaped structure (Spirula-small coil). The scientific name of Spirulina is *Corcussativus* .It is belonging to the family Iridaceae ; genus Spirulina and species platensis. In general there are many species have been reported in recent decades but among them *Spirulina platensis* and *Spirulina maxima* are highly cultivable. These are single-cell autotrophs with high nutritional value it is cultivated world wide and used as dietary supplement or whole food. And also used as a feed supplement aquaculture aquarium and poultry industry. Spirulina has been studied as a potential nutritional supplement for adults and children in getting cure from disease. In 16thcentury spanish invaders collected newfood from the lake and used as "Dihe" along with the sauce of tomatoes, peppers, fish and meat. In 1940, it was rediscovered by Dangeard nearlake Chad in Rift valley of East Africa. In 1964-65 Jean Leonard found this curious edible green cake in market of fort-lamy. In 1967 Spirulina was established as a wonderful future food source in International association ofapplied microbiology. In 1997 1st large-scale production plant was started in Africa near Mexico City. In India first initiative revolving around Spirulina production can be seen in Madurai, They worked to produce 150 Kgs of Spirulina per month with 15women production facility running about 40 Spirulinatanks. The cultivation of Spirulina is started to reduce the major problem faced and still facing in recent and present census in mal nutrition and food crises. This single cell autotrophs with high nutrition value cultivated worldwide and used as dietary supplement or whole food.

Later in recent trends it has incorporated in aquaculture due to following significance of Spirulina.This single cell protein Spirulina is used as ingredient in aquaculture as it has goodvalue of protein. As Spirulina has better digestibility of protein and fat absorption in Spirulina it is incorporated in diets due to better absorption.Spirulina flakes are being used in shrimp's hatcheries for better growth and survival. It also used in milth fry, yearlings culturing and in ornamental fishes for good pigmentation and in prawn for more commercial significance.Spirulina also enhances the fish performance, increases RBC count and blood profile, improvespigmentation, increases stress tolerance capacity and immuno-competence, and reproduction performance. Not only in aquaculture it is also a super cool food with high nutritive profile for human beings too.It eradicates malnutrition, reduces risk of cancer, anti-diabetic, boosts immune system, bloodpurifier, anti-ageing, balances blood circulation, anti- rickets and it works for many disorders exceptliver failure.

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## AIMS AND OBJECTIVES

- To purchase the mother culture from organic culture farms.
- To prepare two types ofculture medium.
- To culture the Spirulina production in our college premises in different culture mediums.
- To use the Spirulina production as fish feed for our college pond fishes and to analyse the growth and weight of the fishes.
- Planning to bringing awareness among people about the benefits of Spirulina and encouraging forhome units for production of Spirulina in household purpose.

# REVIEW OF LITERATURE

## Use of *Spirulina* in Fish Culture

-ByShibly Noman

The use of blue green algae Spirulinain aquaculture has several potential advantages over the culture of fish. This seminar is to review the effect of using Spirulinain culture of different fishes as a replacement and nutrient supplement and its potentiality of using as an alternative source of protein in fish feed. Spirulinahas high quality protein content (58%), which is more than other commonly used plant sources. So it can be used as an alternative protein source in fish feed. Generally Spirulinais used in fish feed as a replacement of fish meal and a nutritional supplement. In case of Common carp (*Cyprinus carpio*) replacing fishmeal up to 10% with Spirulinashowed doubled weight gain up to 16.59 gm compared to the control group 8.37gm. The growth rate was found higher when *Pungasius sutchi* feeding with 5% Spirulinasupplement. The growth performance and the mean survival rate higher (100%) than the control group (80%) when Tilapia (*Oreochromis niloticus*) was fed with 5% dietary *Spirulina platensis*. Inclusion of 10% *S. platensis as* a natural pigment source resulted in the highest carotenoid deposition (1.2mg/l) which resulted better coloration in Rainbow trout. Using Spirulinain fish diet improves the haematological parameters and immune response and makes the cultured fish healthy and disease resistant. Only 5% inclusion of *S. platenssis* in the diet of Tilapia (*O. niloticus*) improved the haematological parameters where the Erythrocyte count (RBCs), Haemoglobin (Hb), Haematocrit (PCV), Mean Cell Volume (MCV), Mean Cell Haemoglobin (MCH) and Leucocyte count (WBCs) were significantly increased. Replacement of fishmeal with 100% Spirulinaalso reduced the cost of feed by reducing the incidence cost (46.21tk) compared to the control groups (83.21 tk) with 0% Spirulina. And all these findings prove use of Spirulinaas a potential nutritional supplement and a better alternative source of protein in fish feed with lots of beneficial effects.

