



Potential of *Spirulina maxima* in the Bioremediation of waste water

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ABSTRACT

Bioremediation is a technology which uses biological systems for the degradation of various toxic chemicals to less harmful forms. Algae act as important bioremediation agents, and are used in wastewater treatment. The present study was carried out to determine the physico-chemical properties of domestic waste water from the two different sites of Sikandra in Agra city. One sample is collected from Neerav Nikunj and another one is from Bajrang Nagar. The analysis was done for the parameter like- pH, Acidity, Alkalinity, Hardness, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Total Solids (TS), Dissolved Oxygen (DO), chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). The D.O. level is increased during the interval periods. Bioremediation process is used for the treatment of water to remove the wastes. For the studies it was revealed that the parameter was changed during the 5th, 10th, or 15th day. The D.O. has been increased during the interval period was 4.5mg/l 5.5mg/l and 6mg/l in sample 1 and 6mg/l, 6.5mg/l, and 7.0mg/l in sample 2 respectively. The other parameters acidity, alkalinity, hardness, TSS, TDS, TS, B.O.D, C.O.D were decreased during 5th, 10th, or 15th day.

Key words: - CFTRI medium; Waste Water; *Spirulina maxima*; Parameters

INTRODUCTION

Bioremediation is considered as an efficient and environmentally safe technology to control the pollutant system. In this work an attempt has been made to evaluate the effectiveness of cyanobacteria *Spirulina maxima* for bioremediation of waste water. Experiment has been done to explore the Acidity, Alkalinity, Hardness, TDS, TSS, TS, Dissolved Oxygen (DO), chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). This work has been done to examine the efficiency of microalgae strains in removal of inorganic nutrient to prevent further deterioration of water quality of domestic waste water and focused on the bioremediation of waste water by using culture of *Spirulina maxima*.

Spirulina maxima are a filamentous, non heterocystous and photoautotrophic micro-organism. The main reason of increasing pollution is due to increasing population, industrialization, deforestation etc. The pollution load in water bodies such as rivers,

lakes etc. has also been increased because untreated and domestic wastes directly falling into rivers or water bodies. Ultimately, this lead toxicity, rise in BOD, COD, hardness and death and decay of flora and fauna. Sewage treatment or domestic waste water treatment is the process of removing contaminants from waste water and household sewage, both run off and domestic. It includes chemical and biological contaminants. Waste water discharge from sewage and industries are major component of water pollution contribution to oxygen demand and nutrient loading of the water bodies promoting toxic algal blooms and leading destabilized aquatic ecosystem (Morrison *et al* 2001, DWAF and WRC 1995). The human beings can reduce the pollution by taking certain steps;

1. To stop the uses of polybags, mineral water pouches etc.
2. Dispose of unwanted kitchen wastes carefully.
3. To stop the washers man, animals, etc from polluting the Yamuna.



4. Stop or ban on those peoples who throws the idols of God into the Yamuna on any rituals

Occasionally.

For mass cultivation of *Spirulina* optimum temperature was recorded to be 30° C while the Mass cultivation of *Spirulina* is being done because of its high proteins, lipids and carbohydrates (Belay *et al.*, 1993. The use of microalgae and cyanobacteria for waste water treatment has been reviewed by many authors (Lincoln *et al* 1996) these reviews demonstrate that algal cultures is useful for the removal of nitrogen and phosphorus.

METHODOLOGY

Water is dynamic medium and its quality varies with the environment. In order to characterize these water bodies studies on physico-chemical characteristics has been carried out. These parameters are- Acidity, Alkalinity, Hardness, TSS (Total suspended solids), TDS (Total dissolved solids), TS (Total solids), COD (Chemical oxygen demand), BOD (Biological Oxygen Demand) and DO (Dissolved oxygen).

1. *In vitro* and *in vivo* cultivation of *Spirulina maxima*

For this work we collected the *Spirulina maxima* from the Manjul *Spirulina* Samvardhan Sansthan Burthal Bassi Jaipur (Rajasthan.).

In vitro (Fig 1.b.) Cultivation by using CFTRI medium at 1 litre flask under certain conditions 28-30°C at 1600 lux light intensity with proper agitation of the flask 3- 4 times a day for 5 minutes each time.

In vivo cultivation (Fig 1.c.), in the beginning all the culture was kept in *Spirulina* Lab, Dayalbagh, Agra. After this all these cultures were used in further mass cultivation. for *in vivo* cultivation we transferred this 1 litre mother culture of *Spirulina* was inoculated in

PVC Tube which is previously filled with 5 litre CFTRI Medium as proposed by Venkataraman, 1983 and kept these tubes in Fibre Glass Chamber then regularly monitored these upto 30 days along with proper agitation of these tubs.

