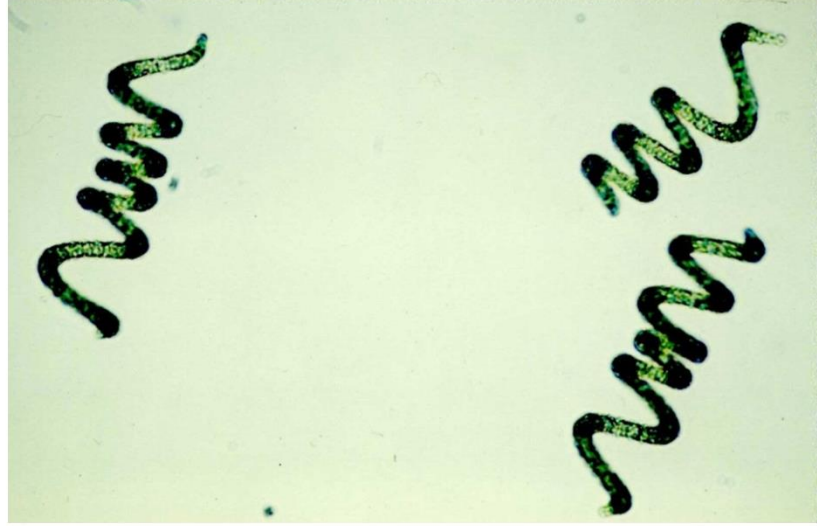


SPIRULINA CULTIVATION

Spirulina as SCP

- Spirulina is a spirally coiled, multicellular, filamentous blue green algae
- The coiled may tight or relaxed
- The trichome has no definite gelatinous sheath around it
- Spirulina is a naturally found in fresh waters, brackish waters, marine water, inland saline lakes, hot springs and moist soils
- Biomass of Spirulina is rich source of **protein (67%) vitamins, minerals and β - Carotenes**
- Hence, the US Federal drug Administration recognised Spirulina as supplement to human food and animal feed in 1980



- *Spirulina maxima* biomass was collected from Texcoco lake and made into biscuits
- The biscuits were sold in Mexico in the name Tecuitlatl
- The chemical constituents of dried biomass of *Spirulina fusiformis* is given below
- Major constituents are crude **protein 65%**, **Carbohydrates 16%**, **lipids 6.7%**, **nucleic acids 4.2%**
- Vitamins like biotin, Cyanocobalmine, folic acid, Riboflavin, Thiamine, tocopherol, β - Carotenes

- Minerals like **Calcium, lysine, phosphorous, cystine, Iron, Methionine, sodium, phenylalanine, potassium, threonine**
- The digestibility of Spirulina SCP is as high as 84%
- So it can be digested easily by human system
- A 20 g of Spirulina SCP can full fill the daily requirement of essential aminoacids, vitamins or minerals for an adult man for a day β - Carotene in the SCP prevents cancer risk

Mass culture of Spirulina

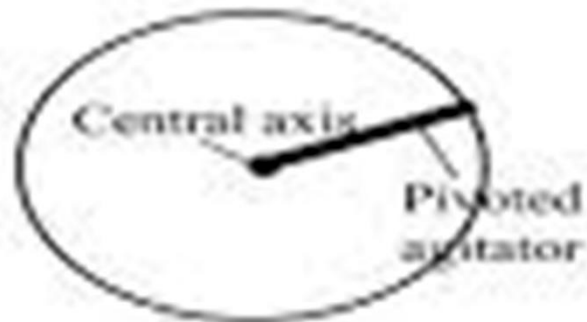
- Spirulina is cultured in large scales in artificial **ponds or tanks or oxidation ponds**
- Relatively Simple economic media have been used for this purpose
- Cost effective culture of Spirulina requires improved biomass productivity, better light utilization & efficient CO₂ consumption
- Both open & closed system are used to grow Spirulina in a large scale