## The Significance of Spirulina Meal on Fishmeal Replacement in Aquaculture: A Review

-By Sebastian S. Mosha

In fish farming operations, feed accounts for more than half of the total variable operating costs. The costs are mainly contributed by protein source from feed ingredients. Therefore, the potential use of unconventional feed ingredients such as algae, as feed inputs in replacement of high-cost feedstuffs such as fishmeal has been increasing. Among unconventional algae feed ingredients, Spirulina which is a fast-growing cyanobacter of large size have been a possible alternative protein source for cultured fish due to high and good quality protein, vitamins and essential fatty acids contents, antioxidant pigments, antimicrobial activity, and anticancer properties. A review was conducted on the significance of Spirulina meal on fishmeal replacement in Aquaculture, mostly focus was on finfish culture. About 20 published online journal papers, from Research gate, Google scholar and other online platforms in aquaculture nutrition were reviewed. Among reviewed papers revealed that the amount of fish meal to be

replaced with Spirulina in the diet has been in a certain limit, with the positive growth performance, improving non-specific immuneactivity, enhancing good quality of fillets and increase the quality of eggs at the inclusion levels between 0.5 to 15%. Therefore, this review suggests that 1-20% inclusion level of Spirulina can be used to replace fish meal in a diet for effective low feeding costs in both omnivorous and herbivorous fish species.Fish Growth Performance; Herbivorous Fish; Immunostimulants; Omnivorous Fish; Spirulina Meal among unconventional algae feed ingredients, Spirulina which is a fast-growing cyanobacter of large size (0.5 mm) have been a possible alternative protein source for cultured fish. This is due to high and good quality protein, vitamins and essential fatty acids contents (gamma-linolenic acid), antioxidant pigments, such as carotenoids

(C-phycocyanin C-PC), antimicrobial activity, and anticancer properties. It also reported to increase feed utilization, physiological activity, stress response, starvation tolerance, disease resistance, and carcass quality. In addition, Spirulina can be produced by low-cost open pond technologies and are marketed as dry powders, and their nutritional profiles are well-documented.

## SPIRULINA CULTIVATION: A REVIEW

-BY P. Saranraj

Blue-green algae (Cyanobacteria) are among the most primitive life forms on Earth.
Their cellularstructure 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. Interestingly, they also share characteristics of the animal kingdom as they contain on their cellular membrane complex sugars similar to glycogen. Among blue-green algae, both edible and toxic species adapted to almost any of the most extreme habitats on earth. Edible blue-green algae, including Nostoc, Spirulina, and Aphanizomenon species have been used for food for thousands of years. Spirulinaare 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 aquacultures diets. It grows in water, Can be harvested and processed easily and has very high macro and micro nutrient contents. Spirulina platensis, Zarrouk's medium, Mass cultivation and Protein content.

# MATERIALS AND METHOD

## MATERIAL:

The material we used for the culture set up and forculturing are following- Cement bricks, HDPE black and blue sheets, Bamboosticks, Green sun mesh, Binding wire, Mud pot; Hot air oven; Nylon cloth with 30µm size pore; pond water from our college, cooler motor of about 80-90watts, digital weighing machine, nutritive culture medium, spirulina mother cells, portable digital parameter kit, motar, bucket and one litre measuring mug.Nutritive medium is of two types –1.Sodium chloride, Eating soda- Sodium bicarbonate, Magnesium sulphate, and NPK- Nitrogen, Phosphorous, Potassium.2. Powder of Cow dung ash.

# METHODOLOGY

The methodology of spirulina culturing includes seven steps they are:

- Construction of culture tank and shed.
- Filling the tanks.
- Preparation of the different culture medium.
- Purchasing of spirulina mother culture.
- Addition of Spirulina mother culture and further maintance.
- Harvesting of the production.
- Utilizing spirulina production as feed.

## STEP-1:CONSTRUCTION OF CULTURE TANK AND SHED

We constructed the shed by using bamboo sticks and covered all sides with green sun mesh to allow the moderate amount of sunlight which is required for spirulina growth. Thenwe constructed two tank set -up in a rectangular form with different measurements in open area with maximum exposure to sunlight. The rectangular tank has equipped with a length of 5 feet, breadth 3.5 feet, and a depth of 25cm .With the above mentioned measurements we placed the cement bricks which is rolled out by black and blue tarpaulin sheaths one over the other. After the set-up has done we cleaned it once with a clean cloth to remove rock granules and dust granules.

## STEP-2: FILLING THE TANK

The both tanks one is for spirulina culturing and other for stocking of mother inoculum has to be filled up with about 250 litre and150 litre of water respectively from our college water supply.

Then the filled tanks was covered with green sun mesh to avoid contamination and also to stabilize thermally then left it for overnight for proper settlement of water.