2. Collection of waste water from sites of Sikandra, Agra.

Waste water samples were collected from different sites of Agra. Water samples were collected from two different sites of Sikandra, Agra in a 2 litre bottles which is previously washed with 10% HNO₃.

2. Evaluation of Physico-chemical parameters such as Acidity, Alkalinity, Hardness, TSS, TDS, TS, COD, BOD and DO.

The physico-chemical parameters of collected waste water samples will be determined before and after treatment by following the Standard Method Examination of Water and Waste Water given in "Environment and Pollution" of Ambast (1990) and APHA (1998).

RESULTS AND DISCUSSION

Waste water samples were analysed for their physico-chemical characteristics before and after treatment with *Spirulina maxima*. Table 2 and Table 3 makes a comparison between the parameters before and after treatment.

The growth of *Spirulina maxima* on waste water show slight increases in the growth upto 10th day but after that reduced growth was observed further in between 10 to 15 day observations. pH of the water in both cases is slightly shifted from acidic to alkaline or from alkaline to little more alkaline by addition of *Spirulina maxima*. It is because *Spirulina* acclimatize itself and raises the pH of the growing medium.

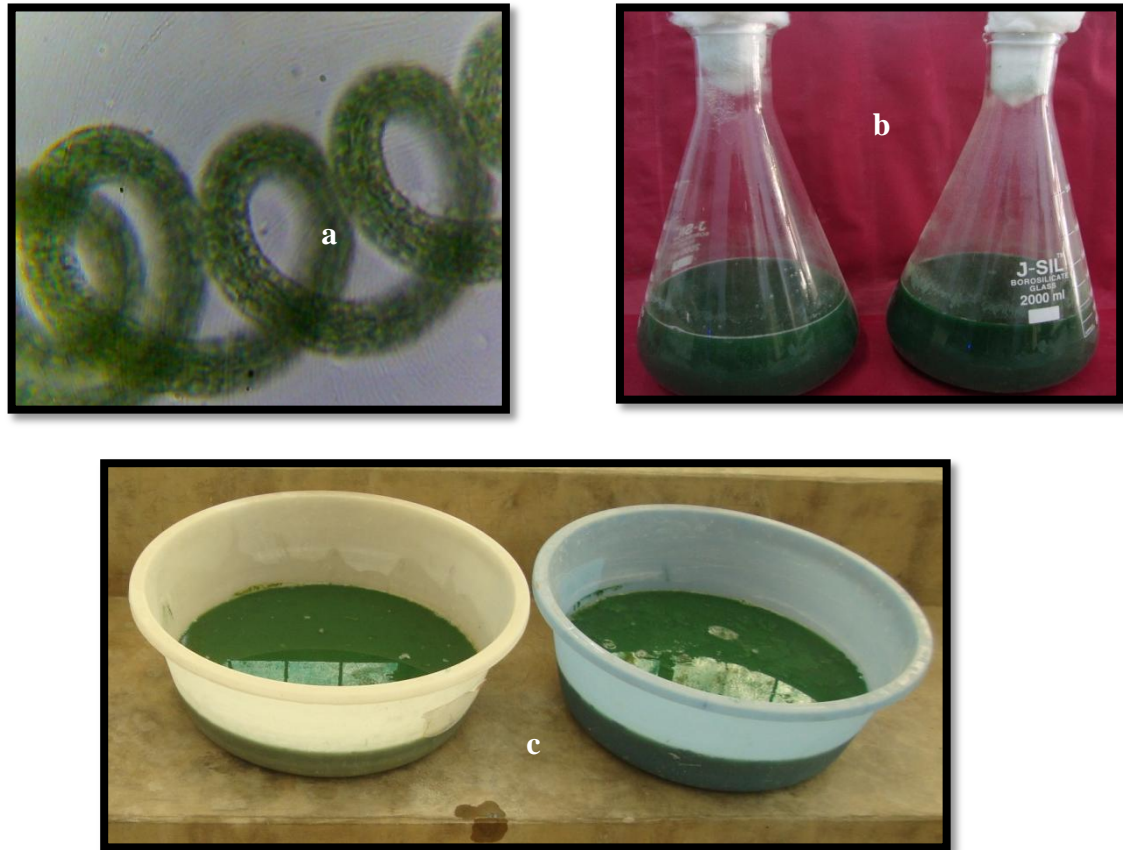


Fig 1. a. *Spirulina* Filament seen under Light imaging Microscope, b. In vitro cultivation of *Spirulina maxima* and c. In vivo cultivation of *Spirulina maxima*

Table-1 Pre- treatment analysis

Parameters	Domestic water (sample 1)	Domestic water (sample 2)
Acidity	125mg/l	63mg/l
Alkalinity	200mg/l	125mg/l
Hardness	152mg/l	250mg/l
TDS	1.11mg/l	2.1mg/l
TSS	2.95mg/l	3.0mg/l
TS	3.61mg/l	5.0mg/l
D.O.	3 mg/l	4 mg/l
B.O.D	70mg/l	65 mg/l
C.O.D	74 mg/l	76 mg/l

The acidity of first water sample was 125mg/l and second water sample was 63 mg/l but when *Spirulina* grown in water sample the acidity on 5th day were and on 10th or 15th day were changed.