Open circulating system

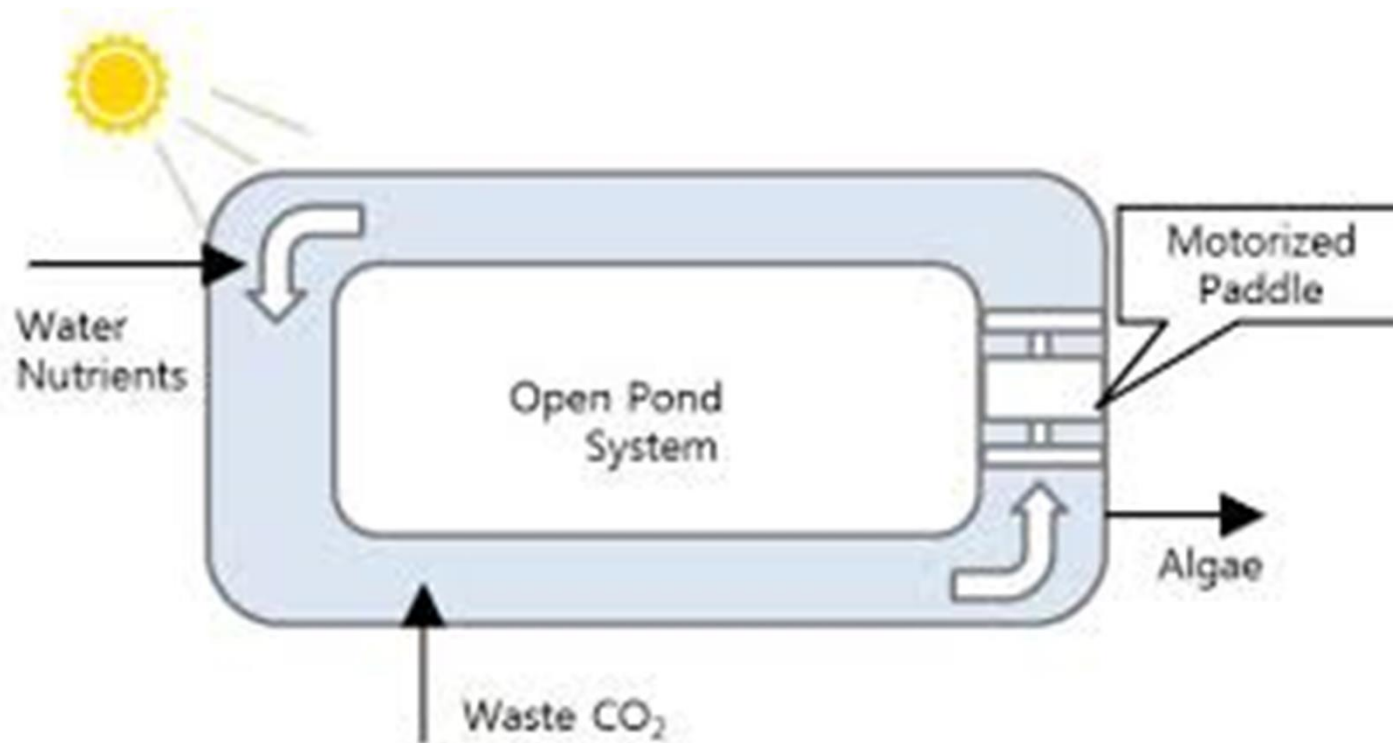
- An open circulating system is a man made open tank or shallow pond.
- It may be **circular or rectangular** in shape
- The depth of the tank should be in between 25 to 30 cms.
- Size of the tank may be 500mz-5000mz
- It is built with bricks or concrete and the interior is lined with a sheet of **polyvinyl chloride (PVC)**

- In circular tanks, a stirrer with a rotating arm is kept at the centre to provide enough stirring for the culture
- On the other hand, in the rectangular tanks a paddle wheel is kept in the tank to stir the culture
- Usually the culture tanks are kept open while functioning
- Sometimes they may be covered with a transparent glass or plastic sheet to prevent contamination

Circular open tank



Rectangular open tank





Media

- 1. Economic media are used to culture *Spirulina***
 - Liquid effluents taken from well digested human excreta
 - Modified Sea water medium is also used for this purpose
 - Human excreta is diluted and digested in a digester at 55°C for 10 days
 - Liquid effluent is then taken from the digester and filtered through a fine cloth to get a filtrate
 - The filtrate is again filtered through a Sand-bed filter to remove the contaminants
 - The final filtrate is used as medium for *Spirulina* culture
 - It is used in a rural villages and municipalities in developing countries