## STEP-3: PREPARATION OF DIFFERENT CULTURE MEDIUMS

For the culturing of spirulina we need nutrition for the processed growth for that we have to prepare nutritive mediums. Here we used two types of mediums. Among them one of the nutritive medium for 250 litre tank constitutes about sodium chloride-2000grs/2kg ; sodium bicarbonate-2000grs/2kgs; N:P:K-125grs ; Magnesium Sulphate-46grs and for 150 litre tank sodium chloride-1200grs ; sodium bicarbonate-1200grs ; N:P:K-75grs ; Magnesium Sulphate-24grs weighed by digital weighing balance.The measured substances has to be taken into a container with water and stirred it up for 10-15 minutes to dissolve completely in water.

An another type of medium is cow dung ash : For this firstly we have to collect fresh dung from nearby cattle shed and make them into cake and left it to get dried completely for 2-3 days under sunlight for evaporation of whole moisture content in it. Then burn it into ashes and collect the ash and filter it with sieve and collect the powdered ash in a container. Now weighing 8grms of ash powder and add into 5 litre of water taken in mud pot and leave it for about 1-2 hrs for settlement.

## STEP-4: PURCHASING OF SPIRULINA MOTHER CULTURE.

Parallelly we purchased 1 kg of spirulina mother culture from Shamshabad, NETRINS Spirulina organic farm at a cost of 1200Rs/-..

This mother cells has transferred into a container for its better survival and to habituate to the environment.

## STEP-5: ADDITION OF SPIRULINA MOTHER CULTURE AND FURTHER MAINTANCE.

The mother culture which act as an inoculum for culturing of spirulina measure it with digital weighing machine. For every 100 litre of water we should add about 250 grms of spirulina.
According, to this ratio for 250 litre of water we should add about 625 grms of spirulina.
After the addition of spirulina stir the culture set up smoothly for about 5 minutes. And the remaining mother culture is inoculated for stocking it for further use.
Regular monitoring of water level and maintenance of optimum conditions is important for good yield. After the above mentioned guideline followed after 7-8 days weekly based nutritive medium should be added that includes: sodium bicarbonate-2000gr/2kgs ; N:P:K-125gr: Magnesium sulphate-46gr.

### NOTE:

After the addition of nutritive medium and before the addition of spirulina we have to check the water parameters. After checking the optimum conditions only we should proceed the further steps.

### PHYSICO-CHEMICAL PARAMETERS:

The water parameters are measured in morning and evening with regular time interval.
The sample from the set up should be collected by stirring it once and little deep by using a beaker.
The parameters includes pH, temperature, water level, color, and Electrical conductivity and alkalinity.

### PH:

PH is a measure of hydrogen ion concentration in water/solution.

It is recorded with portable HANNA KIT TEST device.

The optimum level of pH that should maintain is about 8-11.

### TEMPERATURE:

Temperature is a measure degree of hotness or coldness of water.
The optimum level of temperature that should maintain is about 22°c – 38°c.

### WATER LEVEL:

The level of water is important for its survival as spirulina is aquatic organisms. The optimum water level that should maintain is about 20cm – 30cm.

**COLOUR:**

Light green to dark green.

**PADDLE WHEEL SPEED/AERATION CAPACITY:**

25 rpm speed.

**Physico-chemical parameters culture set-up in morning and evening are given below.**

| DATES | PH Morning | PH Evening | Temperature Morning | Temperature Evening | Color Morning | Color Evening |
|---|---|---|---|---|---|---|
| 18/3/22 | 7.5 | 7.6 | 26.0°c | 27.6°c | Light green | Light green |
| 19/3/22 | 7.5 | 7.5 | 24.6°c | 26.7°c | Light green | Light green |
| 20/3/22 | 7.9 | 7.8 | 24.6°c | 26.8°c | Light green | Light green |
| 22/3/22 | 7.9 | 7.9 | 24.0°c | 27.4°c | Light green | Light green |
| 24/3/22 | 8.0 | 8.0 | 23.°8°c | 27.7°c | Light green | Light green |
| 25/3/22 | 8.3 | 8.4 | 26.1°c | 25.9°c | Light green | Light green |
| 26/3/21 | 8.4 | 8.4 | 24.5°c | 27.7°c | Light green | Light green |
| 27/4/22 | 8..4 | 8.5 | 26.1°c | 32.2°c | Light green | Light green |
| 1/5/22 | 8.4 | 8.6 | 22.8°c | 32.4°c | Light green | Light green |
| 2/5/22 | 8.7 | 8.7 | 24.9°c | 33.2°c | Light green | Light green |
| 3/5/22 | 8.8 | 8.9 | 22.4°c | 30.5°c | Light green | Light green |
| 4/5/22 | 8.7 | 8.9 | 24.3°c | 31.0°c | Green | Green |
| 5/5/22 | 8.9 | 9.0 | 23.5°c | 31.5°c | Green | Green |
| 6/5/22 | 9.0 | 9.1 | 25.6°c | 29.8°c | Green | Green |
| 8/5/22 | 9.0 | 9.1 | 23.5°c | 30.1°c | Green | Green |
| 9/5/22 | 9.0 | 9.1 | 24.2°c | 29.8°c | Green | Green |
| 10/5/22 | 9.1 | 9.2 | 30.5°c | 32.0°c | Green | Green |
| 12/5/22 | 9.0 | 9.2 | 31.4°c | 32.6°c | Green | Green |
| 15/5/22 | 9.0 | 9.3 | 28.9°c | 31.2°c | Green | Green |

