



Growth performance and biochemical analysis of *Spirulina platensis* under different culture conditions

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Abstract

The present research work was carried out for assessing the optimum culture conditions for the growth and the chemical constitution of *Spirulina platensis*. *Spirulina* was cultured in conical flasks under 3 different culture conditions i.e. F.G.C. (Fibre Glass Chamber), Outdoor conditions and lab conditions. After 30 days of inoculation cultures were on the peak of growth and ready to harvest. Dried *Spirulina* powder was subjected to biochemical analysis. The metabolites considered for biochemical analysis were protein, carbohydrate, carotenoids and chlorophyll_a. An excellent growth performance and maximum percentage of metabolites was observed in cultures, those were kept under Fibre Glass Chamber (F.G.C.). Optical density was considered growth parameter and so deliberated after the intervals of 5 days up till 30th days. In FGC, optical density of cultures from 1st -30th day was 1.312, 2.618, 5.60, 12.80, 20.19, 26.30 and 28.35. In outdoor conditions OD were 1.312, 1.41, 3.10, 6.21, 8.10, 12.18 and 15.16. In Lab conditions OD were 1.312, 1.92, 3.12, 7.11, 7.90, 12.10 and 14.20. In FGC, the percentage of protein, carbohydrate, chlorophyll_a and carotenoids 59%, 15.95%, 1.34%, 0.27% respectively. In outdoor conditions the percentage were 56.5%, 14.50%, 1.31%, 0.26, while in Lab conditions percentage were 55%, 0.23%, 1.24%, 14.20%.

Keywords: *Spirulina*, Cyanobacteria, Single Cell Protein and Metabolites

Introduction

Spirulina is an edible blue green micro alga has received much attention as a most promising and food source (Dillion *et. al.*,1995). Its diverse biological and pharmacological properties (Belay 2002; Becker 2003; Khan *et. al.*,2005; Mani *et. al.*,2008) have promoted *Spirulina* as being a functional food. So no doubt, that its cultivation is beneficial medicinally as well as supplementary food. But its cultivation and processing is not a easy task. In this present research an attempt has been made to cultivate and biochemical analysis of *Spirulina platensis* in three different culture conditions. In their natural habitat, cyanobacteria are susceptible to sudden physical and chemical fluctuations of environmental conditions such as light, salinity, temperature and nutrient limitation (Tomas Elli *et. al.*, 1933). The climatic conditions affect the *Spirulina* growth performance as well as its cellular constituents. The cellular metabolites considered were- protein, carbohydrate, chlorophyll and carotenoids.

Materials and Methods

Spirulina platensis cultivated in different culture conditions to explore the effect of culture conditions on growth performance and cellular constituents. *Spirulina platensis*

was cultivated in conical flasks and these flasks filled with freshly prepared CFTRI medium (Venkataraman, 1983) and each of them were inoculated with 100ml of mother culture. These cultures were subjected to grow under three different culture conditions i.e. (a) Fiber Glass Chamber (FGC) (b) Outdoor Condition (Botanical garden) (c) In Laboratory. Growth of *Spirulina* was measured daily by taking optical density of cultures by using Systronics Spectrophotometer 166. *Spirulina* cells were harvested firstly with 65µ- mesh nylon cloth. Algal slurry was sun dried for 8-14 hours depending on climatic conditions. Sun dried algal flakes were grinded by pastel mortar and then biochemically analyzed. Protein was estimated by the method as described by Lowry *et. al.*, (1951). The estimation of total carbohydrate was carried out by simple anthrone method (Roe *et. al.*, 1955). Chlorophyll was estimated by the procedure and equation, suggested by of Parson and Strickland (1965). The extraction and estimation of carotenoids was carried out with the help of method proposed by Jensen (1978)

Results

Spirulina platensis was cultured under three different conditions in conical flask of 2.0 l. capacity. The optical density of each measured by regular intervals of 5 days to

know about growth performance of cultures in different conditions. The growth parameters like temperature and light intensity were variable in all three conditions. Due to the variable growth parameters, the growth rate of all three sets was also variable. Growth performance of *Spirulina platensis* under different culture conditions was measured in terms of optical density. The maximum growth was reported from FGC. The OD of these cultures was 1.312,

2.618, 5.60, 20.19, 26.30 and 28.35 from 1st to 30th day. While the minimum growth rate represented in Lab. condition. The OD of the cultures which were kept under laboratory conditions was 1.312, 1.92, 3.12, 7.11, 7.9, 12.10 and 14.20 from 1st to 30th day. The OD of the cultures which were kept in the Botanical garden was 1.312, 1.41, 3.10, 6.21, 8.10, 12.18 and 15.16 from 1st to 30th day. (Table.1).