2. Another economic medium is the Sea water

- The Sea water is treated with NaHCO_3 (19.29/lit) to precipitate out excess Ca^{2+} and Mg^{2+} ions
- To this Sea water K_2HPO_4 (0.59/ lit) FeSO_4 (0.01g/lit) and urea (0.2g/lit) are added to make it a culture medium.
- The ph of the media is adjusted to 8.5
- A medium is filled in the open circulating tank and the tank is inoculated with a small volume of pure Spirulina culture

- The culture is stirred continuously for giving aeration to it
- It is illuminated with a low intensity light
- If it is inside the room the temperature is maintained at 35° to 40°C which is suitable for the rapid growth of spirulina and forms a bloom in the culture
- Spirulina filaments develop gas vacuoles in the cells and hence they float on the surface of culture medium
- As the density of the filament increases
- A dense bluish green mat develops on the surface of the culture
- The biomass is harvested by filtration using a fine mesh or cloth
- In this way, about 12.20 gram of Spirulina/m²/day can be harvested from a pond

Oxidation Pond system

- In this method, all solid wastes and suspended particles are removed from the sewage water by primary and secondary treatments
- The sewage water is allowed to flow into an oxidation (tank) pond
- A few litres of Spirulina culture inoculated into pond as a starter culture.
- Spirulina grows in the natural system and produces a dense mat on the surface of the sewage water
- The biomass is harvested by using special devices that can filter a large amount of sample

Uses of Spirulina SCP

- Spirulina is used as a health food, therapeutic agent and a source of cosmetics
- The important uses of Spirulina biomass are given below
 1. **Spirulina as Health Food**
 - Spirulina SCP is rich source of nutritionally valuable **proteins, vitamins and minerals**. It is easily digestible and it has a good acceptability by human system
 - Eating 20 g rams of Spirulina SCP daily can fulfil the essential aminoacids, vitamins & minerals required for an adult man

- Medical councils all over the world have recommended to use Spirulina as a supplement food in the diet of **under-nutritioned children**
- In India, Spirulina capsules are available in the trade names **Eufit, Nuclina, Reolina and Zyrulina** at local medical stores.
- Generally, **2 capsules** are recommended for adults per day

Murugappa Chettiar Research Centre (MCRC)

- Chennai, has been trying to use Spirulina slurry along with the popular South Indian dishes like **Idli and Dosa**
- Spirulina also used in purce and bread sandwich
- It enhances flavour, colour and acceptability of the dishes
- Spirulina serves as food for instant energy for sports men and others who need more calories

2. Spirulina as therapeutic agent

- Spirulina SCP is recommended for patients to reduce body weight, cholesterol deposition and to reduce blood-sugar level in diabetics
- It promotes wound healing by stimulating the skin metabolism
- Taking a 3 grams of Spirulina in the previous night reduces pre-menstrual stress in women
- Because of the presence of **Phycocyanin** in Spirulina it stimulates the immune system to provide resistance to the body against many **pathogenic diseases**
- The β - Carotene in Spirulina acts as an **anticancer agent** to prevent cancer risks
- It also increases the eye power via the synthesis of Vitamin A
- Spirulina biomass increases lactation in nourishing mother

3. Spirulina as a Supplement Animal feed

- Feed supplemented with Spirulina increases lactation in Cow & Buffalo
- It increases the growth rate of **pigs & goat** & increases the **meat yield**
- Calves grow well when they are feed supplemented with Spirulina
- Silkworms fed with leaves of Morus alba & Spirulina give more silk in the cocoons
- Fish feed supplemented with Spirulina increases growth rate and body weight of fishes. Eg.: Catla catla, Tilapia, Moss ambica
- Spirulina increases layering in poultry

4. Spirulina as a raw material for cosmetics

- Spirulina is rich in essential aminoacids and vitamins A & B which are essential for the growth of hairs
- It is used to formulate hair-oils which promote hair growth
- Phycocyanin a bluish pigment, is extracted from spirulina and used for making herbal lipsticks and face creames