| | | | | | | |
|---|---|---|---|---|---|---|
| 16/5/22 | 9.2 | 9.3 | 30.5°c | 32.8°c | Green | Green |
| 17/5/22 | 9.2 | 9.3 | 29.7°c | 33.1°c | Green | Green |
| 18/5/22 | 9.5 | 9.6 | 30.0°c | 33.9°c | Green | Green |
| 19/5/22 | 9.6 | 9.6 | 29.9°c | 33.7°c | Green | Green |
| 20/5/22 | 9.7 | 9.9 | 30.9°c | 33.6°c | Green | Green |
| 22/5/22 | 10 | 10.0 | 31.0°c | 33.2°c | Dark green | Dark green |
| 23/5/22 | 10.1 | 10.3 | 32.4°c | 34.0°c | Dark green | Dark green |
| 24/5/22 | 10.2 | 10.2 | 31.2°c | 32.4°c | Dark green | Dark green |
| 25/5/22 | 10.4 | 10.5 | 33.6°c | 35.0°c | Dark green | Dark green |

TABLE-1: PHYSIO-CHEMICAL PARAMETERS

## STEP-6: HARVESTING OF THE PRODUCTION

After 45 days of careful monitoring and maintance the PH increased to 10 which indicates the production is ready to harvest. At this point we observe dark green colored thick layered colonies on surface of water. Now with the help of nylon cloth with pore size of 30µm filter the water and collect the biomass formed. Then spread over a plastic sheet as let it be dry under shady temperature for about 2-3 days then we obtain flakes of Spirulina.

## STEP-7:UTILIZING SPIRULINA PRODUCTION AS FEED

Now the dried flakes are subjected to 50-100°c in hot air oven to arrest the bacterial growth by removing moisture content.
Then it allowed to get cool down and this was grinded in to powder and incorporated in feed ingredient for fish and feeded it with respective intervals of time.
High yielding and high growth rate is seen in fishes.

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## OBSERVATIONS

- We observed that as days increases the color of changes from light green to dark green.
- We observed increase in PH.
- We observed the number of colonies increased.
- We observed thick dark green layer on water surface.
- We observed high yielding and great growth rate of fishes by using this Spirulina as feed.
- We observed greater tenderness and taste in fish meat.

## RESULT

- By utilizing one kilogram of mother culture we got 5.6 kg of production.
- Each fish weighed about 1.5-2 kgs.
- Bulk amount of production has been seen.

## CONCLUSION

- By the end of this project we got complete awareness about benefits of Spirulina.
- And we brought awareness about its dietary composition and need to use in daily intake.
- In fishery industry, by using spirulina as feed we can reduce the feed cost.
- And it a great substitute of protein content with many essential vitamins and minerals required for body growth.

# GALLERY

## FIG-B, C: CONSTRUCTION OF CULTURE SET-UP

## FIG-D, E: MOTHER CULTURE

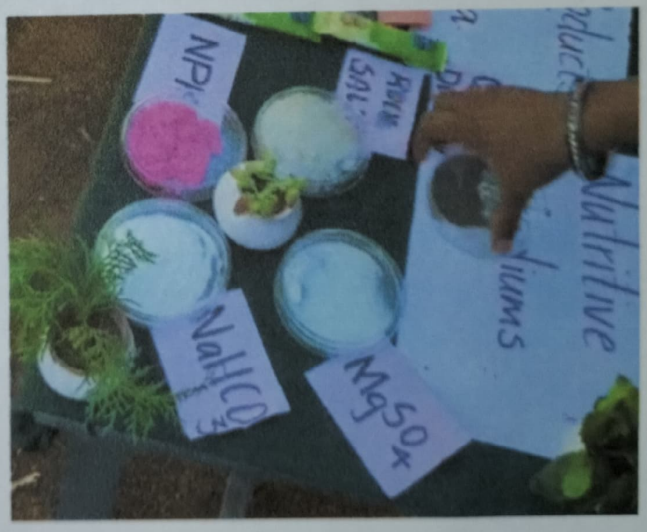




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FIG-F,G:COMPONENTS OF NUTRITIVE

FIG-J: ADDITION OF WATERFIG-K: ADDITION OF SPIRULINA

FIG-L: SPIRULINA IN MUD POTFIG-M: MEDIUM IS ADDED

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THANK YOU