The DO levels are in pre- treatment analysis of Sample 1 and Sample 2 is 3mg/l and 5.2mg/l. The BOD and COD levels in Sample1 and Sample2 in Pre-treatment analysis-70 mg/l, 65 mg/l and 74 mg/l, 76 mg/l respectively.

Table 2:-Post- treatment analysis in Sample 1

Parameters	Before treatment	5 th day	10 th day	15 th day
Acidity	125mg/l	50mg/l	22.5mg/l	22.5mg/l
Alkalinity	200mg/l	425mg/l	450mg/l	450mg/l
Hardness	152mg/l	125mg/l	113mg/l	96mg/l
TDS	1.11mg/l	0.66mg/l	0.5mg/l	0.4mg/l
TSS	2.95mg/l	2.50mg/l	1mg/l	1mg/l
TS	3.61mg/l	3.16mg/l	1.5mg/l	1.4mg/l
DO	3mg/l	4.5mg/l	5.5mg/l	6mg/l
BOD	70mg/l	54mg/l	32mg/l	32mg/l
COD	74mg/l	64mg/l	45mg/l	42mg/l

On 5th day after treatment the values of BOD, COD, acidity, alkalinity, hardness or other parameters are reduced except DO

Table 3:-Post- treatment Analysis in sample 2

Parameters	Before treatment	5 th day	10 th day	15 th day
Acidity	63mg/l	61mg/l	45mg/l	41mg/l
Alkalinity	125mg/l	250mg/l	300mg/l	300mg/l
Hardness	250mg/l	200mg/l	138mg/l	110mg/l
TDS	2.1mg/l	1.8mg/l	1mg/l	0.8mg/l
TSS	3.0mg/l	2.7mg/l	2mg/l	1.1mg/l
TS	5.0mg/l	4.5mg/l	3mg/l	1.9mg/l
DO	4.0mg/l	6mg/l	6.5mg/l	7.0mg/l
BOD	65mg/l	54mg/l	40mg/l	36mg/l
COD	76mg/l	66mg/l	56mg/l	48mg/l

The COD levels and BOD levels are reduced in the experiment these levels are checked after the 5 days intervals on 5th day, 10th day and 15th day or the other parameters are also but the DO levels are increased during the interval period as shown in Table 2 and Table 3. However on the 10th and 15th day observation no such appreciable reduction in BOD levels was found. It may be because of the two reasons. Firstly, the decline in growth of *Spirulina maxima* after 10 days. Secondly, the restricted activity of *Spirulina maxima*, i.e., the biological agents present in waste water resistant to *Spirulina maxima*. Colour showed remarkable improvements by adding *Spirulina maxima*.

COD levels were reduced from 74mg/l to 64mg/l, 45mg/l, and 42mg/l in Sample 1 (shown in Table 2) and in sample 2 before the treatment the level was 76mg/l but after the treatment it is reduced from 76mg/l to 66mg/l, 56mg/l and 48mg/l during the 5th, 10th or 15th day (shown in Table 3) which was reported to be 80 percentage by Jayant Doke *et al.* (2004) reported upto 80% reduction in COD during treatment of waste water by *Spirulina maxima*. Reduced activity on 10th or 15th day observation could be attributed to reduced *Spirulina maxima* growth.

CONCLUSION

1. *Spirulina maxima* sub cultured successfully in Botany Department by using CFTRI medium.
2. The test alga *Spirulina maxima* found effective in waste water treatment.
3. No change in morphology of *Spirulina* grown on waste water was observed.
4. DO levels increased sharply in initial 5 days, i.e. in domestic water which was 3mg/l in sample 1 but before the treatment 4.5mg/l, 5.5mg/l and 6mg/l on 5th day, 10th day and 15th day



respectively or in sample 2 it also increases on 5th day, 10th day or 15th day respectively.

5. BOD and COD levels were reduced in sample 1- 54mg/l, 32mg/l, 32mg/l and 64mg/l, 45mg/l, 42mg/l respectively. In sample 2- 54mg/l, 40mg/l, 36mg/l and 66mg/l, 56mg/l, 48mg/l respectively.

6. pH of the water in both the cases is slightly shifted from acidic to alkaline or from alkaline to little more alkaline by addition of *Spirulina maxima*. It is because *Spirulina* acclimatize itself and raises the pH of the growing medium.

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