Table -1: Optical Density (1st -30th day) of *Spirulina platensis* cultures kept under different culture conditions

S.No	Culture conditions	1 st day	5 th day	10 th day	15 th day	20 th day	25 th day	30 th day
1	Fiber Glass chamber (F.G.C.)	1.312	2.618	5.60	12.80	20.19	26.30	28.35
2	Out door condition (Botanical garden)	1.312	1.41	3.10	6.21	8.10	12.18	15.16
3	Laboratory condition	1.312	1.92	3.12	7.11	7.90	12.10	14.20

All the flasks were harvested after 30 days of inoculation by nylon cloth of 65 μ mesh . The algal slurry was washed with fresh water for 3-4 times to remove the adhered salts and dewatered by pressing gently for few minutes and finally dried under the sun or keeping in the hot air oven and the dried powder was subjected to biochemical analysis. The blue green microalga *Spirulina platensis* is a important source of nutrients, proteins, amino acids, carbohydrate , chlorophyll_a and minerals.

The F.G.C. cultured *Spirulina platensis* possess 1.34% chlorophyll_a while it was 1.21% in outdoor condition and 1.24% chlorophyll_a was recorded in lab condition. Carotenoids were 0.27% in F.G.C. while it was 0.26% in outdoor and 0.23% in Lab condition.

Carbohydrate was 15.95% in F.G.C., 14.50% in outdoor and 14.20% in lab condition. The protein in F.G.C. was 59%, in outdoor condition it was recorded 56.5%, while in lab condition it was 55% (Table 2).

Table- 2: Biochemical analysis of *Spirulina platensis* cultured under different conditions.

S.No.	Metabolites	Lab. Condition	Outdoor condition	F.G.C. condition
1.	Protein	55%	56.5%	59%
2.	Carbohydrate	14.20%	14.50%	15.95%
3.	Chlorophyll _a	1.24%	1.31%	1.34%
4.	Carotenoids	0.23%	0.26%	0.27%

Discussion

Spirulina platensis was cultured under three different conditions to explore optimum conditions for *Spirulina* cultivation. The dried powder which came from three different culture conditions also analysed to predict the best culture conditions. The metabolites which considered analysing were proteins, carbohydrates, chlorophyll a, and carotenoids. The growth parameters like temperature and light intensity were variable in all three conditions. Due to the variable growth parameters, the growth rate of all three

sets was also variable. Growth performance of *Spirulina platensis* under different culture conditions was measured in terms of optical density. Among three conditions the optimum growth performance of *S. platensis* was observed under FGC. This is because of diffused light (50-55klux) and optimum temperature (30-32 C). Light intensity was measured by Leutron LX-101 Lux meter. Richmond *et. al.*, 1990 observed that the low temperature not suitable for the growth of *Spirulina*. The minimum growth performance observed in outdoor and Laboratory conditions.

The fluctuation in atmospheric temperature is the main factor affecting the biomass production rate in outdoor open cultivation. The high temperature and high light intensity resulted in the reduction of biomass yield Richmond *et. al.*, 1980, Vonshak 1985 and Lu&Vonshak 1999. Vonshak and Richmond in 1985, observed a marked decrease in productivity of *Spirulina* during scale-up to outdoor cultivations even in favourable conditions. This they attributed to photoinhibition. Vonshak *et. al.*, 1988, have studied photoinhibition in two strains of *Spirulina*, one vacuolated and other non-vacuolated, under laboratory conditions. They have observed that the vacuolated strain is more prone to photoinhibition than the non-vacuolated one.

The biochemical analysis indicated that the *Spirulina* cultures kept under FGC was Superior chemically. So FGC is excellent not only growth performance wise but also chemically. Results shows that Fibre Glass Chamber was good for successful cultivation of *Spirulina platensis* under semi arid climatic conditions of Agra.

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